INFORMATION ON DISASTER RISK MANAGEMENT

CASE STUDY OF FIVE COUNTRIES

Main technical report

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The views expressed in this document are those of the authors and do not necessarily reflect the views of the sponsor organisations.

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PROLOGUE

Reducing the risk of destructive natural phenomena increasingly looms as a strategic line of developmental action. Since 2000, the Economic Commission for Latin America and the Caribbean (ECLAC) along with the Inter-American Development Bank (IDB) have stressed that proper disaster prevention, reduction and response are a facet of regional development and as such demand a systematic and coherent approach to lowering the risk of disaster consequences. ECLAC views the inclusion of such policies as indispensable to comprehensive development, meaning one that is sustainable, equitable and provides improved productivity and competitiveness while also promoting social cohesion throughout the countries of the region.

Latin America and the Caribbean are marked by a high degree of exposure to natural phenomena that have considerable destructive potential and which in the past two decades have taken the form of events with catastrophic social and economic consequences for governments and populations alike on both a social and economic plane. This geographic location combined with pronounced features of economic physical, environmental and politico-institutional vulnerability have all been tragically reflected in the frequency with which tremendously disastrous events occur. At the same time the region continues to suffer a range of limitations that stand in the way of an effective risk management. A conditioning factor for these obstacles is the lack of information available to those throughout the various phases of the management process when they are making decisions and formulating the proper projects.

There is growing evidence, data and experience that substantiate the need to adopt pro-active risk-mitigation strategies in light of the major benefits they afford and the extent which they allow for a more sustained course of development. Nevertheless, there has yet to be a generalized sharing of information regarding each country's experiences or the adoption of specific indicators.

In the framework of a cooperative programme between IDB and ECLAC, a project on disaster risk information was conducted on the basis of the case studies of five countries seen as representative of the region owing to their sizes, relative degree of development, and geographic locations. It is our hope that the results of that endeavour will contribute to a better understanding of risk, its specific management in the region and the handling of information related to such issues as well as in formulating proposals for creating a more systematic handling of information that can make it more effectively available for decision making. This report contains the general conclusions of these investigations and sheds light on the institutional structures and disaster risk management that exist in the countries studied. By providing a chronological account of the evolution of institutions responsible for emergency and civil defence processes and for risk management as part of planning and development policies the study constitutes a valuable record of national experiences and explains how the countries studied have made changes in recent decades to the institutions in charge of disaster and risk management as well as their information systems. Based on the experiences that have been documented regarding the responses to disasters, some conclusions are drawn that have region-wide implications and recommendations directed at decision makers are formulated.

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EXECUTIVE SUMMARY

OBJETIVE AND SCOPE OF THE PROGRAMME

There is a generalized opinion in Latin America and the Caribbean that a major obstacle to correct disaster risk management is the lack of information on risks and risk mitigation measures available to those in charge of making decisions throughout the various stages of the management process.

In order to rectify this weakness, the Inter-American Development Bank (IDB) and the Economic Commission for Latin America and the Caribbean (ECLAC) have joined forces to conduct a project regarding an Information and Indicators Programme for Disaster Risk Management. The programme was geared toward determining what type of information regarding risk and the methodologies for analysing such data were needed by risk-management decision makers, those producing the information and the agencies that promote a quality approach to the management process.

The project was based on case studies of five countries seen as being representative of the various sub-regions of Latin America and the Caribbean and that are exposed to different hazards–Colombia, Chile, Jamaica, Mexico and Nicaragua. The studies centred on evaluating a country's risk-management situation as well as the information available for such purposes.

In order to establish a common basis from which to conduct the case studies we prepared a Basic Methodological Document which defines the analytical framework for evaluating the quality, quantity and use of information needed for suitable risk management. In addition we prepared five Specific Methodologies for obtaining the necessary information and evaluation of management strategies.[1]

STUDY CONCLUSIONS

The production and use of information

Over the course of the past 15 years there has been a notable improvement in the information available regarding natural hazards, the monitoring of dangerous natural phenomena–especially of a hydro-meteorological sort–and systems for alerting the public in the countries we studied.

However, the information is not always available, or is not employed when formulating policy to deal with, and designing instruments to measure, vulnerability–especially on the level of critical infrastructure–, nor for risk reduction. There is a general deficit of information regarding the possible impact of the sort of mitigation and risk-reduction measures that could be implemented.

1 The methodologies and reports on the case studies can be found on the project's website: http://www3.cepal.org.mx/iadb—eclac—project.

While norms exist in terms of urban zoning and land-use rules, there is a lack of follow-up and oversight mechanisms for determining to what extent they are being applied or respected.

The progress achieved in hazard and risk information needs to be extended from the macro (national, regional) plane to the local level, where the conditions that most influence risk are to be found. While the public receives information on how to prepare for natural hazards and what to do during an emergency, very little has been done to date to reduce vulnerability in their environment.

Institutional structure and disaster risk management

Generally speaking the number of those killed or injured in disasters has tended to decline, but the same cannot be said of the amount of damage and losses from disasters, a dichotomy that suggests a lack of progress in lowering the physical vulnerability of assets at risk and of risk transfer mechanisms.

Responsibility for disaster risk management is increasingly being transferred to local governments, but the efficiency of that management varies greatly and is often limited by a lack of the economic, technical, and structural resources essential to an efficient management.

In the case of financial management, government funds for calamities, if they exist at all, lack the resources needed to attend to disasters of the magnitude that they will have to confront, and they lack stable sources of funding. In many instances, the funds deal primarily with emergency response or the reconstruction of public sector assets. Only a few countries allot funds for prevention and mitigation measures. Among the few that do, Mexico and Colombia should be seen as examples to be shared with other countries of the region.

RECOMMENDATIONS TO RISK MANAGEMENT DECISION MAKERS

Generation and use of information.

Risk studies should be generalized, transversalized and uniformed between sectors and levels of government. Both prevention and response measures should be based on a correct identification and analysis of risk. There is a great paucity of knowledge on how best to design risk studies. In order to overcome these weaknesses it is useful to begin by defining model reference terms for local, regional and national studies as well as indicators to be used to validate study results.

Consultation and participation processes.

It is advisable to establish mechanisms of consultation between those who use and those who produce information so as to define basic informational needs and how it should be applied. Such mechanisms may be concretized through informational inter-connectivity agreements on various levels and in this way avoid problems of duplication and incompatibility.

Vulnerability of critical infrastructure.

The considerable vulnerability of public buildings and goods to disasters largely arises out of a lack of proper maintenance and rehabilitation of infraestructura. It is necessary to conduct disaster vulnerability studies and to establish rehabilitation programmes as a way to reduce risk to crtitical infrastructure, especially hospitals.

Institutional structure and risk management.

The national experiences observed in our studies underscore the importance of granting the risk management system significant institutional weight and ranking risk management high among national priorities. Only

in this way will it wield the attributions necessary for coordinating the actios of the sectors involved and establish the mechanisms for concretizing the application and observance of norms. On the other hand, it is necessary to deal with the problem of a lack of committed personnel that are highly skilled in matters of risk management and the accelerated attrition or turnover of such professionals.

PROPOSAL FOR ADDITIONAL STUDIES ON THIS SUBJECT

- Standardize risk information and its components.
- Improve the methodology for risk and risk-management indicators.
- Improve the methodology for extreme event scenarios.
- Produce and make widely known vulnerability reduction techniques for low-resource communities.
- Conduct cost-benefit studies that help to decide which part of catastrophic infrastructure risk should be transferred to the insurance market and which should be assumed by the government.

I. DISASTER IMPACT ON REGIONAL DEVELOPMENT AND DISASTER MANAGEMENT

1. RISK AND DEVELOPMENT

Disaster impact is clearly a developmental issue. First, because natural phenomena tend to produce more severe consequences in economically weak countries than in industrialized ones. Second, because a number of factors related to low levels of development amplify those consequences. Third, the impact of natural phenomena on long term developmental possibilities is significantly greater in less developed countries.[2]

Global statistics show that disasters cause greater and sometimes irreversible social damage in developing countries as their effects are concentrated and more pronounced among the poorest and most vulnerable population groups. It was no accident that 95% of disaster-related deaths in 1998 occurred in developing countries. Disasters tend to inflict losses that greatly set back efforts to improve living conditions in developing countries among other reasons because of having to divert resources to rehabilitation and reconstruction, or to pay off foreign currency debts assumed for such purposes.[3]

In the past 20 years disaster risk management has assumed ever greater prominence in the policy agendas of both governments and the leading international bodies. The problem has become particularly critical en the countries of Latin America and the Caribbean, most of which have been severely affected by disasters owing to their exposure to a wide array of natural phenomena and extreme vulnerability arising out of physical, economic and social factors.

Evidence suggests that disasters have contributed to raising poverty and inequality levels in the region. This is because such phenomena tend to have a disproportionately greater impact on the poorest members of society as they are the ones least capable of properly responding to contingencies that destroy their possessions and drastically reduce their incomes. The persistence of high poverty indicators has forced many people to settle in geographically unstable environments, thereby heightening disaster risk to natural phenomena and the ensuing environmental and ecological disasters.

The extent to which the poor disproportionately suffer devastation is evident in the direction of causality: because one is poor, one is vulnerable. Statistics compiled by the United Nations over the past 30 years show that the risk of death from disasters is four times greater in poor countries than it is in countries with high per capita income.[4]

The accelerated urbanization arising out of growing demographic pressures in rural areas has increased

2 "Desastres, un tema de desarrollo: La reducción de la vulnerabilidad frente a los desastres", CEPAL-México, March 2000.

3 IDB/ECLAC Project, Basic Methodological Document, 2007.

4 International Federation of Red Cross and Red Crescent Societies, "World Disaster Reports", several years.

disaster vulnerability. The destructive impact of flooding in urban areas has been exacerbated by the proliferation of precarious settlements, greater demographic density, weak or inadequate infrastructure and deforestation. Inadequate urban planning, deficient and often ignored building codes, and failures to properly enforce land use regulations have heightened the vulnerability of the urban poor. In addition, a lack of drainage and proper handling of garbage in such settlements increases the probability of floods and both land- and mudslides.

The Latin America and Caribbean region is highly exposed to hydro-meteorological, seismic, volcanic and other types of potentially destructive natural phenomena. This considerable exposure combined with accentuated characteristics of social, economic, physical, environmental and politico-institutional vulnerability means that the region experiences a high and rising incidence of disasters.

Natural disasters in Latin America and the Caribbean inflict human and economic losses on a horrible scale by any account. Estimates made by the Economic Commission for Latin America and the Caribbean (ECLAC) indicate that in the past three decades more than 150 million inhabitants of the region have been affected by disasters that have led to the deaths of more than 108,000 people and produced 12 million direct victims. In the absence of an exhaustive estimate throughout the entire region, we calculate accumulated disaster damage at more than 50 billion 1998 US dollars, losses that are concentrated in the smallest and least developed countries, especially in the Andean region, Central America and the Caribbean.[5] Given that ECLAC only conducts damage assessments when called upon by governments and its evaluations only cover part of the disasters, the real loss of life and property is much greater.

It is estimated that 80 per cent of the poor in Latin America live in marginal areas that are exposed to flooding or are located on the slopes of volcanoes, where they try to scratch out an existence. These zones are highly vulnerable to environmental degradation and disasters as these deforested and eroded lands lack the water-absorption capacity needed to cope with torrential rains, thereby increasing the threat of landslides and flooding.

5 "Handbook for estimating the socio-economic and environmental effects of disasters", ECLAC, 2003.

Varied and complex reasons explain why vulnerability is so great in Latin America and the Caribbean. Without a doubt the pattern of development in most of these countries, complete with high poverty indicators, socioeconomic exclusion and environmental degradation, is a leading factor. The poor live in the highest risk areas, rely on environmentally predatory farming techniques or work on marginal lands, and have less access to information, basic services and both pre and post-disaster protection.

The countries of the region are generally fiscally and financially limited in their ability to allot funds to prevention and mitigation measures, and suffer from both institutional weakness and planning horizons limited to a short term perspective. Frequently there is a lack of risk-management coordination between local and national governments. Some times there is an over reliance on post-disaster assistance from abroad at the same time as risk transference practices are extremely limited.

Efforts have been made recently in some countries to link risk management with problems of national development such as the most appropriate management of natural resources (soil, water, forests and agriculture land use) and proper infrastructure maintenance, actions that reduce vulnerability to disasters and contribute to economic development.

Despite these actions, problems subsist that weigh negatively on risk management policies. In addition to those we have already mentioned we can cite deficient fiscal planning, a lack of land reserves, land speculation and the proliferation of shanty towns that are sometimes promoted by clientelist political operations.

2. OBJECTIVES AND SCOPE OF THE DISASTER MANAGEMENT INFORMATION PROGRAMME

The high number of victims and growing extent of economic losses from natural disasters in the region have led international development agencies, and many of the institutions and specialists dealing with disaster prevention to promote a shift of focus in risk management. The idea is to encourage countries to change their approach from one centred on emergency response to one emphasizing prevention. A basic prerequisite for

succeeding with such an approach is to have widespread access to reliable information on the risks to which human settlements are exposed, a country's socioeconomic infrastructure, and the measures capable of reducing the leading sources of vulnerability.

In 1999, the United Nations General Assembly adopted an International Strategy for Disaster Reduction with the aim of encouraging the development of disaster resilient communities as an integral component of a disaster risk reduction strategy that in turn serves as a basic component of sustainable development.

Making vulnerability reduction a facet of economic development is a goal that has been promoted by ECLAC, the Central American Bank for Economic Integration, the Caribbean Development Bank, the Andean Development Corporation, the Inter-American Development Bank (IDB) –which maintains a very active policy in this field– and the World Bank's Disaster Management Facility (DMF).[6]

For a number of years the IDB has worked to strengthen and make more effective disaster risk management, particularly in its financial aspects so as to assure that economic losses do not produce crises that affect a country's development. The strategy on this point is laid out in an action plan published in 2000,[7] and was update in 2005[8] based on an evaluation of the results accumulated up until that point.

ECLAC, which is a regional commission of the United Nations Secretariat, has conducted studies for the past 30 years on the social, economic and environmental effects of disasters. For that purpose it has developed a specialized methodology that is described in the Handbook for estimating the socio-economic and environmental effects of disasters, the most recent edition of which can be found at the organization's website.[9] Based on that methodology, ECLAC has assessed the damage from most of the major disasters that have occurred in the region since 1972.

As part of its activities to promote the adoption of a correct disaster risk management strategy by the countries of the region, ECLAC and the IDB have joined forces to conduct an **Information and Indicators Programme for Disaster Risk Management**. ECLAC was placed in charge of the execution of the first component of the project, the **Disaster Management Information Programme**, aimed at providing decision makers in the countries of the region the necessary means for evaluating and improving their disaster risk management strategies. The results of this component are the object of this report.

The second component was focused on defining the main indicators for determining disaster risk and evaluating the management systems of the 12 countries in the region. The indicators make it possible to identify the characteristics of the management systems, identify their weak points and make cross-country comparisons. The project was conducted by the Universidad Nacional de Colombia at Manizales' Environmental Studies Institute (IDEA) and its results were published in a general report and a series of accompanying documents.[10]

The **Disaster Management Information Programme** that is the subject of this report is oriented toward identifying the information and determining the analytical methodologies needed by those responsible for risk management in order to make decisions before (*ex ante*) and after (*ex post*) disasters occur based on a better understanding of hazards, vulnerabilities and risks and in order to adopt prevention measures and orient emergency response, recovery and reconstruction actions.

The programme's main objectives are to:

- Improve the availability, presentation and use of information so that those in charge in formulating policies may identify prevention and mitigation investment priorities.
- Provide decision makers with tools for measuring key hazard and vulnerability factors and evaluating the capacity for managing risk, as well as the parameters for estimating the effects of the risk management policies and investments they eventually adopt.

The purpose of the programme is to facilitate decision making on the part of government bodies in order

6 "Living with Risk, a global review of disaster reduction initiatives", International Strategy for Disaster Reduction (ISDR), Geneva, July 2002 p.253.

7 IDB (2000), Facing the Challenge of Natural Disasters in Latin America and the Caribbean: An IDB Action Plan. Washington, DC. IADB.

8 Bank Action Plan for Improving Disaster Risk Management 2005-2008. Washington, DC.

9 See http://www.eclac.cl/mexico/

10 See http://idea.unalmzl.edu.co

to promote a rational and efficient disaster risk management. It is directed first of all at economic decision makers (finance and economy ministries and other bodies responsible for making decisions about investing in the development of infrastructure), helping to show them that the economic burden imposed by the occurrence and accumulation of major disasters can be reduced or avoided through proper policies of financial hedging such as insurance coverage and contingency funds, as well as through prevention and mitigation actions that are linked to development plans. Secondly, the programme is directed at those responsible for national, provincial and municipal disaster prevention agencies (such as civil defence systems) in order to help the respond more efficiently before, during and after disasters. Thirdly, it is directed at assisting those units that generate technical-scientific information regarding disaster hazards and risks (attacked to academic institutions and both public and private institutions) to consider the type and quality of information that is needed by decision makers in addition to that which is used in the scientific study of phenomena.

This report summarizes the results of the various parts of the Disaster Management Information Programme. In essence it is designed to serve as a guide enabling the decision makers in the countries of the region to evaluate their programmes and consider measures for making them more efficient. In recognition of the cultural, social and developmental differences of countries, we do not try to offer guidelines to be followed in each and every instance but instead try to highlight the experiences and approaches followed in various countries so that each one may choose the ones most appropriate to their conditions.

3. PROGRAMME METHODOLOGY AND PRODUCTS

The execution of the study was divided into three phases:

a) Defining an Analytical Framework and developing Specific Methodologies for the design and evaluation of disaster risk management strategies. The Analytical Framework is designed to serve as a common conceptual basis and a general methodology for evaluating disaster risk management strategies. The first part comprehends the evaluation of existing information on hazards, vulnerabilities and risks as well as risk-reduction measures. The second provides a critical view of the methods of national risk management organization and the bases for evaluating them. The third refers to the various approaches to the financial aspects of risk management. The results of this part are contained in a Basic Methodological Document and are summarized in Chapter 2 of this report.
The specific methodologies focus on the following aspects: expanding the ECLAC methodology for estimating losses through making retrospective evaluations and assessments of the damage accumulated through successive disasters; an evaluation of disaster management strategies; determining macroeconomic effects; and creating the employment scenarios for extreme events as a means to evaluate risk management capacity. The five respective documents are available at the project's website.[11]

b) Conducting case studies and dialogues on risk management policies in five countries in the region. In order to construct a broad panorama of disaster-related risk and of the policies for managing it, five countries (Colombia, Chile, Jamaica, Mexico and Nicaragua) were chosen as offering a representative selection of economic sizes and degrees of development and that are subject to various types of threats.[12]

The objectives of each national case study were to:

i) Identify the sources of information and analysis on natural disaster risk, evaluate its quality and to what extent it approaches an ideal state, as well as the extent of relevant knowledge in each country and the degree to which risk management decision makers are familiar with such information.

11 See http://www3.cepal.org.mx/iadb-eclac-project

12 In previous documents and in most of the National Case Studies the term "hazard" is used as this is the word most commonly used in scientific circles.

ii) Evaluate the relative importance of risk management in government policies and planning.
iii) Investigate the existence of risk perception studies that measure alert levels and the degree of awareness both among the general public and authorities. Estimate the importance that the risk management system assigns this type of studies.
iv) Determine and evaluate the risk management organization in *ex ante* and *ex post* situations.
v) Identify the levels of government or actors that assume the financial burden of the consequences of disasters (central government, local governments, private sector, civil society, foreign donors).
vi) Design impact scenarios for possible events that could produce extreme consequences for economic performance.
vii) Test and evaluate the evaluation methods of strategies proposed in the Analytical Framework and in the Specific Methodologies designed for this programme.

Consultants experienced in this subject in each country were placed in charge of conducting the five studies. The resulting reports can be found at the programme website.[13]

In order to collect the experiences and opinions of the decision makers and specialists from the various fields of disaster related issues, two National Workshops were held in each country. The first was held at the outset of the study at which time the proposed focus was presented and evaluated and the other to present study results and collect the opinions of the specialists involved. A Regional Workshop was also held with the participation of disaster management authorities from each country, members of the project's Scientific Advisory Committee, specialists from the IDB and ECLAC, and members of the project's technical coordination. This workshop received the study results as well as suggestions to be incorporated into the final report. The reports of all of the workshops can also be found on the project website.

c) Preparing the final project report
- This report was based on the case studies in the five chosen countries, and contains:
- A comparative evaluation of the specific situation of each of the five countries.
- Criteria for each country to evaluate whether the available risk information and local management strategies are ideal.
- Recommendations regarding policies and strategies for improving the availability and usage of information and risk management in general.

ECLAC's regional headquarters in Mexico City took charge of the project's executive and administrative management and hired a Technical Coordination Board to draw up the terms of reference for the consultants to be hired, supervise their work and reports, coordinate the case-study workshops, draw up documents on specific analytical framework and methodologies, as well as to compose the final report. The IDB Office on Sustainable Development took charge of supervising all phases of the project. The sponsoring bodies designated a Scientific Advisory Committee for evaluating project scope and products.

Below we list the documents that resulted from this endeavour:[14]

- Basic Methodological Document for evaluating national disaster management strategies.
- Methodologies:
  - Methodologies for the design and evaluation of disaster risk management strategies by J. Baraqui.
  - **Disasters and the macro economy: empirical** and modeling issues, by R. Hernández.
  - **An abbreviated damage evaluation methodology** by D. Bitrán.
  - **A retrospective evaluation of the socioeconomic** impact of disasters by D. Bitrán.
  - **Evaluation of the impact of extreme events** (Technical Coordination Board)
- Workshop reports.
- Reports on the five National Case Studies.

13 See http://www3.cepal.org.mx/iadb-eclac-project

14 Ibid.

II. BASES FOR ANALYSING DISASTER RISK INFORMATION

The analysis of information for risk management can be divided into three parts:

i) Information for risk evaluation and reduction;
ii) Information for disaster management,
iii) Information for financial risk management.

1 INFORMATION FOR RISK EVALUATION AND REDUCTION[15]

a) Problems of risk information

Determining risk for purposes of managing it is a laborious and complicated task due to the manner in which risk factors are interrelated, and the complexity of the physical and social systems involved as well as the processes that lead to losses. Even after overcoming these issues, it is necessary to establish lines of communication between risk determination specialists and competent officials to assure that the risk-analysis transcends the national, regional or provincial level.

b) Information for hazard evaluation

The principal objective of a study of hazard or threat in a place of interest is to become familiar with the phenomenon that poses it by identifying and measuring its intensity and zone of influence. There are two types of proposed studies: (1) **Probable maximum event** (or Maximum Credible Event –MCE), which is one achieved by maximizing, on a theoretical basis, the factors directly related to the intensity of the phenomenon; (2) frequency-intensity analysis based on probability studies of historical records, in theoretical models of a specific phenomenon or a combination of both. Table 1 lists the information that may prove useful for evaluating some of the main hazard affecting the region.

Local effects: A detailed estimate of the hazard must deal with the local amplification effects of topographical, subsoil or climatic conditions. These specific conditions, which may vary even within differing points in the same locality or city, are capable of increasing or decreasing the intensity, frequency or area of influence of the phenomena.

c) Information for evaluating vulnerability

The purpose of a vulnerability evaluation is to uncover the relationship between the intensity of phenomena and the damage inflicted or the probable losses of goods at a specific location.

An evaluation of physical vulnerability may be conducted using a qualitative focus (using indicators) or by employing a quantitative approach (involving vulnerability functions). Social vulnerability is the sum of circumstances that affect population groups, and

15 For more details see Documento Metodológico Básico at http://www3.cepal.org.mx/iadb-eclac-project/05.html

TABLE 1. INFORMATION REQUIRED FOR EVALUATING SOME HAZARDS IN THE REGION						
Seismic activity	**Tsunami**	**Wind**	**Precipitation**	**Volcanic eruption**	**Storm waves**	**Landslides**
Historical seismicity, seismic catalogues	Records of floods, high water levels for past events.	Studies on the frequency and intensity of hurricanes, histograms.	Historical information: maps of flooding from past events.	Catalogues, records of areas affected by past events.	Historical information and records of water levels.	Historical data for the area or other sites with similar conditions.
Tectonic and geological studies. Models of rates of magnitude exceedance.	Land surveys: costal bathymetric charts, curve maps of costal areas	Cyclogenic area. Hurricane generation, trajectory and probability studies.	Records from pluviometric stations and of both maximum annual and average daily rainfall.	Geological studies and estimated dates of occurrence.	Costal bathymetric studies.	Study of physical and geological characteristics.
Risk reduction laws specific to, or suitable for the region being analysed; rates of exceedence of maximum accelerations.	Seismic and tectonic information for the surrounding area. Studies of propagation velocity and arrival times of waves reaching the coast.	Topography of costal areas. Relief and topographical maps for affected zones.	Hydrograms of avenues, determination of areas susceptible to flooding. Topography, level curves, relief of drainage works.	Classification of volcanoes, volcanic explosivity indexes.	Cyclone generation studies.	Modelling of possible landslide formation, behaviour, velocity and distance covered.
Acceleration amplification and transfer functions, spectral coeffi-cients.	Identifying and studying natural or man-made defences for the mitigation of tsunami effects.	Data from meteorological observation stations. Distribution models of extreme values.	Suitable runoff and filtering models for the zone under analysis, studies of solid permeability	Wind direction and velocity (only in the case of hazard from volcanic ash).	Theoretical studies and storm-related high-tide models.	Frequency/intensity studies for triggering events (torrential rains, earthquakes, etc.)

constrain their ability to take care of themselves. Table 2 lists the general information needed for estimating physical and social vulnerability

d) Information for risk evaluation

Risk evaluation consists of determining the nature and extent of said risk in order to arrive at a measure of its potential societal consequences. Two approaches exist: (1) an analysis of how risk factors (potential hazards or dangers, and existing exposure and vulnerabilities) interact, and (2) an analysis of records of past events.

e) Extreme event scenarios for performance evaluation

The analysis of these scenarios consists of determining a critical event in which extreme demands are placed on the system of risk and disaster management, estimating a country's economic loss and the performance of the country's financial disaster risk management.[16]

The information that might be needed for making such an analysis consists of:[17]

- Historical information on the phenomenon in question: statistics on injuries and deaths, the number of people displaced by events with similar characteristics as the one proposed in the scenario.
- Studies on the probability of occurrence of phenomenon: occurrence rates, exceedance rates, distance covered, and both trajectory and site amplification effects.
- Hazard maps: regionalization of the country, microzonification of cities.

16 See the document "Metodología de Evaluaicón de Escenario extremo" at http://www3.cepal.org.mx/iadb-eclac-project/05.html

17 The ECLAC methodology for calculating losses is a good guide for identifying information that is desirable in escenario studies.

TABLE 2. INFORMATION FOR VULNERABILITY EVALUATION	
PHYSICAL VULNERABILITY	**VULNERABILITY SOCIAL**
Degree of development of and compliance with building codes.	Distribution of the population by urban and rural, sex, age groups, geography and historical growth.
Characteristics of buildings and critical infrastructure such as quality and types of construction, age and state of conservation.	Spatial distribution of the principal human settlements and their growth rate over time. Location of hazardous installations or activities.
Information on type and severity of damage from past natural events.	Social infrastructure, including for educational, historical and cultural assets, recreation and sports facilities, housing and healthcare installations.
Mathematical models of existing vulnerability or structural fragility for the place analysis and the hazard in point.	Farm, industrial and commercial (including tourism) production, its spatial distribution over a period of a year (when seasonal).
Existence of structural rehabilitation and maintenance programmes.	Infrastructure of transportation and telecommunications services, supply of potable water and evacuation of residual water and solids, and energy (hydrocarbons and electricity), identifying sources and spatial location.
Area planted and type of crop, existence of water reserves.	Development indicators —such as the Human Development Index developed by the UNDP— and its spatial distribution in the country under study.
Spatial distribution of infrastructure by type of structure. Damage maps from past events.	Existence and application of educational programmes and those for lowering the adverse affects of extreme natural events such as seismic and tsunami warning systems.

TABLE 3. RISK STUDIES	
TYPE OF ANALYSIS	**DESCRIPTION**
Risk indexes a/	May be constructed on the basis of historical data or the superposition of hazard and vulnerability indexes. The Disaster Risk Index proposed by the United Nations for instances involving earthquakes, flooding and wind is an example of a relative index for nationwide risk, calculated on the basis of information and records of losses of goods and human lives.
Probable losses	In the assumption that natural processes and damage generation may be modelled as stochastic processes, consequences or losses may be valued in terms of their probability of occurrence or, alternatively, in terms of expected values and variations. A rigorous calculation of this rate is an effort that requires a considerable computational effort and a detailed knowledge of Stochastic hazard and vulnerability models, as well as a spatial correlation between damage and losses.
Extreme scenario b/	Analysis of society's general behaviour and performance of in response to an extreme hypothetical event that would pose major economic, social, environmental or strategic demands.

a/ The question of indicators is dealt with to a greater extent in paragraph f)
b/ Extreme-event analysis is discussed in greater detail in paragraph e)

- Vulnerability studies: vulnerability indexes, vulnerability functions for the zone and for the hazard.
- Land surveying, land office records, processed satellite photographs.
- Average construction value by square meter for the various types of structures.
- Location, capacity and state of vital and critical structures (hospitals, medical attention centres, shelters, fire and police stations, theatres, dams,

water lines, electric power lines, electric power stations, oil pipelines, gas pipelines, refineries, roads, bridges and means for urban transportation).
- The distribution of the population by zone, age, social status, sex, religion, etc.
- Possibility of secondary effects: fires, explosions of flammable material.
- Existence and maintenance of programmes for disaster mitigation, alarm systems, disaster drills, evacuations, etc.

f) Risk and management system performance indicators

A number of international bodies, especially the IDB, have encouraged the use of indicators for measuring the main factors related to disaster risk management as a tool for comparing the risk situation or performance of the risk management systems between countries or regions based on numerical parameters that are intelligible to risk-related decision makers in this field, especially those engaged in financial issues.

Indicators are useful for regional developmental planning, especially for implanting the mitigation measures that should form part of such plans. Indicators try to use a single numerical value to represent a complex situation dependent on numerous factors, some of which are difficult to express through quantitative parameters, in which case they should be defined based on the subjective appreciations of evaluators.

Risk indicators for the Americas

In component 2 of this project we developed a system of indicators to be applied in the countries of Latin America and the Caribbean (IDEA, 2006) that is more complete than the systems we described above. A methodology was prepared for determining four complex indexes derived from a diversity of components.[18] In contrast to the indicators described above, this new approach not only measures disaster risk, but also the management performance and efficiency of the countries. The procedure was applied to 12 countries (Argentina, the Dominican Republic, Jamaica, Chile, Ecuador, Mexico, Colombia, El Salvador, Peru, Costa Rica, Guatemala and Trinidad and Tobago). Of the five countries where this project conducted case studies, only Nicaragua was not included in the indicators project. As a way to compensate for this weakness, the case study of that country was conducted using an estimate for the indicators employed by this methodology as readers will observe in the next chapter.

The **Disaster Deficit Index (DDI)** relates expected losses from possible catastrophic events to a country's financial ability to cope with the situation. To construct the index it is necessary to estimate losses from a catastrophic event that inflicts the maximum losses for a specific period of time. Figure 1 shows the DDI for the 12 countries analysed of a 100-year event. As the reader will note, half of these countries have an index reading above 1.0, which suggests that they lack the capacity to amass the reconstruction funds necessary for coping with such a 100-year event.

The **Risk Management Index (RMI)** is used to gauge risk management system performance. This is the most valuable aspect of this methodology for the purposes of the project objective of this report. It is built on the sum of four indicators that gauge an equal number of risk-related areas of public policy that in turn employ eight underlying indictors that are subjectively determined by local officials and specialists: Risk Identification (RI), Risk Reduction (RR), Disaster Management (DM), and Financial Protection (FP). The results that appear in Figure 1 show that Chile, Costa Rica and Jamaica rate highest among the 12 countries studied on the RMI while the Dominican Republic and Ecuador are lowest on the scale.

There are significant difficulties and limitations in defining indicators owing to the complexity of the problem and characteristics of the various variables that do not lend themselves to being measured on a quantitative basis.

g) ECLAC methodology for analysing economic losses

This section offers a summarized version of the methodology for analysing economic losses developed by ECLAC as well as two other methodologies that are based on that same approach: one to be applied in suc-

18 Cardona, Omar Dario. 2005. Indicators of Disaster Risk and Risk Management. Programme for Latin America and the Caribbean. IDB, Special Report of the Sustainable Development Department. Washington D.C.

Figure 1. DISASTER DEFICIT INDEX (DDI)

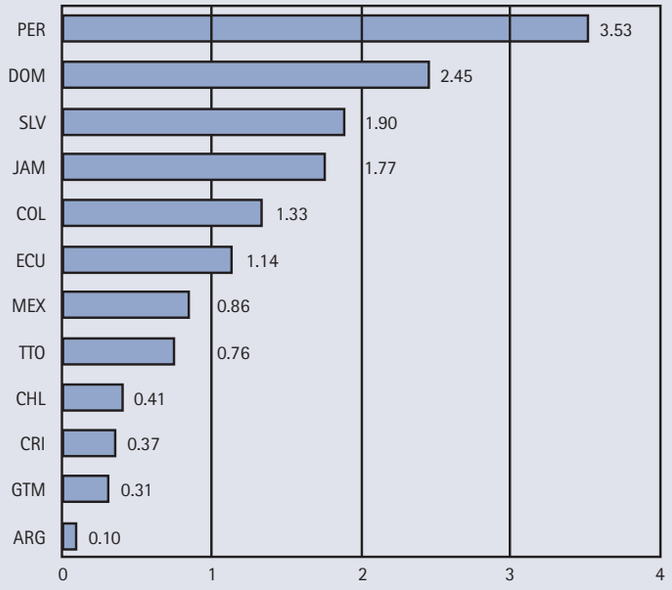
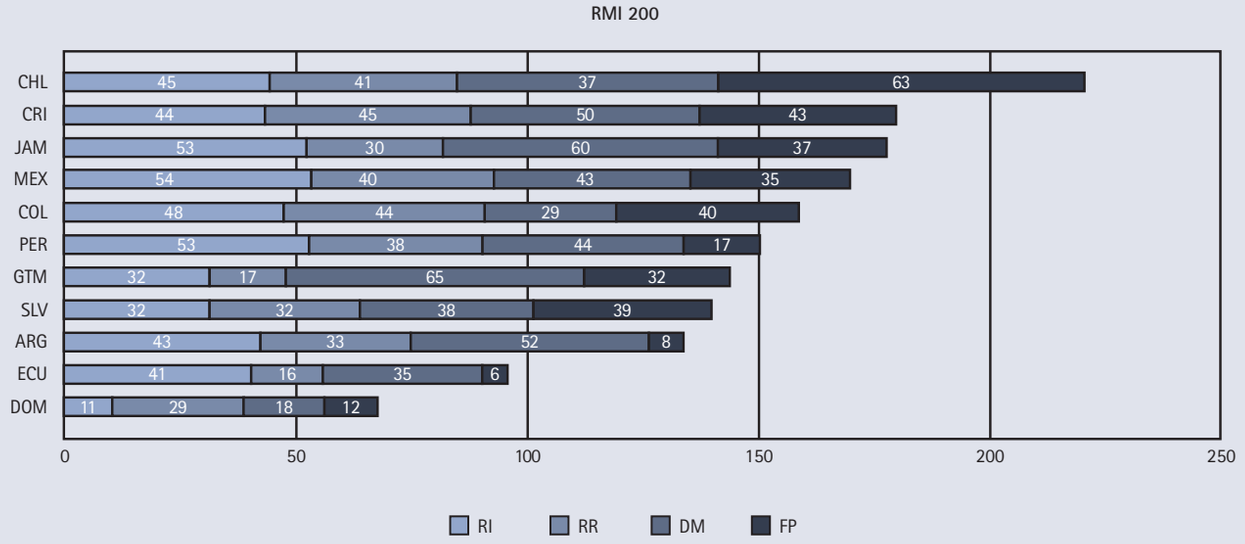


Figure 2. RISK MANAGEMENT INDEX (RMI) AND ITS COMPONENTS



cinct damage evaluations and the other for conducting retrospective appraisals.

i) Fundamental features of the ECLAC Manual. The ECLAC methodology for evaluating the socio-economic impact of disasters has been applied with increasing frequency in Latin America and Caribbean countries. This methodology is laid out in a manual that we have updated on several occasions since it was first published in the decade of the 1980s.[19]

The manual is structured into five parts. The first involves methodological and conceptual issues. The second takes up the methodology for diagnosing a disaster's effects on the public (housing and human settlements), and on both educational and healthcare infrastructure. The third section deals with quantifying damage inflicted on energy, potable-water, sanitation, transportation and communications infrastructure. Assessing damage in each economic sector –agriculture, industry, commerce and tourism– is the subject of the fourth section. The manual concludes with the methodology for evaluating global disaster effects (on the environment, women, a recapitulation of damage and its macroeconomic, employment and income effects).

We will now succinctly describe the general evaluation criteria contained in the ECLAC manual. **Direct damages** are those inflicted on assets that are immobilized, destroyed or damaged and on stocks including final goods, goods in process, raw materials, inputs and spare parts. In essence, this category consists of damage to assets that occurred practically over the course of the disaster. The main items in this category include the total or partial destruction of physical infrastructure, buildings, installations, machinery, equipment, means of transportation and storage, furniture, damage to farmland, irrigation works, reservoirs and the like. The destruction of crops ready for harvest must also be assessed and included as direct damage. Direct damage occurs practically at the moment of the disaster or within a few hours thereafter. Indirect damages as well as global and macroeconomic effects, in contrast, have an extended duration which should be estimated at up to five years depending on past experience and the magnitude of the phenomenon. In the case of slow onset or prolonged events (meteors, droughts or the consequences of an El Niño-Southern Oscillation), direct damages may occur over an extended period of time and even be further expanded should any infrastructure that had been initially repaired or replaced once again be affected (such a bridges destroyed by recurring flooding).

Indirect damages basically consist of production **losses**, a curtailment of the flow of goods and services that cease to be produced or provided during the time extending from the moment a disaster occurs and potentially lasting until the rehabilitation and reconstruction process, which as we have already indicated may extend over a maximum time horizon of up to five years although the greatest losses are experienced during the first two. In any event, calculating its effects can extend throughout the period needed to partially or completely restore productive capacity. Indirect damages include the greater expenditures or costs required for the production of goods and the provision of services owing to disaster effects as well as the revenue shortfalls arising out of an impossibility or greater difficulty to produce or provide them, which in turn will take the form of macroeconomic effects.

Macroeconomic effects refer to the incidence of the disaster on the behaviour of the main economic variables. As a result, these effects reflect the repercussions of direct and indirect damage so they should not be added to those tallies. In some, localized events in specific zones and in larger countries, it may prove important to conduct this analysis at a provincial, state, departmental or municipal level.

The most significant macroeconomic effects of a disaster are those that are felt in Gross Domestic Product levels and growth rates as well as in the degree of activity in specific sectors of the economy, the trade balance (owing to the change in export, tourism and service activities, as well as in imports and payments for external services), in indebtedness, monetary reserves and in both public finance and gross investment. Depending on the characteristics of the disaster, it can

19 The most recent version of this manual can be found at the ECLAC website under the title "Handbook for estimating the socio-economic and environmental effects of disasters".

be important to estimate secondary effects such as price increases and changes in both employment and household income levels.

The valuation criteria for assessing damage that occurs during a disaster may vary and cover a broad range of situations that we can classify in three categories: a) original value (cash value, at current prices); b) replacement cost (in conditions of quality and services similar to those prevailing prior to the disaster); c) reconstruction needs (based on determining how reconstruction is to be conducted and what improvements or reinforcement and mitigation measures are needed in anticipation of future events). One approach to disaster damage valuation begins by calculating the depreciated value of lost assets (at "book value"). In this way it is possible to estimate the cost of the lost or affected assets as they were at the moment of the disaster, taking into account the age of such assets in order to calculate the "use life" it had left. In countries experiencing a significant inflationary process, the book value is not useful as an approximation of the market value of an asset or good. In such instances one may wish to try calculating its original value and revalue it based on the increase experienced in purchasing prices between the time of a good was acquired and the year it was destroyed. However, such an exercise involves numerous complications arising out of the absence or lack of reliability of the components of price indexes over an extended period of time.

There is another damage valuation approach that can be based on estimating the replacement-cost value of lost assets while incorporating mitigation factors in anticipation of future disasters. In other words, lost assets should be valued not only in terms of the cost of new ones which will necessarily include considerations for any technological advances: depending on the age of the asset in question, it is unlikely that the exact same product, with identical characteristics will any longer be available in the market), but also any characteristics that would make it more resistant to the impact of new natural phenomena o anthropogenic (mitigation).

There are intermediate criteria between these two "extremes" that, as we have explained earlier, are determined based on analytical needs, the specific characteristics of the assets in question, the availability of information when making a valuation and, to an important extent, the time that the valuator has for conducting such an assessment. In each case, one must consider the value of the equipment that is functionally closest to the one destroyed and whose purchase and financing are feasible.

It is important to determine the difference between replacement costs with and without mitigation as this will determine the country's financial and eventual external-credit needs.

ii) Summary of the abbreviated damage evaluation survey methodology.[20] This methodology was designed to evaluate damage from frequent events of non extreme magnitude. It is an abbreviated variant of the methodology developed by ECLAC that appears in the aforementioned manual. This focus was developed based on the experience of Mexico and involves a prior effort to identify the affected area and its socio-economics, as well as to establish the support of authorities in the affected zone, (local provincial and municipal governments, depending on the case) and of local civil defence agencies.

The field work requires that a team of four researchers (two specialists in socio-economic matters and two engineers specializing in risk related issues, depending on the type of disaster to be evaluated) travel directly to the affected area for a period of three to four days. The study, complete with conclusions should be drawn up as a team effort within roughly ten days and the presented to the corresponding authorities.

Two weeks after the emergency response phase has passed public officials and representatives of the private sector should be interviewed and field visits to affected areas conducted as a way to collect information on the ground. During this phase emphasis should be placed on detecting the precise causes of the damage in each economic sector arising out of the natural phenomenon, the intensity of the phenomenon, its characteristics and the degree of vulnerability of both the population and

20 This section summarizes Daniel Bitrán's work, Abbreviated damage valuation survey methodology. Existen datos bibliograficos para esta publicación?.

exposed goods. It is possible to deduce from such an assessment the technical mitigation proposals at the heart of the evaluation.

The criteria for valuing damaged or destroyed assets is based on their replacement cost including mitigation works that are to be included in the reconstruction or repair of the affected economic and social infrastructure. The valuation strategy, which is explained in detail in the document, includes efforts prior to and during the field trip to the affected region.

iii) Summary of the retrospective evaluation of the socioeconomic impact of disasters.[21] In order to achieve a long-term view of the impact of different types of disasters a recount of their effects over an extended period of time is of fundamental importance. Accumulated totals and annual averages make it possible to identify the most vulnerable regions, the incidence of the various phenomenon and the financial demands of rehabilitation and reconstruction. Given the prolonged period of return of most financial expenses a retrospective study are needed to detect and quantify the effects of extreme events, which are those that make it possible to determine the upper limits of the efficiency of a country's risk management system.

Many problems are posed when conducting a retrospective and cumulative evaluation of socio-economic impacts that extend well beyond those that arise in the course of a post-disaster, on-site assessment. As we have already explained, a valuation on the ground and in the immediate wake of a disaster primarily involves quantifying the damage or destruction to property. Indirect effects (losses in the production of goods and services) are much more difficult to estimate because the available records generally are confined to loss of life and physical infrastructure, meaning that retrospective evaluations tend to underestimate real economic impacts. Such an undervaluation of disaster effects also arises from the tendency to record only medium or large scale events.

Once a decision is made as to the time span as well as the sectorial and regional breakdown one hopes to achieve, direct consultations are needed with officials, especially authorities with the longest service with the most relevant agencies as well as with educational institutions international bodies, business groups, and emergency aid associations. Furthermore, bibliographic, hemerographic and internet sources should be consulted. During interviews one should ask to consult historical records. Given the diverse origin of sources of historical information and the various evaluation criteria used, it may be necessary to make adaptations to the ECLAC Manual methodology. It may also be necessary to resolve problems with economic statistics so that accumulated effects can be expressed in constant terms and in that way measure real disaster impact over time.

2. INFORMATION FOR DISASTER RISK MANAGEMENT

a) National risk management systems

Risk management refers to the actions and policies aimed at avoiding or reducing disaster-related loss of life, goods and infrastructure in a given country. This definition includes measures adopted for limiting environmental destruction from disasters. Risk management covers a broad spectrum of activities the help raise public safety levels. A risk reduction strategy, therefore, should focus on managing each and every risk component.

A national risk management system consists of the interaction between institutional actions, financial mechanisms, norms and policies. The principal task facing risk-management decision makers is to establish an effective nationwide system with a comprehensive outlook and which engages levels of both the central and local governments, the general public and local businesses. Disaster risk management refers to the part of the system that executes actions before, during and after a disaster.

The measures, activities and timing of actions related to disaster risk management, as well as their cost-benefit in relation to expected results are decisive in choosing effective risk management strategies and policies in the context of sustainable development. Such strategies in Latin American and Caribbean countries have achieved

21 This section summarizes Daniel Bitrán's work, "Evalution Retrospectiva del Impacto Socioeconómico de los Desastres y consideraciones metodológicas para llevarla a cabo." http://www3.cepal.org.mx/iadb-eclac-project/05.html

varying degrees of development. Disaster reduction as expressed in terms such as prevention and mitigation generally loom large in political discourse if not in concrete measures. Most disaster management institutions have concentrated on strengthening emergency response preparations, drawing up hazard maps and implementing early warning mechanisms. The great diversity of demographic density, socio-political systems, levels of development and exposure to disasters of variable intensity have led the countries of the region to adopt different risk management forms.

In order to assess the efficacy of a country's risk management strategy one must study the organizational structure of disaster management, its institutional development and operational efficiency in preventing future effects and in conducting a rapid and efficient recovery of the population and the economy following a disaster. One important component of such a strategy is the capacity to undertake an efficient handling of the post-disaster crisis situation. All of the above will make it possible to gauge the relative importance the government of the country in question assigns to risk management policies.

Institutionality is a particularly important issue. Risk management demands an efficient organization at all levels of national, provincial and municipal government. In order to be effective, public risk management system must possess three main characteristics: rank high enough within the institutional organigram to assure that this issue becomes a national priority and that the measures and actions that are adopted are quickly and efficiently implemented; effective inter-sectorial coordination mechanisms as the system's functioning depends on the will and coordinated action of several sectors; personnel with the necessary training and experience for handling the various tasks involved in disaster management and who have the professional commitment needed to overcome the problems of accelerated personnel turnover that chronically plagued the system. The public risk management system must attend to all management issues and not just the emergency, as is frequently the case, and have contingency plans for executing the main tasks.

The countries of the region have adopted diverse institutional forms for purposes of risk management and the importance of the subject for the political life of those same countries also varies. Such diversity makes it difficult to define typologies in these countries' recent evolution and actions. A measure of the efficiency of the analysis of the results of the different strategies over time can be achieved by comparing the natural phenomena that have taken place and their socioeconomic impact.

The methodology for designing and evaluating disaster risk management strategies that Jaime Baraqui prepared for this programme displays some strategic risk management orientations for rehabilitation, reconstruction, prevention and mitigation. The methodology includes institutional, political, financial, technical, development, investment and macroeconomic issues. Its recommendations were developed on the basis of more than 30 years of ECLAC experience in the region.

b) Information for the various phases of disaster management

An efficient handling of a national risk management strategy should include information decision makers need for executing the various stages of risk management as well as that required by the potentially affected population, and for informational media. Such information should not be confined to the greatest risks associated with the most disastrous events. Several studies have documented that smaller disasters frequently account for a degree of accumulated losses similar to that of large scale events as the smaller-scale ones tend to occur more frequently. Nevertheless, the smaller events receive considerably less attention and documentation as large scale disasters tend to be seen by the pubic as being of much greater significance.

Decision makers should adopt policies and measures based on risk analysis (hazards, risk exposure, vulnerability). The identification, analysis and quantification of probable losses should be the basis for instrumenting the proper measures. So it is essential that they wield information and methodologies for gauging and analysing hazards –their frequency, magnitude and localization– vulnerability (the exposed population and assets) and the resulting risk.[22] There is also an indispensable

22 "Living with Risk, a global review of disaster reduction initiatives", International Strategy for Disaster Reduction, Geneva, July 2004.

need for records of the experience and lessons drawn from the characteristics and impact of past disasters. For this reason it is desirable to have data banks with historical series.

In order to determine what information is needed for disaster management decision-making it is helpful to divide management issues between those in the *pre-disaster* and *post-disaster* phases.[23] The ideal situation is to have in place policies and programmes in keeping with the guidelines described in this publication so as to better assure that actions are most effective in both phases.

c) Information for the pre-disaster phase

Among pre-disaster activities the following have been identified as the most important for assembling the information necessary for proper risk management:

Prevention. This refers to activities that tend to avoid the adverse frontal impact of hazards as well as of technological, ecological and biological disasters. Investments in prevention measures should be prioritized depending on social and technical feasibility and cost/benefit considerations. They should also be justified in relation to zones frequently affected by disasters. With regard to public awareness and education campaigns, prevention is aimed at reshaping attitudes and behaviour so as to promote a 'culture of prevention'.[24] In light of those considerations, in addition to actions of a strictly physical nature, prevention includes actions for raising awareness as well as the organization, education and preparation of civil society about disaster prevention and response. This stage demands general risk information and above all the need to identify the most vulnerable zones as well as the most adverse probable scenarios.

Preparation. This facet consists of the activities and measurements taken ahead of time to assure an effective response when a disaster hits, including early and effective warnings and the temporary evacuation of threatened people and goods. For these reasons it requires the existence of observation, forecasting and public alert systems, as well as networks for measuring hydro-meteorological, geological and anthropogenic hazards. These systems require fluid communications mechanisms that can reach the most remote communities.

Emergency planning. An efficient management of a crisis produced by a natural phenomenon must rest on effective emergency planning. The basis for such planning is a sufficient volume of information to allow for prior and timely access to the following resources: contingency plans for event scenarios with varying degrees of hazard; preparations and resources set aside to attend to emergencies; evacuation plans and shelters; the assigning of responsibilities among protagonists in the emergency plan (especially on the level of the armed forces and non governmental organizations); and the existence of funds budgeted for emergency response. Other strategic *pre-disaster* orientations involve assuring the presence of alternative routes of communication, redundancies in the healthcare system and basic resources such as the provision of water for sanitation systems.

For this phase, decision makers need efficient information systems regarding the evolution of the phenomenon and its consequences. It is necessary to have plans for launching informational campaigns directed at the general public, and especially for those in high risk situations. Plans should anticipate rapid response for implementing self-protection measures including the production and distribution of special information for people with special physical or cultural needs. It is particularly important to anticipate broad and timely mechanisms for providing with information the media, which is indispensable for raising public awareness and informing the public of self-protection measures.

Mitigation. This refers to structural and non structural measures undertaken to limit the adverse impact of natural and technological hazards, and those resulting from environmental degradation[25] such as:

Prevention and Mitigation Works. The pre-disaster part of a national strategy must include hydraulic works for the prevention of flooding and drought, and vulnerability studies regarding strategic installations and vital lines or plans for their implementation. Engineered construction demands specialized knowledge

23 Ibid.

24 Ibid.

25 Ibid.

and the adapting of technologies to conform to local conditions. Special attention should be given to risk-reduction programmes for non-engineered construction (particularly self-built homes), including a continuous diffusion programme providing artisanal or self-builders with technologies appropriate to their environment and experience.

Non structural mitigation measures. These non-engineered measures that reduce vulnerability to hazards include land-use planning and regulations; building codes and their enforcement; zoning according to degree of hazards; reforestation of costal areas and hill/mountainsides; government educational and training efforts, and the public's involvement in mitigation works.

It is important to have a solid body of civil defence or disaster management norms, but it is even more important for such rules to be correctly enforced and applied. Of equal significance are land use regulations and zoning policies for the areas with the greatest degree of vulnerability, building codes that contemplate safety in the face of extraordinary natural phenomena such as earthquakes and wind, as well as properly oriented yearly and medium-term planning.

d) Post-disaster phase

Post-disaster involve attending to the emergency as well as both rehabilitation and reconstruction processes.

Emergency response. The provision, attention to or management of an emergency situation includes plans, structures and systems for coordinating the actions of the government with those of non governmental organizations, groups of volunteers, civil organizations and international aid for responding to emergencies. It is important, therefore, to have the information necessary to draw up contingency plans that provide for and assign responsibilities to the sectors involved, evaluate emergency needs (affected population and territory) and facilitate a fluid exchange of information between the affected population and authorities in charge of the emergency. It is necessary to consider where financing for emergency response will come from (central and local governments, international and private aid), humanitarian assistance, the role of the armed forces, non governmental organizations and groups of volunteers, the operational characteristics of emergency response (timely evacuation of the affected or at-risk population, search, rescue and attention to victims), planning for and organizing shelters, assuring the availability of routes that can act as alternatives when other roads are impassable, the handling of in-kind aid, shelter, food, and both physical and psychological help campaigns.

It is important to be able to draw on information regarding the past handling of similar contingencies, the amount of local and foreign resources employed and how they were used, as well as the regular and special budget items (in the case that special funds were assigned) from the responsible bodies.

Rehabilitation. Rehabilitation largely consists of repairing installations, infrastructure and assets in general without modifying the principal characteristics and respecting their general installation, size, general design, coverage and breadth. In contrast to the reconstruction phase, major studies and projects are not required. What is necessary is to determine in each instance whether rehabilitation or reconstruction is required. This phase demands the existence of quick evaluation systems that set priorities for the various rehabilitation tasks such as re-establishing essential public services and productive activities including the provisioning of potable water, electric power and the means of communication, medical attention for the injured, clean-up and removing debris, repair of housing and sanitation systems, rehabilitation of roads providing access to affected areas, financial support in the form of soft loans to small-scale producers and delivering seeds to medium-sized and large-scale farmers.

It is necessary to have in place procedures for determining and obtaining financing with which to cover the need for funds throughout the rehabilitation phase. Special attention should be paid to describing and analysing rapid assessment tools[26] with which to determine priorities and the volume of financial resources available for the rehabilitation of basic services.[27] The same degree

26 These techniques should not be confused with those emplyed by United Nations agencies and some national organizations for estimating urgent needs in the the emergency phase.

27 In this regard the government of Mexico has developed a tool for quickly assessing needs. The Asian Disaster Preparedness Center (ADPC) has developed the methodology DANA, which has been used on an experimental basis by some Latin American countries.

of attention should be provided to identifying the sources that were available for financing rehabilitation during recent disasters whether they be from public sources (owing to the special or extraordinary reassigning of budgeted fund) or private one (in the case of privately controlled basic services).

Reconstruction. When a disaster occurs, the authorities must design a reconstruction strategy, defining priorities based on existing needs and available resources and take into account the need to introduce proper mitigation factors. During this phase comprehensive civil works projects must be designed, a process that demands a series of prior studies. This phase is of major importance owing to its economic, social, environmental and financial repercussions. Its execution should lead to fully restoring the public's normal living conditions as well as the pre-disaster economic and social developmental dynamics of affected region or country. This phase takes the form of executing specific projects that have been properly evaluated, prioritized, harmonised, coordinated between one another and consistent with the amount of financial resources available, which means those that have been fully programmed and inserted into a medium- to long-term reconstruction programme.[28]

During this phase, in contrast to that of rehabilitation, finished projects are needed. Civil works, for example, demand a series of prior studies including those contemplating basic engineering, geometric and structural design, demand analysis, determining the locations that are ideal for an optimal use of investments and costs as well as in relation to demand, vulnerability reduction needs, optimal scale and dimensions based on both current needs and those that are projected for the foreseeable future among other considerations. Vulnerability reduction is an indispensable prerequisite of the reconstruction programme as the new installations –whose execution will involve very large sums– must be sufficiently protected against disasters.

The programmatic orientations that ought to guide reconstruction programmes include, among others: the replacement of physical infrastructure and of social losses; the recovery of productive activities that have been affected; re-establish a proper management of basins and environmental preservation; have available the necessary human settlements and resettlements; implement proper urban environmental management; reactivate the affected population's economic and social fabric and generate productive jobs. Reconstruction actions should also consider the conservation of natural resources and be linked to sustainable development.

3. INFORMATION FOR FINANCIAL DISASTER RISK MANAGEMENT

a) Introduction

Such information includes that which underpins the financial management of disasters. As such, in its broadest acceptance it must extend to include not only information related to indirect damages and subsequent losses, but also comprehend information on costs that might be incurred in the prevention and preparation phase. It must also cover data on the expenditures made during the emergency response, recovery and rehabilitation phases as well as the cost of reconstruction investments. [29] It also extends to information on instruments designed to cushion through risk transferences the financial effects of disasters on the country.

An analysis of information on financial allotments for such objectives offers an appreciation of the extent to which the government prioritizes prevention actions over disaster response activities. For that reason it is worthwhile dealing separately with the financing of risk-reduction activities in the prevention phase (*ex ante* financing) funds allotted to emergency response, and the rehabilitation and reconstruction phases. By applying the ECLAC methodology for assessing the impact of disasters it is possible to produce information on the investment costs of the rehabilitation and reconstruction phases. Such evaluations usually include the profiles of projects needed for diminishing a country or region's vulnerability to future disasters.

However, owing to the customary timing of these evaluations (roughly three weeks after the event, essentially after the emergency has passed given that the purposes of this assessment is quantifications for

28 Informe sobre Aspectos Metodológicos y de Estrategias, Jaime Baraqui, document for the IDB/CEPAL project, May 12, 2004.

29 *Evaluation of Inter-American Development Bank's Operational Policy on Natural and Unexpected Disasters*, DRM, September 2003, pp. 34.

rehabilitation and reconstruction), emergency related quantifications are overlooked. Under the ECLAC methodology, the cost of attending to the emergency based on real expenditures and donations is included under indirect disaster effects.

The public sources of information for documenting the financial handling of disasters include *internal resources* (such as disaster funds, budgetary reassignments, new taxes for generating additional revenues, soft loans used to support productive sectors and the flow of insurance claim payments) and *external resources* (the aid, loans and donations from international organizations and private credit sources as well as those derived from risk transferences in the form of reinsurance and catastrophe bonds).

It is useful to deal separately with the financing of prevention-related risk reduction actions and of the emergency, rehabilitation and reconstruction phases. In both instances there tends to be a combination, in varying proportions, of situations in which:

a) The central government assumes a high degree of risk either through calamity funds or by drawing down resources from other programmes.
b) International assistance becomes the main funding source both in terms of loans and donations.
c) The private sector largely assumes the consequences by recovering insurance or reinsurance premiums.
d) A very incipient practice of securitizing catastrophe bonds.

The sources of information for documenting the financial handling of disasters are scattered and generally suffer from gaping holes. Of particular concern is the considerable lack of oversight of post-disaster activities. Information on spending or the reassigning of public spending is registered in each country's public accounts while that of foreign assistance is generally recorded by the central institution in charge of risk management. The hardest data to come by is often that of insurance claim recovery. The official institutions that set the operating norms of insurance firms tend to collect such information.

Decision makers must turn to multiple sources of information –to which access is often limited- for implementing the necessary policies. The information in question includes public accounts that are sufficiently detailed as to make it possible to discern the volume of funds applied and the redirecting of programmes, external financing and the probable re-channelling of loans as well as the extent of insurance coverage and claim recovery once a disaster has occurred.

b) Financing pre-disaster actions

The countries of the region continue to suffer from a limited amount of financial resources for the pre-disaster phase, but what is available appear to be increasingly taking the form of programmes oriented toward promoting the prevention and reduction of disaster risk.

Pre-disaster actions include the assigning of resources for:

i) research and activities aimed at improving risk awareness (hazard, vulnerability and risk maps);
ii) prevention actions including public awareness;
iii) vulnerability studies, particularly of strategic installations;
iv) mitigation works;
v) activities related to emergency-response preparations and rehabilitation;
vi) those allotted for setting up early detection and warning systems, and
vii) those oriented toward creating a public culture of prevention.

When a country's national budget includes calamity funds, whether they be earmarked for emergency, reconstruction or prevention-investment, their effectiveness will depend on the relationship between available resources to the risks that they intend to cover as well as the fluidity of the procedures through which they are paid out. A fund's effectiveness is also dependent on which sectors are to be covered and the way in which priorities may be set for awarding funds to the population segments most vulnerable to disasters. Information on the size and priorities of such funds tend to appear in the data that the institution in charge usually publishes over the internet.

c) Financing post-disaster actions

When a disaster occurs, the emergency, rehabilitation and reconstruction phases depend to varying degrees on financing from different sources: allotments or transfers from the budgets of central, provincial and municipal governments; domestic or foreign donations; additional external financing or the re-channelling of loans or lines of credit that had been previously authorized; tax cuts; the issuing of soft loans through banks and the collection of insurance and reinsurance.

In order to finance actions in response to disaster consequences it is necessary to have previously put into place mechanisms that provide the resources needed for covering expenses during the emergency, rehabilitation and reconstruction phases. Disasters provoke direct damages and lead to a curtailing of the production of goods and services. Calamity funds are largely set aside for emergency response and in some instances for the repair and reconstruction of damaged or destroyed public sector infrastructure.

In the countries that have set up such funds, they only cover direct damages except for agricultural damages. Several countries provide various forms of insurance with which to support farmers in the event of disaster-induced agricultural losses, especially the least affluent sectors. Non farm informal sectors receive virtually no support except those countries with programmes for housing reconstruction that almost always involve hiring people from among the same affected sectors.

When it comes to external financing, it is important to distinguish between non refundable resources –mainly donations from financial institutions, governments and non governmental organizations– and those that must be repaid: contingency credits from international funding agencies, the reorientation of existing loans or new loans. Such resources include IDB and the World Bank facilities and mechanisms, the reorientation of previously approved loans and the reformulation of active lines of credit to meet reconstruction needs, and the rejection of new loan requests.[30] In fact, the World Bank and the IDB have leading sources of post-disaster recovery and reconstruction funding. The agency in charge of risk management can obtain information on such issues from the records of the Central Bank of the country in question.

d) Risk transference

Insurance and reinsurance are among the most important risk transference mechanisms. They can be a good option for offsetting the financial imbalances that disasters inflict on public and private finance. However, the type of disasters this type of coverage provides in the region is greatly limited by the high cost of premiums in countries with a considerable incidence of risk from natural phenomena.

Any analysis of this subject should identify and assess the extent of penetration, cost and efficiency of catastrophic insurance and reinsurance covering economic and social infrastructure and other public and private sector assets as well as the extent to which farm production is covered. Such an exercise makes it possible to evaluate the potential for such risk transference mechanisms to assume a broad role in the region. However, the necessary information is often not easy to come by. Useful information in this regard can be obtained from the governmental institutions some countries have established for regulating insurance companies.

Insurance is particularly valuable in helping with financial recovery following a disaster and for reducing losses from future disasters. While premiums are based on risk, insurance can encourage individuals and owners to adopt reinforcement or mitigation measures using cost-effectiveness criteria for lowering risk in their homes and businesses. In this sense it is important to obtain information from insurance firms regarding the risks assumed in areas susceptible to hazards. Similarly, insurance coverage can provide additional economic incentives for taking such pre-emptive action, lowering the premiums paid by those who invest in mitigation on their property, for example.

Seismic risk policies have become increasingly available in the region and some countries have made it a legal requirement that public infrastructure be covered by insurance. Such practices are less common on a local level. There is considerably less coverage available for hydro-meteorological risks. A certain proportion of policies are available to that cover the risk of crop

30 The Inter-American Development Bank and the World Bank offer countries special contingency facilities for such instances as do some sub-regional development banks (for example, the BCIE, CDB and CAF.

damage, but their administrative costs are so greatly inflated that they are affordable only to large scale agribusiness firms. In developed countries such insurance schemes tend to be subsidized.

As we have previously indicated, the use of such insurance and reinsurance coverage is very uncommon in the region despite the frequency of natural disasters. This lack of penetration is explained in large part by the aforementioned elevated cost of premiums and the lack of institutional and legal development required for their implementation. The taking out of insurance as a means to transfer the risk of a major event demands international credibility studies regarding the object of such protection and maximum probable losses underpinning the risk premium. A precise knowledge of hazards and laws as well as adequate controls are needed in order to back up these types of risks.

Catastrophic risk policies in the region are generally limited to a country's most modern sectors, raising the need for the public sector to assume greater responsibilities in financing disaster results among the least advantaged segments of the population.

Flood insurance is also scarce in the region because property located along rivers and canals frequently suffer flood damage, thereby dramatically elevating the cost of such coverage. Catastrophic risk insurance policies are also rarely available for medium-sized or small businesses in non agricultural productive sectors. Catastrophic insurance coverage is even less commonly provided for areas such as municipal infrastructure, sewerage systems and modest housing.

As we have already indicated, another risk transference mechanism consists of catastrophe bonds (also known as CAT bonds). These risk-linked securities tend to pay very high, long-term yields except when a disaster occurs. Investors look for a premium of between 3% and 6% over LIBOR almost regardless of the risk scenario involved. Information on publicly traded CAT bonds is widely available.

4. GENERATING INFORMATION FOR RISK MANAGEMENT

Providing decision makers with access to the necessary quantity and quality of information needed for the various management phases demands a major effort to generate and compile information, their translation into useful products and transfer to the user.

In the most developed countries much of the necessary techno-scientific information is generated by academic research centres and those supported by the government. The least developed countries lack the means to generate all of the necessary information, and often try to rely on information produced in other countries or in studies financed and executed by international bodies or donors. In all such instances it is best that one or more local groups assemble the information and prepare useful products for decision makers at all levels. In some countries such as Mexico, Nicaragua and El Salvador this work is conducted by specific centres and in others by each specific sector. Small countries can turn to regional institutions that coordinate the studies for generating the necessary the information and channel international technical support. CEPREDENAC and CDERA are successful examples of such regional centres.

Whatever the form, it is the responsibility of the management system to generate the conditions needed to provide the necessary information, an undertaking that involves considerable economic and human resources. International technical cooperation has greatly contributed to such efforts in the countries of the region, where the most difficult and taxing endeavours have proven to be managing the specialized technical centres as well as monitoring and warning systems. It is often the case that once the international aid that contributed to the creation and initial operation of such centres and systems is withdrawn, they are abandoned within a few short years owing to the resulting shortfall in necessary resources.

One of the most important questions when evaluating a country's risk management strategy is to determine who assumes the cost of generating and distributing the information needed for risk management.

III. COMPARISON OF RISK MANAGEMENT IN THE COUNTRIES STUDIED

1 THE SOCIO-ECONOMIC CHARACTERISTICS AND IMPACT OF DISASTERS

Based on the corresponding terms of reference, five national case studies were conducted in order to identify what risk-related information is available as well as the analytical tools governmental institutions have at their disposal. At the same time the studies were aimed at identifying the role of actors that assume risk.

This chapter provides a comparative analysis of the state of risk-management related information, as well as the principal aspects of the structure of the management system. This analysis is based on the five national case studies. A tabular listing of each country's characteristics appears in tables in Appendix 2, and the body text makes comparative comments.

In order to provide an understanding of each country's situation we begin with a description of the fundamental features of each one's socio-economic profile and later describe relative disaster impact

With the aim of achieving a broad sample of examples of disaster risks and policies for their management, five countries were chosen as being representative of the various sub-regions of Latin America and the Caribbean that are exposed to high risk from different types of natural and whose economies vary in size and degrees of development: Colombia, Chile, Jamaica, Mexico and Nicaragua.

a) Socio-economic statistics

Before we analyse the differences and similarities in the risk-management information from the National Case Studies, we will offer an introductory description of some of the features of each country's socio-economic profile and its relative standing in the region. We will then mention disaster impact relative to the number of victims and total losses.

México stands at the high end of the population scale with 106.1 million inhabitants and Jamaica at the low end with a mere 2.7 million. The pace of demographic growth has been slowing in all five countries, but still varies significantly from country to country. The least populated country, has the lowest demographic growth rate: 0.5%, which is roughly a third of the regional average (see Table 4). In contrast, the country with the lowest economic and human development index, Nicaragua, has the fastest pace of demographic growth (2%).

Mexico's growth rate is exactly in line with the regional average (1.4% annually), while that of Colombia is faster. In South America, Chile is beginning to approach the low rates that Argentina and Uruguay have registered for quite some time.

The urbanization process has been most accelerated in Chile, where city dwellers now account for 86.6% of the population, well above the 77.6% re-

Figure 3. 2005 POPULATION OF THE FIVE COUNTRIES

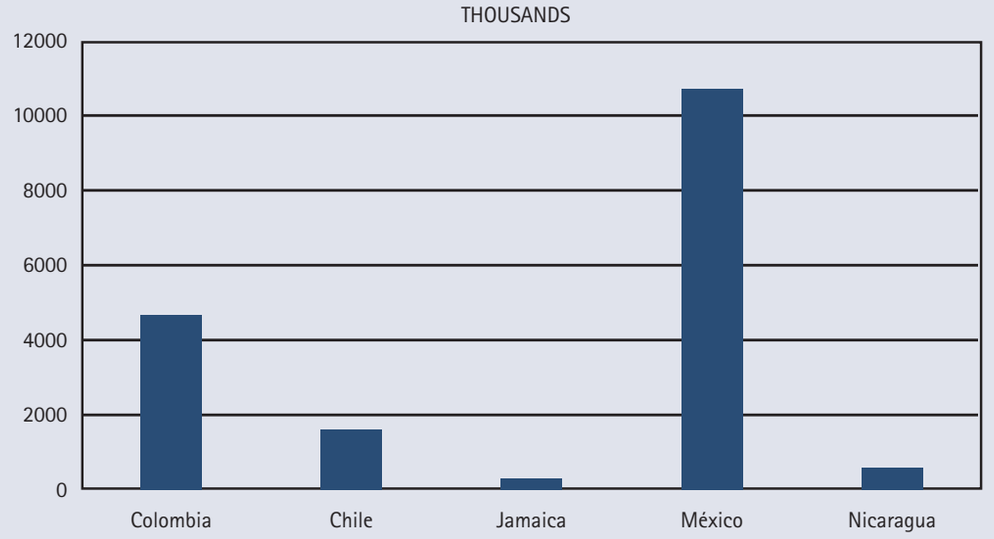
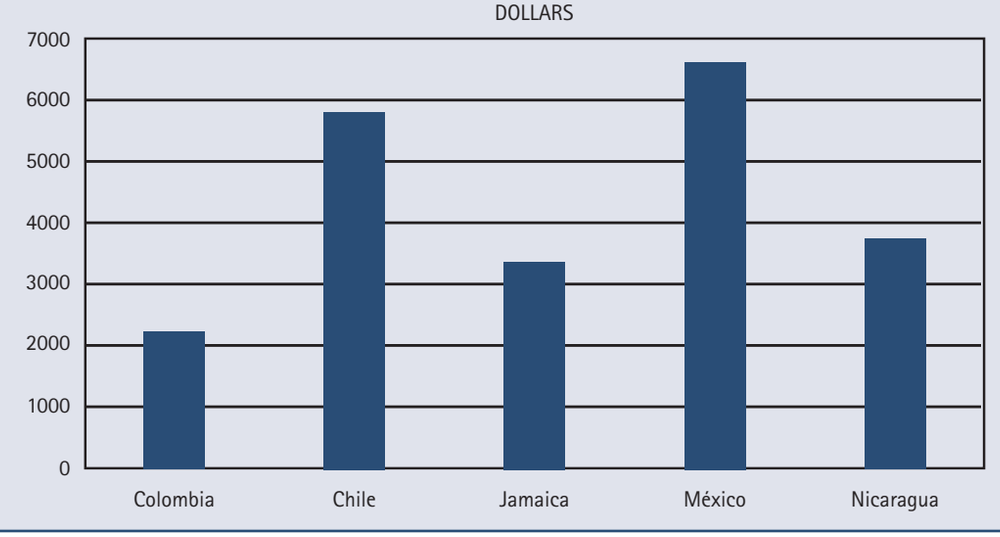


Figure 4. PER CAPITA GDP IN 2004



gional average. Somewhat more than three fourths of the populations of Colombia and Mexico are urban, while Jamaica has the lowest degree of urbanization among the countries studied (52.2%), followed very closely by Nicaragua.

Mexico tops the list in terms of per capita income with a 2004 annual average of US$6,521.9, followed by Chile (US$5,903). Both of these countries are well above the regional average (US$3,755.6), while Nicaragua ranks last at US$836.50. Colombia and Jamaica

TABLE 4. FUNDAMENTAL FEATURES OF THE DEVELOPMENT LEVELS REACHED BY SELECT COUNTRIES						
	Colombia	Chile	Jamaica	Mexico	Nicaragua	Regional Average (LatAm & Caribbean)
Total population (2005) (Thousands of people)	46 039	16 267	2 651	106 147	5 483	562 046
Population growth (2000-2005 annual average)	1.7	1.1	0.5	1.4	2.0	1.4
Percent of urban inhabitants (As per cent of total)	76.6	86.6	52.2	76.5	56.9	77.6
Illiteracy rate[a] (as per cent of total population)	7.1	3.5	11.3	7.4	31.9	9.5
Per capita income in 2004 (Dollars)	2 136.4	5 903.0	3 343.9	6 521.9	836.5	3 755.7
Human development index 2004[b]	0.790	0.859	0.724	0.821	0.698	0.795
Ranking among 176 countries surveyed	70	38	104	53	112	
Electric power coverage (2004) (as per cent of total population)	95.3	98.5	n.a.	97.2	72.4	Na
Potable water coverage (2004) (as per cent of total population)	85.9	92.0	93.0[c]	88.1	61.5	Na
Drainage coverage (2004) (as per cent of total population)	73.6	80.4	80.0[d]	71.1	62.9	Na

Sources: ECLAC, Statistical yearbook for Latin America and the Caribbean, 2005; Human Development Report UNDP, 2006

a Percentage of population 15 years and older.

b This is a combined index that contemplates GDP per inhabitant, life expectancy at birth, illiteracy rates, education enrolment at all levels, a month other indicators.

c 2002.

d 2002.

also rank below average with the latter country closest to the regional median.

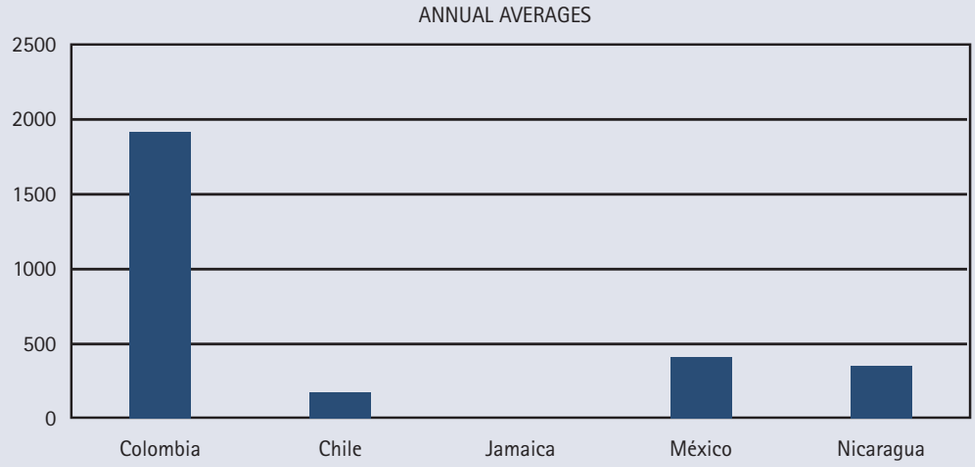
Nicaragua reports the highest indexes for illiteracy (31.9%) and for the availability of basic services (electricity, water and drainage). Jamaica has a relatively high illiteracy index (11.3%), and practically the same reading for potable water and drainage services. The illiteracy rates of the remaining countries are below the 9.5% regional average for those over the age of 15. Chile has the lowest reading at 3.5%.

The rankings of countries on the human development indexes published by the United Nations Development Programme (UNDP) generally coincide with per capita income levels. The only exception is Mexico, which has a lower HDI reading than Chile although it has higher per capita income. For 2004 Chile ranked 38th from the top among the 144 nations included in the UNDP index while Mexico came in 53rd. Among countries in our simple, Mexico is followed by Colombia, which ranks 70th.

b) Disaster impact

On average in recent years, natural disasters in Latin America and the Caribbean have affected four million

Figure 5. DEATHS CAUSED BY NATURAL DISASTERS



people including approximately 5,000 deaths, and US$4.00 billion in losses.[31] The trend toward an expanding scale of disaster appears to be related primarily to demographic growth and an urbanization process that has produced high-density populations in at-risk areas, as well as a process of development that has increased the value of assets in such locales. Climate change appears to be another contributing factor and one whose impact will probably contribute to increasingly severe disasters in the future.

While the amount of losses has tended to grow, recent evaluations suggest that the same cannot be said about the number of those killed or injured in disasters. The proportional drop in the number of human victims reflects the increasingly positive effect of improved warning, evacuation and rescue systems, but such progress has yet be replicated on the level of endeavours aimed at lowering the physical vulnerability of assets at risk and of risk transfer mechanisms.

The five countries chosen for this study display considerably varied degrees of economic and human development. At the same time their societies are exposed to various types of hazards owing to their geographic location, physical characteristics and the uneven vulnerability levels arising out of distribution inequalities as well as the differing degrees to which proper risk management policies have been brought to bear.

When considering the following data on the average incidence of disasters in the countries analysed one should keep in mind that they were drawn from a variety of sources, from different years and that they were calculated based on methodologies that were not fully comparable. Nevertheless, we have included them for purposes of illustrating an order of magnitude. All of these countries suffer from a lack of historical series on disasters. Only in Mexico, and more recently in Nicaragua have the bases been laid for maintaining a systematic recording of the impact of disasters using a common methodology.

A lack of data tracking long-term effects limits the validity of the return periods necessary for building probabilistic models dealing with seismic and hydrometeorological phenomena. The degree of uncertainty arising out of this weakness also affects investment decisions in prevention and mitigation, posing an obstacle to the realization of cost-benefit studies.

Despite the statistical and methodological limitations cited above, the data in Table 5 is useful for delineating what we estimate are valid trends. Note that the number of deaths from disasters in Colombia and espe-

31 *Evaluation of Inter-American Development Bank's Operational Policy on Natural and Unexpected Disasters*, DRM, September 2003.

Figure 6. DISASTER INDUCED DIRECT AND INDIRECT LOSSES

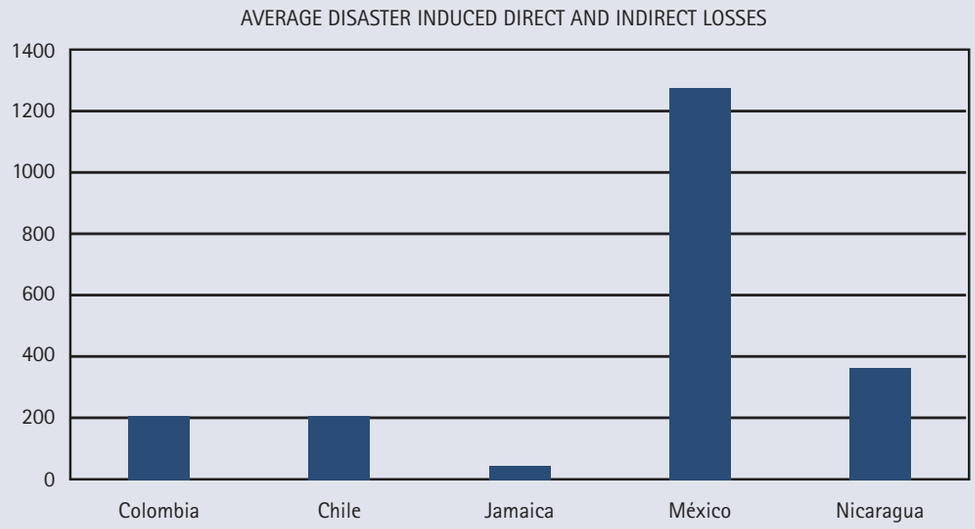


TABLE 5. SOCIO-ECONOMIC IMPACT OF DISASTERS IN COUNTRIES STUDIED AND COMPARISON AGAINST THE REGIONAL AVERAGE[32] (Annual averages)

	Colombia	Chile	Jamaica[a]	Mexico[b]	Nicaragua	Promedio ponderado de los cinco países[c]
Muertes	1 926[d]	156[e]	18	422	370[f]	2 892
Número de muertes por 1 000habitantes	4.2	0.1	0.7	0.4	6.7	1.6
Monto de las pérdidas directas e indirectas (millones de dólares)	195	196	29	1,263	143[g]	1,826
Pérdidas por habitante en dólares[h]	4	12	11	12	26	10
Pérdidas por habitante en porcentaje del PIB por habitante	0.2	0.2	0.3	0.2	3.1	0.2

a Data calculated based on Table 4.5 of the Jamaica report whose source is:"EM-DAT: The OFDA/CRED International Disaster Database; annual averages for 1900-2005.

b Refers to annual averages for 2001-2005. Owing to the incidence of disasters in this last year, losses were greater than in the 1980-2000 historical average, estimated at 700 millon dollars. Annual average deaths, however, were somewhat higher (500) in this earlier period.

c Data drawn from the Inter-American Development Bank's Operational Policy on Natural and Unexpected Disasters, September 2003. The numbers correspond to estimates for 2001

d Obtained by combining the number of annual average deaths from major disasters for 1983-1999 and tose from all other disasters for 1971-2002.

e Only refers to deaths from seismic activity calculated as an average based data for 1939 (10.000), and deaths for 1975-2005, according to Table 16 of the case study of Chile.

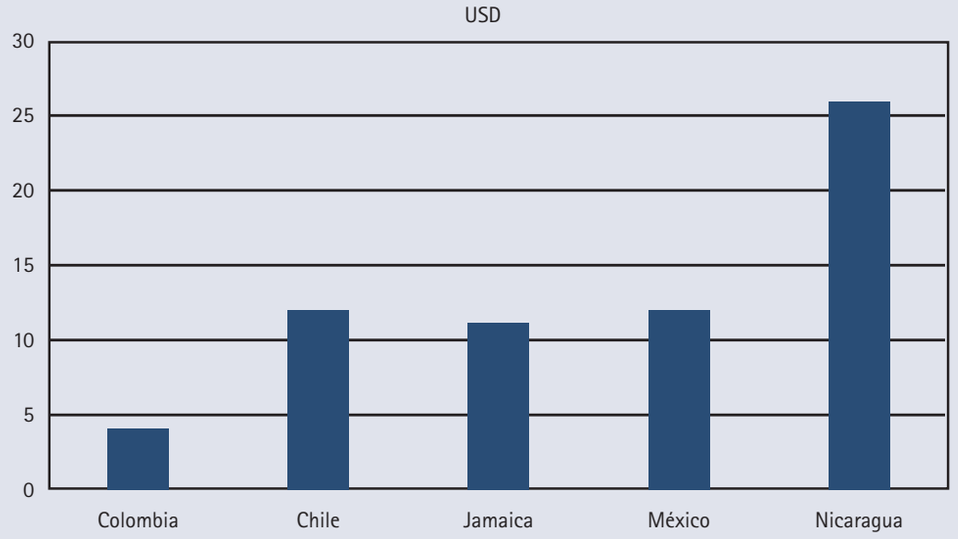
f 1972/2001 average based only on records of the major disasters for the period according to Table 1.1 of the Nicaragua case study.

g Calculated in the Nicaragua study as the 1972-2000 annual average of accumulated losses (4.000 billon dollars).

h Calculated based on the 2005 population.

32 Prepared by D.Bitrán based on national case studies and other sources. Annual averages were calculated using data from varying periods taking into account recent events. Total population is for 2005.

Figure 7. PER CAPITA DISASTER LOSSES



cially Nicaragua as a percentage of the total population are higher than those of the other three countries and easily outstrip the regional average.

Average disaster losses per inhabitant vary from a low of 4 dollars a year in Colombia to a high of 26 dollars in Nicaragua. The other three countries report similar averages (between 11 and 12 dollars a year per person). The weighted average for the five countries is 10 dollars per inhabitant a year. While such losses in four of the countries fell far short of accounting for 1 per cent of per capita GDP, in Nicaragua they totalled 3.2%.

c) Specific data on disaster impact in countries studied

This section offers details on the statistics that were the basis for the comparative tables and figures in the preceding section.

TABLE 6. MEXICO: DISASTER VICTIMS AND DAMAGE 2001-2005 (Millions of pesos)[33]

Year	Deaths	Hydro meteorological	Geological	Others	Total	Type of change[a]	Total (millions of dollars)
2001	276	2 416.8	29.3	30.0	2 476.1	9.34	265.1
2002	453	10 952.0	2.0	272.0	11 226.0	9.66	1 162.1
2003	526	4 267.8	1 290.8	1 413.5	6 972.1	10.79	646.2
2004	336	714.7	0.4	122.2	837.3	11.29	74.2
2005	518	45 096.0	1.4	328.6	45 426.0	10.90	4 167.5
Median 2001-2005	422	12 689.5	264.8	433.2	13 387.5		1 263.0

a ECLAC, Mexico regional office, data obtained from the publication México: Evolución Económica durante 2005 y perspectivas para 2006. They refer to annual averages.

33 D.Bitrán, based on the CENAPRED publication, *Características e Impacto de los Principales desastres ocurridos en la República Mexicana*, Vols. 3, 4, 5, 6 y 7.

TABLE 7. COLOMBIA: MAIN DISASTERS 1983-1999[34]			
Disaster	Year	Estimated Damage (millions of dollars)	Deaths
Popayán	1983	377.8	287
Armer	1985	246.0	24 442
Atrato Medio	1992	45.2	26
Tierradentro	1994	150.1	1 091
Chief Coffee Area	1999	1 590.8	1 862
Total 1983-1999		2 409.9	27 708

TABLE 8. COLOMBIA: ESTIMATED COST OF LOSSES AND DAMAGE CAUSED BY LESSER DISASTERS[35] (Thousands of dollars)		
Period	Total losses	Deaths
1971-1980	166.466	
1981-1990	373.922	
1991-2000	964.562	
2001-2002	147.944	
1971-2002	1.652.893	9.475

TABLE 9. COLOMBIA: SUMMARY OF DISASTER IMPACT (Annual averages)		
	Millions of dollars	Deaths
Annual average major disasters (1983-1999)	142	990
Annual average lesser disasters (1971-2002)	53	306
Total annual average	195	1.296

34 Informacion sobre el Riesgo de Desastres a través de los studies caso piloto, *Estudio Nacional de Colombia.*

35 Ibid.

TABLE 10. CHILE: DIRECT LOSSES FROM EARTHQUAKES

Year	Total (US$ millions)
1939	2 716.4
1942	0.75
1943	25.3
1946	1.69
1949	3.04
1949	0.22
1953	12.8
1953	2.25
1958	0.2
1960	961.7
1965	152.4
1966	0.99
1967	1.99
1971	446.6
1975	38.9
1975	5.68
1976	1.82
1985	1639
Total (47 years)	6 011.63
Average	127.91

TABLE 11. CHILE: RESOURCES ALLOTTED EACH YEAR BY THE AGRICULTURE MINISTRY FOR EMERGENCY RESPONSE AT DECEMBER 2003 (Thousands of pesos*)

Region	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
I		21.111	5		135 024			101 931		5 320	263 391
II								22 651			22 651
III	264 654	571 698	656 050	883 490	132 002						2 507 894
IV	822 597	2 510 324	2 338 256	1 989 475	6 715	28 229				76 000	7 771 596
V	563 288	2 212 289	1 230 184	2 555 715	55 801	158 979	50 043				6 826 299
VI				216 555	24 312	49 607	140 082				430 556
VII				560 812	25 719	52 393	288 776				927 700
VIII				557 281		29 329	460 679	50 966		20 000	1 118 255
IX			1 410 371			190 026	537 318	118 920		4 500	2 261 135
X			993 419			42 771	427 456	45 303			1 508 949
XI			377 468				112 882				490 350
XII							20 545	3 398			23 943
RM		1 582	524 775	1 214 394	66 149	40 892	87 226				1 935 018
Est. Rain						28 597					28 597
Unspecified									710 790		710 790
Total	1 650 539	5 317 004	7 530 528	7 977 722	445 722	620 823	2 125 007	343 169	710 790	105 820	26 827 124

We calculate annual average from earthquakes at 127.9 million dollars. We can roughly estimate that in 2003 dollars it would be 192 million dollars.[36] Accumulated resources allotted over 11 years by the Agriculture Ministry for emergency response at 2003 prices: 26.627 million pesos, which corresponds to an annual average of 2.439 million at an average exchange rate for the last quarter of 2003 of 625 pesos per dollar.[37] Annual average losses would total 3.9 million dollars.

i) Nicaragua. The case study of Nicaragua contains the following paragraph: "Nicaragua has suffered the recurring impact of disasters throughout history. Between 1972 (the year of the Managua earthquake) and 2000, economic losses have totalled approximately 4 billion dollars according to data from the [the National System for Disaster Prevention, Mitigation and Assistance in Nicaragua] SINAPRED Executive Secretariat" (p. 5). Based on that figure, average annual losses were calculated at 143 million dollars.

ii) Jamaica. Disaster damage appears in the following table:

2. INFORMATION FOR EVALUATING RISK[38]

The handling of statistical information regarding the occurrence of severe natural events is generally up to state institutions. These same bodies are also in charge of issuing publications and inventories of extreme events, as well as hazard, vulnerability and risk studies. Table 13 lists some of the agencies that oversee such tasks.

Decision makers have access to numerous catalogues of past events as well as well as hazard maps although these tend to offer little detail on the local level. Table 14 lists some hazard, vulnerability and risk studies produced in the countries analysed along with the names of the authors and target audience of such reports.

All of these countries have made considerable headway in improving the availability of information on disaster risk, especially with regard to hazards. Very encouragingly, the microzonification of seismic regions appears to have become common practice in major cities. It is important to carry through with these efforts so that this type of progress translates into regulations at the state and municipal levels such as those we have witnessed in cities such as Cali, Mexico City and Acapulco.

TABLE 12. NATURAL DISASTERS IN THE COUNTRY FROM 1900 TO 2005

Events	N° of Events	Deaths	Total Affected	Damage in US$ (thousands)
Drought	3	0	100 000	6 000
Earthquake	1	1 200	90 000	30 000
Epidemics	4	46	300	0
Flooding	13	767	898 712	1 262 740
Landslides	1	0	0	0
Wind	23	574	1 324 161	1 793 912
Total 1900-2005	45	1 854	2 413 173	3 092 652
Annual average	0.43	18	22 983	29 454

Created on Nov-14-2006 - Data version v06.06.
Source: "EM-DAT: The OFDA/CRED International Disaster Database, www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium".
*Events recorded in the CRED EM-DAT. First Event: Jan/1900, Last Entry: Oct/2005.

36 25 years based on the U.S. average rate of inflation of 2%.

37 CEPAL *Estudio Económico para Latin America* 2005.

38 The consultants conducted studies in keeping with the terms of reference and basic methodological document for national case studies that can be found at http://www3.cepal.org.mx/iadb-eclac-project/05.html.

TABLE 13. SOME SOURCES OF STATISTICAL INFORMATION AND THE MONITORING OF SEVERE NATURAL EVENTS

Colombia	Chile	Jamaica	Mexico	Nicaragua
• Colombian Institute of Geology and Mining (Ingeominas) • Institute of Hydrological, Meteorological and Environmental Studies, IDEAM • Network of meteorological stations in Manizales operated by the Institute for Environmental Studies, IDEA.	• Meteorological Data Base of the National Water Service • South Andean Volcanological Observatory (OVDAS) • Seismology Service of the Universidad de Chile • RENADIC (accelerographical network)	• Office of Disaster Preparedness and Emergency Management • National Hurricane Centre (NHC)	• National Disaster Prevention Centre, CENAPRED. • Mexican Water Technology Institute, IMTA • National Meteorological Services • Regional Disaster Information Centre (CRID) • National Seismology Service, CIRES • Scientific Research and Superior Education Centre of Ensenada, CICESE • Mexican Geological Service • Mexican insurance companies	• National Disaster Prevention System, SINAPRED • Nicaraguan Institute of Territorial Studies, INETER

TABLE 14. EXAMPLES OF RISK, HAZARD AND VULNERABILITY STUDIES IN THE REGION

Colombia	Chile	Jamaica	Mexico	Nicaragua
Seismic hazard map published by the Seismic Engineering Association with the participation of Ingeominas and the Universidad de los Andes	To-scale geological hazard maps of the National Geological and Mining Services	Storm high-tide estimates conducted by the Caribbean Institute for Meteorology and Hydrology	Geographic Information System for Identifying Risks, developed by the SEDESOL	Isoacceleration maps for various return-time periods prepared by SE-SINAPRED.
Intensity curves, maximum intensity tables, daily and monthly precipitation maps, nationwide maps on areas subject to flooding prepared by the IDEAM	Preparation of Tsunami Flooding Maps for regions I and V prepared by the Navy's Hydrographic and Oceonagrafic Service (SHOA)	Flood mapping through the Water Resource Authority (WRA) of the island's 8 largest rivers for return periods of 5, 10, 25,50 and 100 years (trunk project)	Hazard maps (mainly seismic) generated at the National Engineering Institute and the Geo-physical Institute of the UNAM, the Mexican Institute of Water Technology, Petróleos Mexicanos	Incomplete seismic microzonification of the cities of Managua and León
Maps produced by Ingeominas that chart the threat of landslides and define those areas with the greatest relative and qualitative threat of slides.	Amplification or liquation calculations of by the Universidad de Chile and the Pontificia Universidad Católica de Chile for private firms.	Maps marking areas susceptible to slides prepared by the Government Department of Mining and Geology and the Disaster Studies Unit of the University of the West Indies	Microzonification of the Federal District and Acapulco that form part of regulatory frameworks.	Seismic vulnerability studies of Managua provided by the vulnerability services of the Universidad Nacional de Ingeniería (UNI) and MOVIMONDO
Risk indicators for IDB-ECLAC performed by the Universidad de Manizales as part of the pilot project.	Seismic vulnerability conducted in 28 hospitals throughout the country as part of a joint endeavour between the Mathematics and Physical Sciences Faculties of the Universidad de Chile.	The ODPEM conducts non structural vulnerability studies for the private sector as part of a strategy to promote preparation and planning in that sector.	CENAPRED Risk Atlas offers high-quality, nationwide risk information, but is incomplete and lacks the resolution necessary for local or municipal decision making.	The joint "Natural disaster vulnerability reduction", project between SINAPRED and the INETER. Determines economic and human losses for various return-time lapses.

TABLE 15. RISK INFORMATION IN THE COUNTRIES ANALYSED

	Colombia	Chile	Jamaica	Mexico	Nicaragua
Quality and quantity of risk, hazard and vulnerability studies	Numerous high-quality hazard and microzonification studies exist of major cities. Vulnerability studies contain a considerable volume of approximated information	Most of these risk studies are generated in universities by a select few people who embody the knowledge and scientific trajectory on these topics.	Hazard studies sometimes lack suitable continuity. The generation of new information is limited by the non existence of a budget allotment for vulnerability reduction.	Risk (principally seismic) study projects are focused on the main cities. CENAPRED's risk atlas provides nationwide, risk information of a good quality.	The country has one of the most ambitious risk studies in the region.
Purpose and usefulness of existing studies	The detail and scale of studies on hazards and microzonification are suitable for regulatory purposes.	Studies are generally prompted by the occurrence of extreme events.	There are studies that proved useful for implementing housing-relocation programmes in the Askenish community.	Seismic microzonification studies for the two cities with the greatest hazard (Acapulco and Mexico City) have been included in building codes.	The proposal for a new national building code includes recent information on seismic hazards.
Connectivity and correlation of information produced	No common methodological frameworks exist for national, regional and local risk studies.	Local information is not always correctly systematized. There are some isolated studies of local effects from seismic events in some of the main cities.	Information is not always complete and many times map detail is inadequate.	The risk atlas provides a common methodological framework for conducting studies.	Social vulnerability studies (maps of social marginality, human development (HDI), and extreme poverty indexes) offer very similar results.
Distribution and availability	The information is available but very disperse	The government does little to distribute vulnerability and risk information	Availability is adequate	Information from educational and research institutions is widely available, can generally be accessed from their Internet portals and is distributed for free.	With some exceptions, vulnerability information is not distributed and is confined to academic environments.

Vulnerability studies are generally less common and of a lesser quality than research focused on hazards. Many vulnerability studies are exclusively useful for academic purposes. There few existing risk studies in the region are limited by the quality of the information available and the complexity of the phenomena involved. Table 15 offers a comparison of the availability and quality of risk information in the countries analysed.

The following paragraphs describe in greater detail some aspects of the information for evaluating risk by country.

a) Statistical information and monitoring on the occurrence of severe natural events

This section analyses the available information on the disasters that have affected each of the five countries. The handling of statistical information on the occurrence of severe natural events is generally handled by state institutions, which focus on phenomenon with the greatest economic and social impact and generate publications and registries of extreme events.

i) Colombia. The *Instituto Colombiano de Geología y Minas* (Ingeominas) compiles historical information on major earthquakes. To that end, the institute draws on monitoring networks that are part of projects funded by the World Bank. The information generated is generally considered reliable thanks to maintenance that includes

adapting, updating and expanding the information. Ingeominas' Department of Geological Hazards publishes historical information on volcanic eruptions and bulletins on volcanic activity. The *Instituto de Hidrología, Meteorología e Estudios Ambientales*, IDEAM, supplies environmental data and information nationwide. In order to achieve the most detailed information possible the institute operates local networks such as the Manizales network of meteorological stations managed by IDEA, which processes information that complements the data generated by the national network. This network instantly reports precipitation data for the city of Manizales that is useful for purposes of forecasting and the issuing of alerts.

ii) Chile. The country has a limited historical record of events that lacks the necessary background to allow for an evaluation of direct and indirect economic losses on a national level. There is currently a proposal by the *Oficina Nacional de Emergencia,* ONEMI, to compile information on a comprehensive basis using standardized evaluation instruments, but the evaluation continues to be developed in a strictly sectorial manner, an approach that stands in the way with consolidating a single instrument for comprehensively analysing existing information.

The *Banco Nacional de Datos Meteorológicos* run by the *Dirección Meteorológica de Chile* and the *Servicio Nacional de Aguas* are the official sources of information on these matters. When it comes to geological risks, the statistical volcanic-monitoring data for regions IX and X is generated by the Vulcanological Observatory of the Southern Andes, OVDAS. This information largely consists of seismic readings. Data on the chemical composition and analysis of fumaroles are incomplete for all of the registered events. The greater part of these studies and monitoring station data are not public, and are only made available to regional authorities for purposes of designing prevention plans.

The *Servicio Sismológico de la Universidad de Chile* and the *Red Nacional de Acelerógrafos* (RENADIC) register and manage information on seismic events. Although they publish some information on their websites, most of it can only be obtained at a relatively high price. Although the recording of seismic activity in Chile only began in a systematic way following the 1906 earthquake, so far there is no data base with the historical data. Work on such a data base began in 1999 and has yet to be completed.

iii) Jamaica. The Office of Disaster Preparedness and Emergency Management (ODPEM) has produced a National Disaster Catalogue listing instances of flooding since the nineteenth century, but the information is incomplete and in some cases it is possible to determine either the date or location of the event listed. For hurricane records it is necessary to turn to the Florida-based National Hurricane Centre (NHC). Their information dates back to 1887, but due to improved recording techniques the data is only reliable for events dating from 1950. Using an observation period of 105 years makes it possible to make rough estimates of the occurrence rate of hurricanes affecting the island nation. Little information is available regarding storm tides.

iv) Mexico. The Nation Disaster Prevention Centre (*Centro Nacional de Prevención de Desastres*, CENAPRED), is the agency in charge of compiling and preparing a significant volume of statistical information or natural hazards. Its information is publicly available. CENAPRED has published the report "*Diagnóstico de Amenazas e Identificación de Riesgos de Desastres en México*", which contains statistics through the year 2000 on the impact of impact of geological, hydro-meteorological and chemical-sanitary phenomena, providing a comprehensive overview of the geographical distribution of hazards. Disaster hazards and risks are dealt with from a global and regional perspective, providing general statistics that are generally seen as useful for assessing the importance of certain basic factors, as well as detailed tables on the occurrence of the various types of disasters that are based on journalistic reports on events that occurred over the past century. The publication "*Impacto socioeconómico de los principales desastres ocurridos en México*" assembles information from past events and estimates of economic losses since 1980. This document is based on information obtained from field visits and interviews with representatives from affected sectors. The consultants all agreed that this document is a good catalogue but that it may underestimate losses due to a lack of information and a failure to include lesser events.

INEGI records information regarding estimates of deaths, the number of missing persons and infrastructure losses from natural disasters. Its information is also made public. CENAPRED and the *Instituto Mexicano de Tecnología del Agua* (IMTA) have published the "*Atlas Climatológico de Ciclones Tropicales*", a collection of maps tracking the paths of tropical cyclones. The *Servicio Meteorológico Nacional* has very detailed statistical information on the occurrence of cyclones. The information from educational and research institutions is generally accessible and available for free over the Internet.

v) Nicaragua has a systematized national data base on the country's main disasters, which it developed in the framework of a project coordinated by SINAPRED on the reduction of vulnerability to natural disasters. This project, which was implemented in 2003, was aimed at compiling all existing information on events that had occurred between 1528 and September 2003. Unfortunately, the project failed to obtain access to all relevant sources of information, so some of the data must be revised.

Information regarding the main historical events (tsunamis, seismic and volcanic events, hurricanes, droughts, landslides and flooding) can be found in "*Amenazas Naturales de Nicaragua*", published by the Nicaraguan Institute for Territorial Studies (*Instituto Nicaragüense de Estudios Territoriales*, INETER), in 2001. Since that time the information has yet to be updated. The consultants report that periodicals served as the best source of information on seismic events that occurred over the past 150 years for the catalogue compiled in 1998, which suggests that the information in the INETER catalogue of earthquakes is not complete.

b) Existence of scientific hazard studies

In addition to compiling and storing statistical information and records of events, the agencies mentioned above and some academic institutions conduct meteorological and geological studies that describe natural phenomena based on the characteristics that best correlate to losses.

i) Colombia. The consultants report a list of the country's 13 main volcanoes. Eleven of these are monitored and there qualitative hazard maps of four, three of which are in a preliminary version by Ingeominas. The fourth was prepared by the *Centro de Estudios sobre Desastres y Riesgos* at the Universidad de los Andes, CEDERI, as part of an analysis of the hazards posed to the gas pipelines belonging to the company TRANSGAS. The seismic threat map of the Ingeominas, and the Universidad de los Andes, published in the seismo-resistant norms of 1998, divides the country into three seismic zones. This map is an updated version of a1983 study.

Regarding the level of meteorological hazards, IDEAM generates intensity, duration and frequency curves as well as maximum intensity tables, monthly and daily precipitation maps, and national maps of zones at risk of flooding that are based on previous events. It has produced qualitative maps of local flooding in the Magdalena River Basin using satellite imagery and geomorpholic information. There are also studies focused on local phenomena such as landslides. Ingeominas landslide hazard map identifies exposed zones in a relative and qualitative manner. IDEAM publishes daily qualitative forecasts of the probability of landslides in the country, with detailed reporting on the areas with the greatest exposure. IDEAM has produced methodologies for determining rainfall thresholds capable of detonating landslides on both a national and local level. CEDERI and the *Observatorio Sismológico de Suroccidente*, OSSO, have also made efforts to identify landslide hazards in some zones.

ii) Chile. The *Servicio Nacional de Geología y Minería* has geological hazard maps at scales ranging from 1:10000 to 1:250000. The Navy's *Servicio Hidrográfico y Oceanográfico*, SHOA, is in charge since 1997 of the CITSU project (preparing maps of tsunami induced flooding on the Chilean coast), which has calculated maximum flooding expected for the main coastal urban areas. To date they have published flooding maps for 28 cities located between regions I and V. This information is a reliable scientific source that is distributed to regional authorities and the OREMI (*Oficina Regional de Emergencia*) for purposes of designing prevention and response plans. The studies have been conducted at scales allowing for proper detail (1:5.000 - 1:10.000) that vary depending on the area

studied, and which are complemented event simulations at varying frequencies. The information is free but only available to public institutions.

The Universidad de Chile and the Pontificia Universidad Católica de Chile generate hazard information that contains calculations on amplifications and liquations for interested state and private institutions, but is of little use for making nationwide estimates.

iii) Jamaica. The most common studies are those of storm tide elevation, surge and flooding. The Caribbean Institute for Meteorology and Hydrology (CIMH) has conducted estimates of hurricane-related storm tide elevation using the TAOS model. The consultant recommends that these analyses be used with caution. ODPEM has also made estimates of storm tide elevation using the Hurrevac programme. El consultant that conducted the case study recommends feeding the programme more detailed information on the coast line. The IDB is giving support to the production of flood maps of storm induced tides for the cities of Kingston and Portmore.

Since 1985, the government of Jamaica has implemented the flood mapping project through its Water Resource Authority (WRA). Plans originally called for the production of flood maps for the country's eight main rivers with return periods of 5, 10, 25, 50 and 100 years, but the project has fallen short of that goal. A lack of seismic risk information is troubling in light of the hazard of a seven-point magnitude quake contemplated for the metropolitan area of Kingston. The Mines and Geology Division of the Ministry of Mining and Energy along with the University of the West Indies' Unit for Disaster Studies have developed maps of the zones exposed to landslides. These maps provide qualitative information and have served toward the successful implementation of the housing relocation programme for the community of Askenish.

iv) Mexico. The Social Development Ministry (SEDESOL) and the Council on Mineral Resources (COREMI) published a Guía Metodológica para la Elaboración de Atlas de Amenazas Naturales en Zonas Urbanas (Identificación y Zonificación) 2004, that sets down the basic procedures for compiling the available information on natural hazards and risks related to urban areas. This guide serves as a starting point for preparing atlases of natural hazards in cities as it offers the bases for identifying and zoning hazards. SEDESOL is working to integrate a *Sistema de Información Geográfica para la Identificación de Riesgos* (SIGIR). The first leg of this project includes the production of 50 Atlases for hazard detection and charting potential hazards in cities with more than 50,000 inhabitants. This system constitutes a homogenous and permanently accessible cartographic and informational platform.

The document "*Guía Básica para la Elaboración de Atlas Estatales y Municipales de Amenazas y Riesgos*" serves as a guide for the execution and implementation of the national risk atlas project, which was conceived of as a strategic tool for integrating information risks and hazards on a state and municipal level using a homogeneous, dynamic and transparent informational platform. Much of the basic information used in preparing the hazard maps (principally seismic) was generated by the *Instituto de Ingeniería* and the UNAM's *Instituto de Geofísica*, and to a lesser extent, the *Instituto Mexicano de Tecnología del Agua* and Pemex. The Federal Electricity Commission prepared a map of seismic hazard in Mexico for its *Manual de Construcción de Obras Civiles*. Although this manual lacks any legal validity for other types of building, is tends to be used as a reference source.

v) Nicaragua. In the document "*Amenazas Naturales de Nicaragua"*, INETER rates the hazards of each municipality on a scale of 0 to 10. This text is the result of a qualitative evaluation based on existing information, series of historical, meteorological and hydrological data and the criteria of specialists.

Precursors of seismic zonification in Nicaragua can be found in the study "*Zonificación Sísmica Preliminar de Nicaragua y Microzonificación Sísmica para Posoltega-Quezalguaque*" (2001), developed by MOVIMONDO-ECHO. This study includes isoacceleration maps of rock plinth on a national level based on the analysis of seven seismogenerator sources. ES-SINAPRED recently coordinated the preparation of seismicity maps consisting of isoacceleration curves for various return periods, considering 16 seismic sources, which marks an improvement in the quality of the results, which were used in drawing up a proposed building code for the country.

c) Information on microzonification and local effects

Local topographical, geological and geo-technical conditions and other factors that modify the intensities contemplated in nationwide studies are considered in the microzonification studies of the region.

i) Colombia. Seismic microzonification maps have been made for ten cities (including Cali and Bogotá) and two studies are currently underway. Consultants report that the methodology is meticulously applied in each stage of the Bogotá study. Proper uncertainty factors were chosen, thereby making for coherent results, whose resolution is fine for regulatory purposes. The Cali study is aimed at setting up a local code for seismic-resistant buildings. Seismic hazard in the city of Manizales has been captured in interactive software that is sufficiently flexible for estimating seismic intensity for various return periods and with a resolution of approximately 1:5000.

As for other hazards, Colombia has a geo-technical zonification for liquation for the urban centre of Tumaco that was developed by INGEOMINAS, OSSO, the Navy and the *Centro de Control de Contaminación del Pacífico*.

ii) Chile. The municipalities are good sources of local information as they govern the communes, the level at which one can find the greatest volume of information and with the greatest detail. However, much of this information is not correctly systematized and there are clear deficiencies in the records that are easiest to access. Isolated studies on the local effects of seismic events exist for some of the main cities.

iii) Jamaica. On the level of seismic hazard, most housing in Kingston is located in alluvial deposit zones, whose organic soil heightens risk. The building code does not contemplate possible site effects for the various areas of the city and assigns a constant value for maximum seismic acceleration (0.4g) for the entire city.

iv) Mexico. The microzonification of Mexico City in the Federal District's building code defines the seismic strengths that buildings must incorporate. Academic microzonification studies exist for other major cities, but with the exception of Acapulco, none is used as the basis for building codes. The microzonification of seismic regions appears to have become commonplace in major cities, an encouraging development from a technical standpoint. However, the authorities apparently need to take greater interest in the results of such studies and convert them into state and municipal regulations.

v) Nicaragua. A lack of communication between prevention authorities and the scientific community dedicated to risk evaluation is reported as being the main reason that seismic microzonification studies of the cities of Managua and León have yet to be completed. The hazard of flooding has been dealt with on a local basis because affectation areas are relatively small compared to the scale of other events. For example, COSUDE has promoted hazard studies in 26 municipalities within the Central Macro region that determined that most exposed structures consisted of bridges and housing dispersed and agglomerated between towns and urban centres.

d) Information on vulnerability

This section analyses the information available for identifying the physical, social, economic and financial vulnerability of the countries under study.

i) Colombia. The consultants expressed their concerns that infrastructure is highly vulnerable due to the absence of seismic resistance codes prior to 1984, the great migration of the rural population into urban centres and the extent of extreme poverty. Using housing statistics, they estimated that 81% of buildings are highly vulnerable, but one should keep in mind that this conclusion is based on information that contains many rough approximations and assumptions. The vulnerability index (PVI) developed by the Universidad de Manizales for IDB-IDEA has been applied in almost all of the country's departments. There are nationwide qualitative physical vulnerability studies and research on social vulnerability based on risk perception studies for the Pacific coastal regions. Another study of interest is that of the *Departamento Nacional de Estadística* (DANE), calculating the index of unsatisfied basic needs for all of the country's municipalities. Information on the exposed population and risk zones is handled by DANE, the housing system and MAVDT's housing department. The property registry offices and DANE have information on unit land prices and data on where building has taken place. The Ministry of Agriculture has information

systems on farmed land that is broken down by crop type. Work is underway on an inventory of government buildings, but that information does not include vulnerability data. As for the vulnerability of critical and basic infrastructure, the existing vulnerability studies on hospital infrastructure have not been well received when it has come time to implement projects.

ii) Chile. The consultants say that most research on vulnerability id developed by universities, thereby restricting its availability and use in decision making. Few government agencies even have vulnerability studies of their own infrastructure. The Public Works Ministry's Department of Roads and the Healthcare Ministry have vulnerability studies of hospitals. It was not possible to determine the degree of detail and scope of studies on road and street infrastructure as they are produced by regional offices and the national ministry has no office for compiling such information. Research on hospital infrastructure was developed as part of a study on the seismic vulnerability of 28 hospitals in the country by the Department of Physical Sciences and Mathematics at the Universidad de Chile. The results of these studies are not public. Social vulnerability information is limited to readings of poverty levels.

iii) Jamaica. One ODPEM strategy is to promote vulnerability studies, but a lack of funds for reducing the vulnerability of structures suggests we cannot expect improvements on this level. ODPEM conducts non structural vulnerability studies for the private sector as part of its strategy to promote business preparation and planning. The consultants concluded that housing is highly vulnerable to earthquakes because building codes go largely ignored and there is a local custom of building vertically in the absence of technical supervision.

iv) Mexico. Physical vulnerability studies are largely conducted by universities and almost all of their results are confined to academic circles. One exception is an infrastructure vulnerability study by UNAM's *Instituto de Ingeniería* for the country's insurance industry. SAGARPA has an evaluation program regarding the Mexico's vulnerability in making water available for production. CENAPRED has produced a basic guide for preparing state and municipal hazards and risk atlases that has two chapters on conducting qualitative studies of physical and social vulnerability. It contains proper proposals but we will have to wait to see how well they work in practice. Mexico City's General Office for Civil Defence has undertaken a General Civil Defence Program for the Federal District that includes vulnerability and risk studies and identifies the city's main vulnerability factors: accelerated demographic growth, great migratory currents that lead to high population density, a lack of compliance with existing laws and regulations as well as an inadequate management of risk, environmental contamination and of land. Despite the expectations generated by the programme, the evaluations failed to detect results.

v) Nicaragua. It is also the case in this country that vulnerability studies are largely confined to academic circles and are qualitative in nature, which helps to explain why they have scant impact. Two exceptions are the study on seismic vulnerability in Managua, and on the towns of Quezalguaque and Posoltega by the Universidad Nacional de Ingeniería (UNI) and MOVIMONDO. The first one projects vulnerability functions and the second has produced index-based vulnerability maps.

As for social vulnerability, maps exist with indexes for social marginality, the Human Development Index (HDI) and extreme poverty. One might superficially observe that all maps are similar. One situation that might be shared by all of the countries of the region is that the poorest sectors of the population tend to change their natural environment for the worst, thereby heightening potential hazards.

e) Risk information

Now we will analyse the existence and validity of risk studies that were based on index calculations or on estimates of economic losses for given return periods that were conducted by interested companies or institutions.

i) Colombia. One of the nationwide studies is a calculation of risk indicators made by the Universidad de Manizales for IDB-ECLAC as part of the pilot project. Four indexes were calculated: Disaster Deficit Index (DDI), Local Disaster Index (LDI), Prevalent Vulnerability Index (PVI) and the Risk Management Index (RMI). The research drew on the most recent information on amounts exposed as well as hazard and vulnerability information that had been properly scaled for the

phenomenon analysed. The results may be consulted free of charge at the Universidad de Manizales website, which also provides to results of similar studies for other countries, including those analysed in this report. The study "*Definición de la Responsabilidad del Estado, su exposición ante desastres naturales y el diseño de los mecanismos para la cobertura de los Riesgos Residuales del Estado*" analyses the responsibility of the state in the stages of response, rehabilitation and reconstruction following a disaster. A study of local risk that is unique to the region is an estimate of the impact on the growth and tax receipts of Bogotá that was conducted by the municipality's Finance Ministry, the DPAE, and the Ministry on the Environment, Housing and Territorial Development with the support of the World Bank. The study estimates the economic impact on the city of differing seismic scenarios and return periods and establishes the bases for an efficient risk transference policy for public and private buildings.

The consultants concluded that complete and reliable risk studies are the exception, a weakness blamed on the lack of common methodological frameworks on the national, regional and local levels as well as the extent to which information is disperse.

ii) Chile. Risk and vulnerability research is largely conducted in universities, assembling information in a range of studies. Most of these research projects are conducted by a small number of individuals who are best informed and the most scientifically prepared on this topic. Such studies are reportedly motivated by the occurrence of extreme events. Little information on risk and vulnerability is distributed by the state as the information used for such research is not free, thereby limiting its use.

iii) Jamaica. The study reported an urgent need for quantitative risk studies for decision-making purposes, especially in the case of essential infrastructure and vital lines. This request is accompanied by a recommendation to budget more funds for conducting such studies.

iv) Mexico. Risk studies in Mexico are focused on the major cities and primarily on seismic phenomena, a longstanding academic tradition in this country that has produced information in greater quantities and of superior quality than in the case of other hazards. One example is the risk map for the greater metropolitan area of the Federal District, which was produced for the Federal District's Office of Environmental Protection and Zoning. The results are highly accessible. CENAPRED provides nationwide risk information of a high quality, but its risk atlas is incomplete and it lacks the resolution needed for local decision making. Other risk studies (seismic, landslides, volcanic) have been conducted for the cities of Tijuana, Puerto Vallarta, Ensenada, Puebla and Colima, but their results have not been fully exploited as the form of their publication (generally as graduation theses) means that they are not widely distributed on a national level. Other studies are done specifically on behalf of public or private institutions and their results are also not broadly available to those interested in risk management decision-making.

ECLAC published the study on "*Crecimiento agropecuario, TLCAN, capital humano y gestión del riesgo 2006*" with a focus on the risk evaluation with potential implications for productivity and management capabilities, and with special emphasis on its impact on low income producers. SEDESOL develops an atlas of natural risks in cities and municipalities for purposes of implementing disaster prevention strategies.

v) Nicaragua. The project "*La reducción en la vulnerabilidad ante desastres naturales*", by SINAPRED and INETER, is a risk study that determines economic and human losses by event and with varying return periods. Along with the Colombia's study of losses, it is one of the most ambitious risk studies in the region.

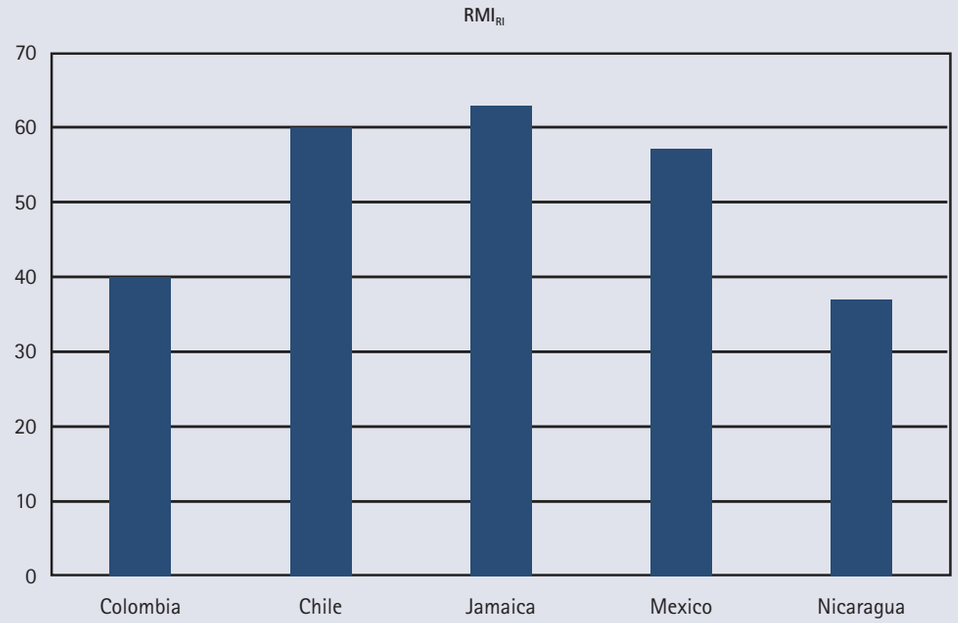
A less ambitious project funded by the country's insurance industry consisted of a vulnerability and risk evaluation study for five insurance firms. The study determined seismic threat in Managua using the probabilistic method for a 100 year return period.

f) Information indicators

Indicators RI1, RI2, RI3, RI4, RI5 and RI6 developed in the second component of this project are useful for measuring a country's capacity for satisfying the risk information needs of decision makers and society in general.

These indicators provide a qualitative evaluation and provided ratings of low, incipient, appreciable, notable, and optimum. Combined these indicators comprise the RMI_{RI} risk sub index, which employs three additional

Figure 8. COMPARISON OF RMI_{RI}



sub indexes for estimating the Risk Management Index (RMI), which gauges the performance of a country's management system.

i) Colombia. Progress achieved in risk information generation are reflected in indicators RI1 and RI3, which are related to the systematic recording of disasters and losses as well as evaluation and mapping of hazards. These indicators climbed from incipient to notable for the period 1980-2003. At the same time progress was achieved in the country's monitoring and forecasting performance (RI2) and in both vulnerability and risk evaluation (RI4), which climbed from low to appreciable. Overall, the RMI_{RI} rose from 7.66 to 40.31 in 23 years, which marks a considerable improvement. The cities that achieved the highest RMI_{RI} levels are Bogotá and Manizales with readings above 65.

ii) Chile. The RMI_{RI} rose dramatically from 9.9 to 59.9 between 1985 and 2003. The indicator with the sharpest increase was on risk management training and education. Hazard inventory and monitoring indicators (RI1 and RI2) also achieved notable levels by 2003.

iii) Jamaica. The RMI_{RI} slowly rose from 12.74 in 2003 to 63.04 in 2005. The improvements achieved in indicators has been impressive, especially the RI5 (public information and community training), with an optimum rating in 2003. Other high indicator readings were achieved on the level of disaster inventory, hazard monitoring and risk training and education.

iv) Mexico. The RMI_{RI} sub index rose from 36.8 in 1985 to 57.4 in 2006 with dramatic gains registered between 1995 and 2000. This improvement was led by the country's hazard monitoring and forecasting performance (RI2) climbing from appreciable to notable, which weighed significantly in the overall reading. Public information and community participation (RI5) moved from low to incipient. Although vulnerability and risk evaluation rose only from moved from low to incipient, it had little impact on the country's RMI_{RI} because it was assigned a very limited weighting.

iv) Nicaragua. Risk identification indicators rebounded between 1985 and 2005. Although on average they continue to rate as incipient on average, progress is notable especially on the level of disaster inventory

and monitoring and hazard mapping. The RMI_{RI} index rose from 4.56 to 36.40 during this period.

Figure 8 shows the RMI^{RI} arrived at in component 2 of this programme.[39] These index readings generally proved to be positive and have improved over time. One should keep in mind, however, that the relative results between countries are not entirely comparable with the qualitative and quantitative evaluations consultants made of available risk information in the case studies. The use of subjective indicators that depend on the judgement of the evaluator in obtaining RMIs appears to be the main factor underpinning this discrepancy.

g) Comparison of extreme scenarios in relation to risk information

For each country case study an analysis was made of extreme event scenarios.[40] We will now comment on the principal results of those exercises and the extent to which the risk information employed is applicable and useful. Appendix 1 contains a list of the primary sources of information that were reported. The knowledge and criteria of local consultants played a very important role when it came time to determine factors or fill in gaps in the information in order to arrive at the desired results.

The choice of critical scenario was based primarily on an analysis of the records of historical events and knowledge of the natural phenomena that threaten the population centres where much of the countries' population and infrastructure are concentrated. No effort was made to determine the probability of occurrence or the frequency of reoccurrence and hypothetical scenarios. An event chosen on an unrealistic basis (excessively conservative or not conservative) could lead to a false appreciation of the performance of disaster risk management.

In a similar manner, cross comparisons of the results of scenarios contemplated for the various countries studied could produce false comparisons largely due to differences in the scenario criteria that were chosen.

Seismic events have produced severe disasters in all five countries.

The seismic events proposed for the studies were seen as affecting the countries' capital cities except in Chile. Hurricanes have led to considerable losses in the recent history of Jamaica, Mexico and Nicaragua so they were designated critical events for those three countries. Floods were included as a critical event only in Colombia.

Hazard information, especially of a seismic nature, was found to be properly presented, scaled and available.

The greatest weaknesses are apparent on the level of information regarding physical vulnerability to hurricanes. In Jamaica and Nicaragua it was necessary to draw on the criteria and experience of the consultants to determine the extent of such vulnerability. Vulnerability to seismic events was determined based on existing studies

The estimates on amounts and numbers of people exposed to risk that appear in the case studies were based on reliable information to which access was free except in some instance in Chile. The chief problem reported during this phase of the analysis was a paucity of detail in the available information for purposes of estimating losses. For example, there was a lack of data regarding construction materials and a tendency to underestimate the cadastral appraisals of infrastructure. Nicaragua reportedly suffered from a lack of economic indicators for the regions affected by the postulated event

There were also reports of a lack of information for calculating the number of people affected by other collateral effects of the disaster (climate effects, lack of medical attention, fires, containment actions and post disaster psychological trauma).

We will now summarize the seismic-scenarios by country.[41]

i) Colombia. The consultants decided to conduct a study of a seismic event due to the existence of cities with major population concentrations and many buildings in high and medium seismicity zones with low levels of earthquake resistance. It also analysed a flooding event as that is the type of disaster most frequently experienced in Colombia. Seismic risk in-

39 "Disaster Risk and Management Indicators Program: IADB-ECLACC-IDEA, Manizales, Colombia, April 2004.

40 Project consultants conducted their analysis using the framework defined in the document "Evaluación de Escenario Extremo" http://www3.cepal.org.mx

41 Los documentos de the case studies se encuentran en http://www3.cepal.org.mx/iadb-eclac-project/05.html

formation from the seismic norm map of 1998, which offers a qualitative hazard zonification, was used for the first phase of the analysis. Also used for estimating the maximum acceleration of land within the city for various return periods was the study of seismic threat to the country conducted by the Association for Seismic Engineering (1996). In the case of flooding, consultants used the IDEAM National Flooding Map, which despite its very limited resolution and failure to specify a period of return is more reliable than local flooding studies, which share no unified system and are not always available. For purposes of the analysis, it was assumed that the flooding map corresponded to a 500-year return period.

Seismic microzonification studies of eight of the cities analysed, including Bogotá and Medellin, used extreme scenario analyses. It proved impossible to determine local effects in the analysis of flooding owing to a lack of resolution and the extent of the flooding analysed. Information on the exposed population was drawn from the 2005 census and DANE projections. Estimates of exposed costs and construction areas were made using cadastral, land registry and crop data and with risk studies that were conducted on behalf of the *Agencia Colombiana de Cooperación Internacional* (ACCI), the *Departamento Nacional de Planeación* (DNP), the World Bank, and the IDB. However, armed with the knowledge that properties are often assessed below their replacement cost, the valuations provided by the tax office are multiplied by two in order to produce a more realistic estimate. For the flooding scenario, the data on crop area was taken from IDEAM, the Ministry of Agriculture and Ingeominas.

Information regarding the seismic vulnerability of the various types of structures considered was obtained through a combination recorded observations of how structures performed in past events, vibrating table tests and analytical models on non linear structural behaviour by type of engineering. The replacement value for each type of infrastructure was calculated using average reference values (as in the case of road and canal infrastructure), and in other instances employing official values such as those provided by the Housing and Urban Development Ministry in its "Table of Construction Unit Cost Per Square Meter".

The consultants reported that they were unable to produce a reliable calculation of the number of people affected by lateral effects (climatic, lack of medical attention, fires, content action and post-disaster psychological effects) due to a lack of local and international information.

The calculation of losses to critical structures and those essential to community attention (fire and police stations, schools, healthcare centres, transit facilities and public offices), for a return period of 500 years was achieved using the studies "*Estrategia de transferencia, retención y mitigación del riesgo sísmico en edificaciones indispensables de atención a la comunidad del Distrito Capital de Bogotá" (CEDERI, 2005), "Estimación de pérdidas económicas para diferentes escenarios de riesgo en edificaciones publicas y privadas en Bogotá"* and *"Análisis económico del riesgo residual del Distrito Capital de Bogotá"* by ERN Colombia for the District Finance Ministry, FONADE and the World Bank. The results of these studies were based on both qualitative and subjective parameters, possibly making it necessary to conduct deeper studies on the behaviour of these buildings.

ii) Chile. Chile is a country with very high levels of seismic activity and the quake that released the greatest amount of energy was recorded on its coasts. The quakes of 1939 and 1960 are the disasters that provoked the greatest human and economic losses in the country while the disasters of the past 30 years have not generated major losses. The Chilean case study attributes these low levels to the lessons learned by the community in the quakes that occurred between 1922 and 1960. The meteorological phenomenon affecting smaller regions have not penetrated the collective memory in the same way as major-impact events probably because they have had lesser consequences. The case study chose two seismic events, one a magnitude 8.5 event 25km off the coast of the Bernardo O'Higgins and Maule regions, where a seismic fault line is located. The quake was estimated to be approximately a 500-years event. The Mercalli intensity readings were calculated for each *comuna* based on a 1996 study by Morales and Sapaj. Calibrated frequency-intensity curves were used for the region's subduction earthquakes based on 1980 information. The affected area of the first scenario is a

zone with a low density of population, infrastructure and economic activity as it accounts for a mere 8.2% of the country's GDP and 11% of its population. The analysis considered local effects on the most populated cities in the region: Talca, Curicó, Molina, Linares, San Javier, Parral, Cauquenes and San Clemente.

The land registry and population information used to estimate exposure is incomplete and private parties must pay to use it. Neither can information on industry and commerce be accessed for free, nor does it contain data useful for estimating losses incurred during the events. Information on education and hospitals is free but lacks data on the building materials for predicting structural damage. Information available on the amounts and population exposed was obtained after the event as part of the tasks assigned to the bodies that intervened in the emergency. Private sector information is not available owing to confidentiality and business-strategy concerns. Information on irrigation canals is available at the Public Works Ministry's *Catastro de Usuarios* at the *Dirección General de Aguas*.

The method for evaluating damage to individuals consisted of finding the qualitative level of habitational damage. This method has been tested with satisfactory results on quakes in the region. The number of housing units that would be left uninhabitable following the event was estimated using information form the INE National Population and Housing Census (2002).

iii) Jamaica. Historical evidence, especially for the past two decades, shows the country's high vulnerability to hurricanes. However, seismic risk is no lesser a threat as evidenced by the 1962 earthquake that destroyed the city of Port Royal, which was then the commercial capital of the country. Based on these records two scenarios were analysed: a quake with a magnitude of between 6.5 and 7 on the Wagwater fault, and a grade 5 hurricane with an estimated return period of 150 years that would pass through the cities of St. Thomas, Kingston, St. Andrew, St. Catherine and Clarendon.

The study's conclusions regarding the consequences of both maximum events are based on knowledge of infrastructure vulnerabilities (housing, healthcare and vital lines) and how society reacted during previous events.

iv) Mexico. Drawing on disaster economic impact statistics obtained from the *Centro Regional de Información sobre Desastres* (CRID), the consultants chose as the source of their scenario the two phenomenon that have produced the greatest losses from natural disasters in the country: quakes and hurricane. This data shows that while losses caused by both phenomena between 1929 and 2005 are similar, quakes produced the greatest losses and number of affected people per event. For this reason a seismic event was chosen as the extreme scenario. Based on work conducted by UNAM and the *Fundación Barros Sierra* between 1985 and 1999, chose a magnitude 8.2 maximum possible seismic event with an epicentre on the Guerrero and San Marcos fault. The event would primarily impact the status of Guerrero, Mexico, Puebla, Morelos, Tlaxcala and the Federal District, which jointly account for close to 40% of GDP. The consultants obtained the intensities for the affected cities using calibration laws reported in technical literature on quakes in the region. When considering local or site effects for the Federal District, consultants used the UNAM School of Engineering's "Z" computational programme.

Information on the exposed population was obtained from INEGI and the geotechnical divisions from the *Asociación Mexicana de Instituciones de Seguros* (AMIS) for Mexico City and Acapulco. The vulnerability information used was provided by CENAPRED, which is applying the computational programme RS-MEX version 2.1, which was developed by the company ERN Ingenieros Consultores.

Indirect losses (from the suspension of services and productive activities) were calculates as a fraction of direct losses. The proportionality factor was calculated using loss statistics from past events that appear in CENAPRED publications. The Mexico consultants pointed out that loss results may vary considerably depending on the date of construction of the buildings in question; assuming that a building is modern cuts direct losses by half. For that reason it is useful to conduct a more thorough cadastral analysis as this parameter is of major importance in evaluating seismic scenarios.

The number of victims is estimated by applying a factor that relates the collapse of the structure with the number of occupants and the percentage of those trapped who eventually die from the disaster. In order to estimate the number of hospital beds, information

from INEGI was used. The study concluded that owing to a lack of data on the number of beds occupied prior to the event and the possibility that many of the injured would only need ambulatory attention, it was not possible to determine for sure whether an adequate number of beds would be available.

v) Nicaragua. Based on geotectonic and geographic considerations, it was determined that both seismic phenomena and hurricanes could lead to disasters of nationwide proportions. This conclusion is corroborated by statistics on losses from past disasters, which indicate that the country's greatest disasters were Hurricane Mitch and the 1972 Managua earthquake. A quake proved to be a more localized event whose impact might be largely confined to Managua while the hurricane would affect a significant part of the country. The extreme seismic event consisted of one similar to that of 1972: a 6.5 quake that affected the Managua region whose epicentre was located along fault lines running under the city. It appears that it is impossible to say whether the fault lines running under Managua have a greater potential for destruction, and there was no word on seismicity studies of those faults whether the be of exceedance rates or return periods that could shed some light on the probability of similar events occurring in or near the city. Although the report incorporated studies that reported zones with grade 3 seismic wave amplifications, the specialists have not reached agreement, so they preferred not to consider site effects when making their estimate of seismic intensity.

For the analysis of a hurricane event a category 3 storm was considered that would hit the Atlantic Coast with waves averaging between five and 10 metres and accumulated rainfall of between 250 and 350 mm within at least two days of impact. Upon landfall, the hurricane would down grade to a tropical storm within three to five hours.

Cadastral construction data, including assessments of building costs, were provided by the City of Managua. It was possible to infer the seismic response of structures using that information. In hurricane scenarios, there is a degree of uncertainty in estimating amounts of exposure largely because of a lack of economic indicators for the affected regions.

Information on the vulnerability of structures in Managua was taken from the "Seismic Vulnerability Study of Managua" that was conducted by the U.S. firm DRM and the Mexican firm ERN, along with Nicaraguan consultants on behalf of INETER and SINAPRED. The information appears in a graphic format (SIG). Assessments of the vulnerability of both infrastructure and forested areas in relation to the path of the hurricane are subjective and were based on the consultant's criteria. Although the statistics indicate that hurricanes have not led to a significant number of deaths and injuries in Nicaragua, the study concludes that it is not possible to rationally estimate a number of victims based on the information that is currently available.

3. INFORMATION FOR DISASTER RISK MANAGEMENT

This section discusses the extent to which those responsible for the various areas of risk management enjoy access to the information they require for making decisions and taking action, and to the way in which such people effectively make use of such information. The section also documents what access the potentially affected population has to the information it needs in order to limit risk as well as the extent to which the public perceives the magnitude and characteristics of the risks to which it is exposed.

a) Accessibility of information to decision makers

i) Colombia. In the past ten years the system has enjoyed the support of bodies that generate a vast amount of information for managers and decision makers. There is a lack of vulnerability-related information expect for the major cities. There is also little coordination between national information systems on scientific and environmental issues. Strong monitoring networks are functioning, but some are of questionable usefulness when it comes to preventing disasters. It is necessary to: establish an integrated and modern system of disaster-related information that is directed at meeting the needs of SNPAD; broaden and upgrade monitoring networks; produce useful risk information.

ii) Chile. The country generally enjoys an abundance of information on hazards and mapping, but some of it is not readily available to decision makers. One problem in this regard is that some of the institutions that produce such information sell it at costs that make it rather inaccessible. Vulnerability information and risk studies are largely the work of groups of researchers and are not widely published. It appears that decision makers lack access to both risk and hazard atlases. A variety of functioning systems are in place for issuing alerts and warnings for tsunamis, flooding and volcanic eruptions.

iii) Jamaica. The Office of Disaster Prevention and Emergency Management (ODPEM) operates geographical information systems regarding major hazards. Information is primarily provided by regional research centres and is accessible to interested institutions and, to a large extent, the general public.

iv) Mexico. CENAPRED assures a broad and reiterative flow of hazard and risk information between decision makers, both the information tends to be confined to a macro level without taking into account local characteristics that affect hazard conditions. Hazard information is known and applied by civil defence decision makers, but the same cannot be said of quantitative risk information because it is primarily aimed at scientific circles and the insurance industry. CENAPRED and other institutions produce abundant information on practices for reducing vulnerability in buildings and settlements that is broadly distributed to civil defence agencies, but not to the general public.

Examples of functional alert systems are those used to monitor the main volcanoes, and for warning of hurricanes and for seismic events in Mexico City. Various local warning systems for flooding and landslides have been created (Acapulco, Motozintla, etc), but all have suffered operational problems. In practice we have seen that most civil defence offices and other actors continue to act in an eminently reactive rather than a pro-active manner.

v) Nicaragua. INETER has complied and distributed a sufficient volume and quality of hazard information, and is currently working to assure that information on the various phenomena is compatible. Recent years have produced a growing volume of information on physical and social vulnerability with the participation of public and private as well as international institutions. The monitoring networks for the various hazards, including tsunamis, have improved considerably.

Cross-country comparisons produced the following observations.

- The countries studied have achieved good levels of assimilation of basic information about hazards, but not about vulnerability and general risk.
- There is a lack of the local risk studies that are necessary for drawing up contingency plans and mitigation programmes, although Colombia and Mexico have made progress in the microzonification of risk in the major cities.
- In Colombia concern has been expressed about the need to establish an integrated and modern system of disaster-related information that is directed at meeting the needs of the risk management system.
- In Chile specialized information is in the hands of separate government ministries and does not easily circulate beyond those agencies, between sectors or other interested parties. It does not appear, however, that such restrictions have negatively affected the ability to manage disasters to date.
- Decision makers generally suffer from a scarcity of information on vulnerability reduction and mitigation measures.
- Norms for conducting mitigation projects, urban zoning laws and land use norms are often inadequate and out of date, but the greatest problem is that with the notable exception of Chile such rules are often ignored or go un-enforced.

b) Diffusion of information and public risk perception

i) Colombia. Some polls suggest that the public feels that there little information on risk, prevention measures and disaster response. Risk perception varies by location and type of type of event.

ii) Chile. The institutions in charge of monitoring phenomena have their own public information programmes. ONEMI conducts campaigns for those

at risk but focuses them on specific cases and zones, limiting information on risk and the probability of event occurrence. The public is aware of the risks of earthquakes, but not of that posed by other phenomenon, particularly flooding.

iii) Jamaica. Information on hurricanes and flooding is handled in the community-warning plan, but it is not clear that the information is based on local risk studies involving the main hazards. A very complete risk awareness program exists on both a national and municipal level and there are reasons to believe that risk perception and information diffusion are good in the case of hurricanes and flooding, but not for quakes and landslides.

iv) Mexico. There are broad and reiterative informational campaigns but considerable diversity and contrasts on the level of risk perceptions and the quality of the information needed to cope. In the case of hurricanes there is an intense and timely flow of information and risk perception is generally good, but the same does not apply to non imminent risks. Inhabitants of high-risk areas often receive warnings, but they tend to have little effect; only on a few occasions has it been possible to relocate the population. The same may be said of residents of buildings with high seismic vulnerability. There is a clear intention to promote a culture of prevention throughout the National Civil Defence System and the general public. The question of prevention disaster has been incorporated into school plans.

v) Nicaragua. INETER makes a major effort to keep the public informed. Many NGOs (especially foreign ones) and universities participate in the efforts to inform and advise the public, but weakness persists as to information on anti-seismic self-building techniques.

The above information led to the following observations:

- In all of the countries studied campaigns have been conducted for informing the population about risks and preparation measures, but the degree of penetration is variable. In any event, surveys reveal scant knowledge on the part of the population.
- Diffusion campaigns have focused on the most frequent events, for example, earthquakes in Chile and hurricanes in Jamaica. There is no awareness regarding the risk of less frequent events, which are capable of producing larger scale disasters such as quakes in Jamaica and flooding in Chile.
- Some case studies suggest that the population at risk proved reticent to respond to evacuation instructions and appeals to move to shelters even in relation to the most frequent events including those that had recently led to disasters. Jamaica is a case in point.
- There have been significant improvements in warning systems and evacuation plans. Thanks in part to improved forecasting, notable progress has been made in establishing warning and forecasting systems for both volcanoes and hurricanes.

c) Damage information

This section analyses the bodies and methodologies for evaluating losses from disasters, as well as the timely availability of diagnoses of direct and indirect damages that make possible the setting of priorities for reconstruction and investment in mitigation

i) Colombia. There is a very complete data base of victims and economic losses since 1971 that includes both greater and lesser disasters, which have been analysed in great detail stressing their effect on the development of the segments of the population with the fewest resources. The data is drawn from various sources and are compiled using differing methodologies so it is not always compatible. There appears to be no formal loss-evaluation programme. The ECLAC methodology is not applied systematically except when the commission participates in damage evaluation missions at the request of the government. There is no clear information as to whether a single body exists for conducting systematic loss evaluations that could serve as the basis for post-disaster recovery and reconstruction plans.

ii) Chile. There is no agency in charge of disaster loss evaluations. ONEMI has begun to distribute to the relevant institutions forms for assembling information, but there does not appear to have been an effort yet to assemble the results. Cabinet level ministries probably estimate the losses that correspond to their area of at-

tention, but nothing is known of their methodology are the results are never integrated. Some cost estimates are made by those who study events. Since 1997, ONEMI systematizes information regarding the consequences of disasters by a registry of all emergencies anywhere in the country, but this record is limited to a description of the characteristics of the emergency, thereby excluding the possibility of an analysis of economic losses.

iii) Jamaica. For years economic losses were assessed using local criteria, but recently the country began routinely applying ECLAC methodology, for which local ad hoc committees have been established. In severe cases ECLAC is asked to help. Damage statistics since 1990 are reliable.

iv) Mexico. CENAPRED takes charge of making a timely estimate of direct and indirect losses and prepare statistics on the largest disasters since 1995. Disaster losses incurred prior to that time and since 1980 have been estimated retrospectively. In all such instances the ECLAC methodology was used. Although evaluations have been made in a timely manner, their results are not available during initial phases, leaving each sector to devise its own way of responding (with their own methodologies and without including indirect effects) and organize its part in recovery.

v) Nicaragua. There is no compiling or systemization of data, nor of reliable statistics on damage or disaster response. When estimating resources for recovery and reconstruction, COE complies and distributes the information, but the results of that work have not been made public. After 2000 progress has been made on the level of basic information for determining immediate recovery actions, but there is no ECLAC-type formal evaluation, except major disasters in which ECLAC participated.

The following general conclusions were drawn with regard to the existence of agencies and methodologies used for loss evaluation as well as for quickly making a diagnosis of direct and indirect damages, which is a prerequisite for establishing reconstruction and mitigation-investment priorities.

- Most countries studied have yet to adopt a systematic approach –and one using a standardized methodology—for conducting the disaster-loss evaluations needed immediately after an event for planning rehabilitation activities and later for reconstruction as well as for statistical purposes.
- Mexico is the country with the most systematized loss evaluation process, and it employs the ECLAC methodology. In Chile such evaluations are made independently by each ministry and rarely are their results integrated. Colombia is the only country that has tried to make an evaluation of losses from lesser disasters.

Table 16 offers a comparison matrix of the most significant aspects of disaster management in the analysed countries.

4. INFORMATION FOR FINANCIAL RISK MANAGEMENT

a) Ex ante financial management

The availability of information for financial risk management varies greatly between the five countries studied. In some of them it proved difficult to obtain and in others a fee was charged to access it. Information on the monetary impact of disasters is discontinuous and partial (except in two cases) or employs methodologies that are not fully comparable. It proved to be even more difficult to document the course and cost of reconstruction processes, for which there was generally a lack of follow up. Nevertheless, it was possible to obtain sufficient information to achieve a panorama of the way in which disaster risk has been financed in each country.

i) Existence of financial measures for the preparation and identification of prevention and mitigation priorities.

1) Chile. Resources budgeted for catastrophe prevention programmes are scarce, accounting in the past decade for a mere 5% of those assigned for attending to emergency situations. Nevertheless, since 1980 Chile has dealt with financial solvency with earthquakes, flooding and white winters. This success is explained in part by the practice of the national budget assigning each year funding for investment programmes aimed at disaster prevention or mitigation through improved

TABLE 10. INFORMATION FOR DISASTER MANAGEMENT

Topic	Colombia	Chile	Jamaica	Mexico	Nicaragua
Degree to which information is accessible to decision makers	A considerable volume of information is generated by a variety of groups, but little coordination with the national science system.	An abundance of information on hazards and mapping, but in some cases the institutions that produce the information sell it at costs that make it rather inaccessible.	International agencies and donors are intensely engaged in generating information and transferring it to decision makers.	A broad and accessible supply of hazard-related information, but little of it takes into account local characteristics that reshape hazard conditions.	The volume of vulnerability has increased in recent years with the participation of public and private as well as international institutions.
Information distribution and the public's risk perceptions	Functioning monitoring networks, but some are of questionable usefulness for disaster prevention purposes.	The institutions in charge of monitoring phenomena have their own public information programmes.	There is a public risk-awareness programme that is structured on both a national and municipal level.	There have been intense and constant public information campaigns but risk perception varies greatly.	The INETER has played an important role in informing and educating the public.
Damage information	Some polls suggest that the public feels that there is a lack of information available. A very complete data base on economic losses and victims has been maintained since 1971 and which also tracks lesser disasters.	There is no agency in charge of evaluating disaster-related losses.	The ECLAC methodology has recently been applied on a rudimentary level.	Since 1995 the CENAPRED has been in charge of determining direct and indirect losses from the main disasters.	There is no collection or systemization of data, or any good data on damage and disaster response.

infrastructure. The same applies to programmes for the reconstruction of affected infrastructure by disasters, funding that is incorporated into the yearly budgets of each agency once the allotments have been approved by a central investment oversight body, the National System of Investments.

2) Nicaragua. Law 337 establishes that the National System "guarantee the financing of activities related to prevention and mitigation on the part of public or private institutions, depending on their sphere of competence." Resources for the country's disaster fund may only be employed "for response to imminent risk or disaster situations". As a result of that limitation prevention and mitigation activities should be included in regular budgets. However, not all government ministries follow through and assign funds to the specific 'technical linkage units' known by the Spanish acronym UTE. Several UTE work on a response basis and do little to minimize and prevent disasters.

Nicaragua's Emergency Social Investment Fund (*Fondo de Inversión de Emergencia Social*, FISE), receives a combination of funding from the state and foreign sources (World Bank, IDB, KWF of Germany, among others) for implementing projects for mitigating risks at the local level. Another source of funding is the Centre of Coordination for the Prevention of Natural Disaster in Central America or CEPREDENAC), that acts as a coordinating body for channelling foreign donations for disaster reduction in member countries. The resources that the centre makes available come from the Scandinavian countries, World Bank, IDB, JICA-Japan, OFDA, OAS, UNDP and others.

In synthesis, the governments of Colombia and Chile assign or reassign funds for risk studies and recognition or prevention and mitigation actions. Budgeted resources for catastrophe prevention programmes in Chile only account for 5% of the funds assigned to emergency response in the past decade. In contrast, Mexico has

a Fund for the Prevention of Natural Disasters (*Fondo para la Prevención de Desastres Naturales*, FOPREDEN) for providing resources for prevention actions, which may only be requested by the states or federal cabinet-level agencies. Jamaica does not assign any funds specifically for risk reduction. Nicaragua operates a reimbursable lending mechanism for funding risk identification, prevention and the detection of structural vulnerabilities. It also operates the aforementioned (FISE), a mixed fund with the participation of the World Bank for actions aimed at local risk reduction.

ii) General characteristics of governmental disaster funds and related issues. The five countries studied have differing approaches to this issue ranging from one in which the central government assumes a considerable proportion of risk (as in Mexico), to the one in which the private sector deals with the losses and the government finances emergency expenses or reassigns funds initially budgeted for other programmes (as in Chile), and one country that relies primarily on international cooperation for funding while the government assumes responsibilities of its own (as in Nicaragua). The two remaining countries employ a combination of these alternatives. The extent of penetration of risk transfer mechanisms also varies as we will discuss in greater detail later in this document. But first we will offer a succinct characterization of the situation in each country and then a comparative analysis.

In the countries that have applied the ECLAC methodology, including Mexico, which uses a succinct version of this approach, information on the financial mechanisms used in disaster attention and recovery appears to be sufficiently itemized.

1) Colombia. The government's financial responsibility in relation to disasters is first and foremost directed at poor households and the direct protection of public infrastructure. To that end territorially defined bodies must assign funds or acquire insurance policies to cover the risks posed to the property of the state and of the population at risk. However, local governments have little means for assigning funds for such a purpose and out of all the local governments in Colombia, only the municipalities of Manizales and Bogotá have rules specifying the percentage of the budget that should go toward managing risks.

There is a National Calamity Fund (FNC) that was set up under a 1989 decree for providing economic support to disaster prevention and attention. The fund initially consisted of a special national account that was independently administered. Later the fund fell under the purview of the Interior and Justice Ministry with the additional task of tending to displaced communities and a special fund for fire fighters. It appears that this change limited the ability of the FNC to operate as a true reserve fund for risk management. Its monies are managed by a board of consultants. The study revealed that since the fund was established its assigned resources have fallen short of what is needed to face the consequences of disasters.

Contributions to the FNC have come from unstable funding sources and have fallen as a percentage of government expenditures. It is worth noting, however, that the largest part of fund disbursements have gone to the country's poorest regions. The FNC lacks any rule on the accumulation and disbursement of funds. The resources assigned to the fund were very irregular between 1988 and 1996, but since then have tended to be more stable and substantial although they remain below 1% of central government revenues.

2) Chile. Unlike other countries, Chile lacks a specific fund for attending to disaster situations, but the President of the Republic is constitutionally empowered to use up to 2% of the funds allotted in the national budget once we obtains the consent of the cabinet ministers involved in its disbursement. Nevertheless, when an emergency occurs that warrants declaring disaster zones, the funds used are freed up under the terms of Law 16.282 on Earthquakes and Catastrophes rather than on the basis of the president's constitutional power. Instead of using the 2% rule as a guide, disaster-related spending is based on a reassigning of funds in keeping with a special law on public administration (*Ley Orgánica de Administración Financiera del Estado*).

This is the mechanism employed in recent decades as the 2% rule has been irrelevant since 1980. There are regular budget items for the emergency units of the Agriculture, Healthcare and Public Works Ministries, but they are minimal and almost nominal. In addition, the budget law contemplates two specific items for emergencies: one in the budget of the National Office

for Emergencies (under current transfers to the private sector) and another in the budget of a Deputy Ministry of the Interior (under current transfers to other public entities). If these two items prove to be insufficient for the emergency, the Office of the Budget can reassign funds from a number of government entities.

Municipal government have an item for expenditures on emergency food and shelter, but funding is limited and dependent on each municipality's annual budget. Nevertheless, in an emergency situation local governments can receive funds for such purposes from the central government.

Since 1980, Chile has experienced various types of events (earthquakes, flooding and white winters) without exhausting its financial capacities thanks to the country's system of financial management and accumulated experience. It is precisely this management system that makes it possible to respond to emergencies and undertake rehabilitation measures by reassigning budgeted funds.

3) Jamaica. No proper fund exists for purposes of risk management so resources are channelled from other programmes. The country also lacks a risk-reduction fund so the country's national assets remain vulnerable.

A National Disaster Fund (NDF) was set up following hurricane "Gilbert" in 1989, but its effectiveness has been quite limited. Its budget has never surpassed 21 million Jamaican dollars; for 2006 it was drawn down to only 5 million (roughly 80,000 U.S. dollars) following the disbursement of the fund in the wake of hurricane "Ivan". ODPEM managed to double the resources of the NDF by managing investments, but it has lacked regular government contributions, but efforts are underway to strengthen its funding. The Finance Ministry recently received a contribution from the government of Japan, trough the World Bank, for a study on the viability of a possible Caribbean Catastrophe Fund.

4) Mexico. Since 1996 the country has a Disaster Fund with several mechanisms for emergency response (FONDEN Revolving Fund) and recovery and reconstruction (FONDEN Programme). The FONDEN Trust, which receives funds that go unspent following a fiscal year, disburses resources for attending to actions contemplated in the FONDEN Programme, as well as acquiring insurance coverage and risk transference instruments (catastrophe bonds). FIPREDEN and FOPREDEN are designed to implement prevention measures as part of the National Civil Protection Plan. In this sense, Mexico stands out among the countries studied for having *ex ante* funds earmarked for studies and prevention and mitigation actions.

FONDEN supports state governments and federal agencies (municipal governments do not enjoy direct access) whose capacity for responding to major disasters has been surpassed and require additional resources for attending to the emergency, rehabilitation and reconstruction.

In order to access FONDEN's revolving fund the Interior Ministry must have declared a state of emergency. In order to access FONDEN Programme funds in the event of major disasters a disaster must have been officially declared. Requests by the state governor or head of the Federal District must demonstrate that an "abnormal situation generated by a devastating calamity that is of natural origin" is imminent. The request must be signed by the governor of the affected state, contain a damage assessment, demonstrate the lack of funds budgeted for responding to the event, roughly indicate the extent of the affected zone, the number of people who might be affected and provide information on damages. The state must request corroborating evidence from the corresponding technical body (National Water Commission, CENAPRED or the National Forestry Commission) regarding the disaster's occurrence.

FONDEN resources are assigned by the Finance Ministry on a yearly basis taking into account: the balance of funds in the trust, recommendations from the Interior Ministry's Civil Defence Office, how well funds assigned in previous years to FONDEN held up and the availability of funds budgeted for the year in question. No technical means of projecting disaster exposure and frequency is used when deciding how much the government should budget each year for FONDEN. Instead, each year the federal government sends Congress a proposal for the following year based on the damages recorded for the current year. This practice leads to extreme situations such as when a year marked by exceptionally few disasters leads to minimal funding for FONDEN the following year. The study to determine whether to issue

a catastrophe bond related to earthquake risk marks a major technical advance over the procedures used in constituting FONDEN.

State requests frequently lack sufficient justification for their claim that the state's response abilities have been surpassed. In contrast, many times emergency declarations include fewer municipalities than those requested by the local authorities, potentially leading to situations in which FONDEN help fails to fulfil those requests.

Problems in carrying through with an application for FONDEN help is one of the main problems in that institution's functioning, one that has raised suspicions and led some political sectors and media sources to question just where such economic support final winds up. This is a problem that must be solved in an effort to achieve greater transparency in federal and state government management. The mechanism under which FONDEN funds are delivered to the states requires that a state trust monitor whether works programmes are fulfilled and whether the calendar for government disbursements is being met.

The Ministry of Agriculture, Livestock, Rural Development and Fishing (SAGARPA) also operates a fund (FAPRACC) for attending to low income rural producers lacking insurance that are primarily engaged in seasonal agriculture, livestock, aquatic and fishing activities that have been affected by extreme climatological contingencies (droughts, freezes, hail storms, snow falls, torrential rains, flooding, tornados and cyclones). Support consists of partial compensation for the loss and help in generating alternative, transitory sources of income. Declarations of climatological contingency and of natural disaster are both needed to request these funds. A state damage evaluation committee is convened to define the bases for a Plan of Action and Works.

5) Nicaragua. There are two ways to finance disasters in this country: 1) the central government assuming a considerable proportion of risk costs; 2) international cooperation tending to serve as the main source of financing (more than 50 per cent), whether through donations coordinated by the Centre of Coordination for the Prevention of Natural Disaster in Central America (CEPREDENAC), or in the form of long-term loans (World Bank and others). For each project financed with foreign aid or loans, the government of Nicaragua supplies another 20%.

The country's general budget law stipulates the existence of a National Disaster Fund that receives funding as part of the budget for the *Sistema Nacional para la Prevención, Mitigación y Atención de Desastres* (SINAPRED). But that funding only consists of eight million cordobas, the fund is unregulated and can only be used to aid those affected by disasters, and it is explicitly prohibited from financing prevention measures. Given those weaknesses, the President of the Republic is authorized to transfer resources from other programmes in keeping with a plan of priorities, but owing to a lack of resources that plan generally is not fully implemented.

The SINAPRED Executive Secretariat is conducting a study with which to identify and strengthen financial mechanisms for disaster response in keeping with the financial strategy of the National Plan of Risk Management.

In synthesis, all the countries have disaster funds except Chile. That of Mexico has accumulated ten years of experience and while its resources fluctuate, it has been able to cope with disasters because funds left over from a previous year are transferred to a trust, thereby assuring certain regularity in the availability of resource flows. One part of the fund is for emergency response, but most of it is used for reconstruction. Colombia's National Calamity Fund has functioned in an unstable manner and its funding as a percentage of the national budget has waned. The country's poorest regions receive proportionally greater resources than the others. In contrast to other countries, the National Calamity Fund has assigned a significant portion (in some years more than 60%) of its resources to prevention. As we will see later in this document, Mexico uses a special fund to disburse resources for that purpose.

Chile has an agile procedure for reassigning funds from other programmes in order to respond to emergencies in addition to the funds that some ministries budget for their own emergency departments. We concluded that these mechanisms have responded satisfactorily.

iii) Cases in which special calamity funds or budgeted funds have also helped to finance prevention and mitigation works.

1) Colombia. The national budget assigns resources to ministries and decentralized institutions for: risk recognition, prevention, mitigation, attention, and preparations for responding to emergencies, rehabilitation and reconstruction. Prevention and mitigation projects correspond to structural rehabilitation and reinforcement of buildings, river, basin and hillside control works, drainage and irrigation works, fire prevention and mitigation and prevention projects on the part of the Social Protection Ministry.

The National Disaster Fund has designated a major percentage of its activities to prevention. Those actions have concentrated on preparing for disasters, vulnerability reduction and promoting the abidance of physical and urban planning norms.

2) Chile. The main way in which the principal prevention and mitigation works have been financed is through decrees from the Finance Ministry that lower some budgeted items and increase others within certain limits that are specified in the budget law. Since the law imposes a limit on spending, the reassignments may consist of uncompensated reductions in an item for the year (savings) and, more commonly, the reorientation of resources.

Other funds for prevention measures exist as part of the annual budgets of some ministries such as the Irrigation Promotion Programme, the Programme for the Conservation of Rivers and Natural Watercourses and the Public Works Ministry's Programme for the Construction of Alluvial Control Systems.

iv) Access to contingency funds from both international agencies and the local bank for financing disaster risk. The IDB and the World Bank offer countries contingency facilities for such cases. Similar facilities are provided by sub-regional development banks such as the BCIE, CDB and CAF.

1) Chile. The government has the clear possibility of using external repayable resources for disaster situations, but has not exploited it.

2) Nicaragua. This country has developed prevention and mitigation projects with the World Bank. Currently underway is a vulnerability reduction project as part of a national strategy for creating an institutional framework, regulate building codes and acquire risk-reduction technologies. The project is being developed based on a USD13,500,000 (thirteen million, five hundred thousand dollars) and is being coordinated by the SINAPRED Executive Secretariat.

b) *Ex post* financial management

i) The way the needs for the disaster emergency, rehabilitation and reconstruction phases are determined and financed.

1) Colombia. Reconstruction activities have largely been ignored by the National Contingency Fund and have demanded instruments such as insurance and joint public/private sector efforts. The government has set up funds such as FOREC for the recovery and reconstruction phases following major disasters.

2) Chile. The Interior Ministry asks the Healthcare, Education, Public Works and Housing ministries for damage reports and an estimate of the resources needed to "normalize activity as soon as possible in the affected zone". It later adds to those projections the estimates supplied by regional governments involved and reports to the Finance Ministry the total resources necessary for attending to the emergency and rehabilitation phases. The Finance Ministry then authorizes the expenditure and decrees the necessary reassignments.

Resources for the reconstruction phase can only be obtained the year following the disaster, when they can be included in the budgets of the respective ministries. Prevention and mitigation projects and reconstruction investments must be reviewed by National System of Investments. Each agency must generate their respective projects and turn them into the Planning Ministry, which decided whether or not they should be implemented. Once that requirement has been met, the Finance Ministry assigns the funds for the project's implementation.

Another alternative is to finance the replacement of affected infrastructure using funds from existing programmes, as has been the case with irrigation infrastructure. In that instance, the National Irrigation Commission asks the Public Works Ministry for the authority to arrange special bidding for the works in the catastrophe zone.

3) Jamaica. When an event of certain dimensions has occurred, rehabilitation of affected infrastructure is principally financed using foreign aid in the form of loans.

4) Mexico. There is a Fund for the Prevention of Natural Disasters (FOPREDEN), for providing resources and creating mechanisms for lowering risk and avoid or lower the effects of the destructive impact of phenomenon. The prevention actions are oriented toward identifying risks, reducing them, and promoting a culture of prevention and self-protection in risk situations.

The resources may only be requested by state governments and federal agencies. The states are required to provide 30% of the total project cost while federal agencies must provide 50%. A series of prerequisites have been established for accessing FOPREDEN resources. If the request is approved, the General Coordinating Office for civil Defence (CGPC) which will in turn send it to an ad hoc technical committee that certifies whether the project will effectively lead to prevention actions. The approved resources may be executed directly by the states and federal agencies through an expansion of the budget. The state that receives such funding must provide quarterly progress reports on who the action or project is progressing and how the monies are being spent.

A Preventative Trust (FIPREDEN) has also been created to provide resources for un-programmed prevention actions meaning public works and acquisitions that were not contemplated in the annual budget because the urgent need for them arose after the budget process was completed. The states and agencies may request funding within 20 business days after becoming aware of the event that demanded such a request. The request must contain a technical study showing that the purchase or project involved are un-programmed prevention measures that are both necessary and urgent. The state has to supply matching funds to cover the total cost.

5) Nicaragua. This country is particularly dependent on bilateral and multilateral aid mechanisms that provide generally non-refundable assistance. These sources strictly fund survival-related activities (food, temporary housing, water and sanitation, healthcare and population displacement). These funding sources include the Eastern Caribbean Donor Group/Disaster Management Group (ECDG is made up of DFID, ACDI, BDC, the European Union, UNICEF, UNPD, USAID/OFDA, and the World Bank). Other members are OPS, CDERA, the Regional Security System (SSR), CERO (*Organización Central de Asistencia Humanitaria en Desastres*) and the Barbados Meteorological Office. Support offices include those of the IDB, OAS, FAO, International Telecommunications Union (ITU) and the Caribbean Planning for Adaptation to Climate Change (CPACC) project.

The country has no budgetary provisions for post-impact actions and such financing is assumed by the central government by diverting funds regularly budgeted for other activities and re-channelling loans and funding from international cooperation programmes. The international community has covered less than 60% of the aid the country has requested for rehabilitation and reconstruction in relation to recent disasters, according to information from the Emergency Investment Fund (FISE), the Urban and Rural Housing Institute (INVUR) and the Transport and Infrastructure Ministry (MTI).

Given that mitigation programmes and funds are a necessity, it is necessary to direct greater efforts to heighten awareness, education and information among public and private institutions and in the most vulnerable locations. Although vulnerability studies are more common and despite recommendations about the need for mitigation works as a way to lower probable damage, the issue has yet to emerge as one of the government's priorities. A particularly positive development is the execution of mitigation works financed by Japanese Cooperation and the Social Emergency Investment Fund (FISE).

ii) The countries' financial capacity for dealing with extreme events

1) Colombia. In the event of an extreme event the government would have to assign crisis-attention resources to small municipalities and cities. The model for estimating the impact of extreme events concluded that the potential direct effects in Bogotá and the surrounding area from a 500-year earthquake would total somewhat more than 15 billion dollars. Of that total, the government would be responsible for 52% of losses in public buildings and infrastructure as well as for the poorest housing.

The FNC must employ technical studies to estimate maximum probable losses and resources needed to cope with such a situation while the Finance Ministry must decide whether to draw on its own resources, assume debt or turn to other sources of financing. The study proposes a model for estimating the reassignment of

public funds in the event of an extreme disaster. The model contemplates options for accessing external sources for financing reconstruction costs, the national government issuing credit and conducting transfers, and drawing on the support of financial markets and international solidarity.

The municipalities and regional departments have only a limited capacity to absorb the impact of such an event and recover. Therefore, most of the resources for emergency and rehabilitation attention would have to be provided by the national government. This situation underscores the need for reserve funds as well as funds for insurance recovery especially in the case of the reconstruction process.

2) Chile. The study of one of the two extreme scenarios posed in Chile, based on the country's experience with an actual earthquake, concluded that: with the exception of the resources allotted for the recovery of buildings of historical value, which largely consist of churches and whose reconstruction would be achieved with the help of international aid and donations for cultural purposes, the remaining funds would have to be drawn from the national budget and channelled through the various cabinet-level agencies. Contributions from international organizations are generally earmarked for attending to the immediate needs of the affected population and, in other instances (such as the recovery of historical architecture), to rehabilitate lower priority buildings.

3) Jamaica. The extreme scenario studies failed to arrive at an estimate of probable losses or any assessment of the ability of the financial system of risk management to cope with the extreme scenarios contemplated in the project.

4) Mexico. The maximum considered event posed for the country was an earthquake that registers 8.2 on the Richter scale occurring off the coast of the state of Guerrero. An estimate of the total losses that would be expected in the two cities that would be expected to be most affected by such an event (the Federal District and Acapulco) was made using a probability model.

It should be noted that FONDEN funds would account for a low percentage of the resources that the government could mobilize. FONDEN's budget was greatly depleted in 2006, drawn down by extraordinary expenditures following the hurricanes *Stan* and *Wilma* that struck parts of southern and south-eastern Mexico in October 2005. The de-capitalization of the fund means that if a major disaster such as the one considered in the critical scenario were to occur, once again the agency would have to turn to the Finance Ministry (as it did following the 1985 earthquake) for additional funds and guarantees for the reconstruction process.

The Disaster Deficit Index (DDI), which is the ratio of direct losses provoked by the phenomenon and the country's economic resilience, produced a 1.82-point reading.[42] Since the reading is greater than one, we can deduce that in the face of the postulated event Mexico's existing disaster funds would be insufficient to deal with losses and replacing the affected capital stock. This weakness points to the need to greatly expand insurance coverage for public and private property, loss reserves, contingency credit and investment in disaster prevention and mitigation measures.

5) Nicaragua. The reconstruction demands posed under the extreme scenario would dramatically surpass the capacity of the country's disaster fund. In fact, the entire disaster management system would be overwhelmed by the event, especially in terms of financing. The need for resources would be very great in every phase of the disaster, demanding the reassignment of resources, the halting of projects in execution and the search for assistance from abroad.

In the recent history of catastrophic events in Nicaragua international aid played a very important part in financing reconstruction and a return to normalcy in the affected towns. Insurance penetration is incipient so the industry's contribution to the reconstruction and repair of damaged infrastructure would be limited.

The Disaster Deficit Index (DDI) for the extreme scenario posed was 2.28%, which suggests that Nicaragua would lack the financial capacity to cope with a major-magnitude event, thereby increasing the country's dependence on international cooperation.

42 When calculating economic resilience (posibles fondos internos o externos a los que the government puede acceder en el momento del evento) se consideró también el pago de seguros y reinsurance que recibiría el país por los bienes y la infrastructure dthe government asegurada, los valores en forma de ayudas y donations públicas y privadas, nacionales e internacionales y el margen de reasignación presupuestal del país.

To summarize, none of the countries studied would have the financial capacity to deal with an event of extreme characteristics.

c) Risk transference

This section deals with information on *ex ante* policies and measures for transferring disaster risk financing.

i) Colombia. Penetration of catastrophic insurance is low and there are weaknesses in the insurance industry. These problems are due to a significant percentage of the economy being informal in nature and the public's lack of familiarity with catastrophic risk insurance. At the same time, high rates of inflation have demolished replacement costs.

Since 1927 the government is legally obligated to insure public property but it has only been since 1993 that bodies have been established to enforce requirement and potentially charging officials with fiscal responsibility. Public entities currently acquire commercial, comprehensive insurance policies that provide coverage against earthquake damage; sin embargo, insurance policies are not readily available to most or prove to be very costly (high premiums and deductibles). It is estimated that 70% of public buildings have some earthquake coverage but there is none in the case of public infrastructure and such policies are virtually non existent on a municipal or departmental level.

Obligatory coverage has been around for years, but it only applies to the property that financial institutions own or are holding as collateral.

Colombia requires coverage for mortgage holders and for the common areas in buildings. The limit that each insurance firm is required to assume cannot exceed 10% of its equity, and reinsurance is required for covering anything above that level. Rates fluctuate between 0.5 and 2.6 per thousand (lower than those in Mexico and Chile). In 1990 the insurance market was liberalized and banking officials lowered reserve demands from 25% to 15% (of the maximum probable losses for a return period of 1500 years).

In recent years property coverage has been renewed at practically double the previous rates and the cost of reinsurance, which is passed along to the customer, has tripled. Premiums have risen constantly. Owing to the impact of recent disasters, most insurance companies practically retain no risk but rather act as insurance brokers, taking out policies under the names of reinsurance firms. At present earthquake coverage falls short of 10% of all premiums issued.

The government manages risk through prevention-mitigation measures, risk transference (insurance) and risk retention or self-insurance. With the support of the World Bank risk studies have been conducted with transference purposes in mind. One possibility that has been evaluated is that of covering losses through layers of excess loss so as to explore collective policies on public buildings from reinsurance firms. Another possibility explored is that of risk transference to capital markets in the form of catastrophe bonds.

The lack of data on inventories of government buildings makes it hard for insurance companies to calculate how much to charge for policies. There are major gaps in the information regarding insurable goods and the descriptions of assets lack structural definitions and do not even specify the number of floors a building has.

However, the government is making efforts to reach an agreement with the insurance industry regarding the mechanisms so that insurance premiums are not calculated as an average but rather based on the degree of vulnerability each individual building displays. In that way the customer will have an incentive to lower premiums by intervening to lower vulnerability. Detailed micro-seismic zonification studies have been conducted in Manizales and Bogotá for the protection of public and private buildings through the use of group policies.

Agricultural insurance. In 1993 agricultural investment insurance was introduced to protect against natural disasters. It includes deductibles depending on the type of crop and the nature of the risk. In addition a National Agricultural Risk Fund (*Fondo Nacional de Riesgos Agropecuarios*) was established to reinsure those entities that provide farm insurance policies. In 1996 the National Agricultural Solidarity Fund (*Fondo de Solidaridad Agropecuario*) was set up to partially or fully acquire from financial intermediaries the portfolios of small producers in the event of crisis situations caused by extreme meteorological phenomena. Since 1998 farm insurance has run into obstacles such as a lack of security in rural areas and the high levels of production losses to disasters.

In 2003 the government modified the National Agricultural Risk Fund to provide resources with which to subsidize the insurance premiums of farm producers. This type of insurance is to be progressively introduced until all types of farm production, regions and risks are covered.

ii) Chile. The insurance market in this country dates back to the nineteenth century and has been transformed in recent decades. It has played an important role in catastrophe coverage, but only major companies acquire protection against natural catastrophes to the exclusion of the rest of the private sector and the government.

Until 1980 the insurance market was strictly regulated, gravitating around investment decisions of insurance companies (price, policy models, reinsurance commissions) and the system under which insurance agents and providers were to be remunerated. Since that time subsidiary, opening and competition criteria began to be introduced referred to in the social market economy programme. This change implied freedom for insurance firms to set fees and rates, to acquire reinsurance either domestically or abroad, and the privatization of the *Caja Reaseguradora* and the *Instituto de Seguros del Estado*. Except for insurance firms, everyone must obtain reinsurance from companies domiciled in Chile. Reinsurance firms have provided support for major projects and investments such as hydroelectric plants, railroad, highway concessions and mining projects.

The insurance industry in Chile is currently characterized by the participation of major international insurance firms, which are primarily based in the United States and Europe. In 24 years, these firms multiplied their equity eight times over. They currently function within a legal framework that regulates insurance and reinsurance activity, both of which are supervised by the *Superintendencia de Valores y Seguros* (SVS), which is part of the Finance Ministry. Maximum Probable Loss (MPL), according to the SVS is 10% of the total value of exposed buildings and their contents, and 15% of the value in the case of all other risks, leading to an 11% average. Owing to difficulties in obtaining information, the study does not identify the extent of public and private sector coverage.

This opening of the insurance market has expanded the weight of insurance coverage in the national economy (from 0.9% of GDP in 1980 to 2.8% in 1998 and 3.9% in 2004). Per capita spending on insurance widened from US$26 in 1980 to US$162 in 1998. According to this indicator, Chile surpasses Brazil, Mexico and Colombia and almost pulls into line with Argentina, but remains well below the penetration percentages of the United States (9.36%).

Chile lacks a policy of encouraging insurance coverage on public infrastructure. The cost of the considerable damage inflicted by natural phenomena is generally assumed by the government or private interests. Private firms and concessionaries providing public services (such as in the water/sanitation and electric power sectors), are generally covered. They are particularly inclined to take out coverage on high-risk, high-cost, critical structures. Furthermore, such firms and concessionaires are legally obligated to assure ongoing public access to such services under penalty of fines, a rule that further increases the need for insurance coverage. The Finance Ministry is currently launching an office for managing publicly owned real-estate.

The bidding process under which the Public Works Ministry concessions infrastructure, concessionaires must obtain insurance to cover civil damages to third parties and for catastrophes during the construction and exploitation phases. However, the public infrastructure that is managed by the ministry is not insured partly due to prohibitively high premiums and the administrative difficulties arising out of budgetary rigidity.

Earthquake insurance is offered as an add-on to fire coverage. Such insurance gained ground as a percentage of total insurance portfolios during 1986-2004 and accounts for 33.52% in the most recent year. The increase in earthquake related insurance coverage is above all explained by the requirements imposed by the mortgage loans banks issue and the emergence of low-coverage, low-premium policies of banks and major retailers.

The number of active policies covering damage from non seismic natural phenomena, in contrast, accounted for a mere 0.15% of total policies issued. These policies cover damage caused by ocean flooding, avalanches, torrential rains and landslides, material damages caused by the weight of snow or ice, fires caused by natural phenomena, material damages caused by wind, flooding

and watercourses spilling over their banks. This type of insurance normally is associated with housing mortgage loans. Earthquakes are not included due to the high premiums resulting from the country's considerable degree of seismic risk.

Earthquake-insurance premiums have risen primarily owing to the growing cost of external coverage that the local companies acquire. In effect, the industry has transferred a good part of the risks and premiums. Nevertheless, the assured amounts retained have reached high levels, thereby demanding additional protection.

Insurance penetration is uneven, a weakness that reflects the cost of premiums and the lack of nationwide awareness about the economic effects of disasters. There is no consensus definition risk or of the necessary coverage levels, thereby leading to sharp variations in and extremely high costs for premiums.

The Chilean state has created subsidized farm insurance to protect medium- and small-scale farmers. The insurance is managed by a *Corporación de Fomento Productivo* (CORFO) through a committee of officials from the Agriculture and Finance ministries and is operated by two private insurance firms with regulatory norms common to the entire insurance market in Chile. This mechanism is a form of risk transference of losses caused by meteorological phenomena that basically consists of a government subsidy covering 50% of total net premiums that farmers should pay. The coverage it supplies is even more limited but its penetration has been significant. It covers damages from drought, excess or unseasonal rainfall, flooding, freezes, hail storms, and wind damage. It covers drought damage only in the case of non irrigated land so drought losses remain considerable in the case of irrigation agriculture. Also excluded are the risks of natural phenomena such as earthquakes, volcanic eruptions and watercourses spilling over their banks (in instances not directly attributable to excess rainfall). So in regions in which losses to irrigation infrastructure significantly affect crops, the lack of alternative means of coverage leads to losses in the income sources of small-scale farmers and puts a dent in public finance as the state must assume the full cost of repairing such infrastructure for lack of any financial mitigation mechanisms.

Chile's booming agricultural export industry lacks any of these benefits, leaving each farmer or enterprise to individually negotiate terms of coverage with insurance firms without any assistance from state policy. Therefore, they assume the costs of losses from natural phenomena.

iii) Jamaica. The government lacks any real risk transference policy and most of its assets are uninsured. Although this culture is gradually changing, the predominant approach remains one in which the government assumes its own disaster risks.

Government buildings, schools, libraries, roads and some hospitals lack insurance or are under insured. There are exceptions, such as seaports and airports as well as service companies with independent access to the insurance market. In order to cover their insurance costs, these service companies have considered a regional self-insurance project with the Caribbean Development Bank and the Caribbean Electric Utilities Service Corporation. The programme includes a support line of credit for the first years of premium accumulation. To the extent that the fund grows, companies should reduce their dependence on the line of credit until it becomes a back up that is to be employed only alter all of the fund's resources are depleted by claims arising out of an extreme catastrophic event.

In 2004 insurance and reinsurance markets throughout the world incurred major losses as a result of four hurricanes in the Caribbean. Total insured losses were estimated to have totalled 2,700 billion US dollars, 30% of which corresponded to property damage and 70% to losses incurred from the interruption of activities. In Jamaica there were 7,100 claims worth 96 million US dollars, less than 2% of total coverage. Greater losses were averted in this country thanks to the improved building techniques and reinforced roofing that were adopted following the experience of hurricane Gilbert in 1988.

Most of the losses from hurricane Ivan were to uninsured or uninsurable property (constructions that continue to be built in low lying areas, along river banks and basis exposed to flooding and unstable hillsides).

The situation is different for the private sector as the proportion of residential and commercial properties that are insured is much higher than in most

developing countries. This situation reflects the extent of disaster vulnerability and the legal requirement to insure tourist installations, a rule that is common to all of the countries of the Eastern Caribbean, where each insurance firm attends to an average of 14,000 inhabitants compared to the average in the United States of 107,000. This could suggest an excess number of insurance firms, a situation that would imply inefficiencies on the level of economies of scale in operating costs and risk management.

Companies from Trinidad and Barbados account for 75% of the insurance market in the Caribbean. Premiums cost more than in the United States due to the relatively small size of the firms and the lack of economies of scale despite the relatively low administrative costs in the region. Those lower costs plus the low retention of insured risk avoid a rapid accumulation of reserves in proportion to capital.

In recent years some major corporations, such as energy producers, have found it impossible to obtain full coverage and in some instances, even limited coverage. That situation has led to the idea of self-insurance with very high deductibles on coverage of the expected, potential losses. The cost and the lack of availability of coverage have led industry associations (such as those of hotel owners) to employ risk management techniques or arrangements with foreign insurance companies to obtain group reinsurance coverage.

CARICOM has recommended that governments and the private sector adopt a regional approach to insurance as a way to diversify risk means and reduce the weight of the global insurance industry on the region. It also suggests that lawmakers in the region adopt a series of measures including building codes that specify appropriate building materials, the reinforcement of existing structures and the use of common protection systems.

Socioeconomic and idiosyncratic factors should also be contemplated from both the supply and demand sides of the catastrophe insurance market. It is useful to distinguish between classes of property segments. The income levels of property owners are a major determinant of demand for catastrophic coverage policies, which cost close to 1% of the value of the structure. Small/informal sectors only acquire this type of coverage to the extent that credit institutions demand it. It is estimated that between 25% and 40% of housing is not insured, and those with the lowest coverage levels are small/marginal housing units. Furthermore, the highest insurance premiums are charged in those regions that most frequently experience storm damage. Owners of medium-sized and large homes lack and that lack the same financial constraints are almost fully covered by catastrophic insurance, as are owners of medium-sized and large-scale enterprises.

These last groups rarely acquire coverage that would cover a catastrophe-imposed interruption of activities. Major corporations enjoy access to insurance brokers (as opposed to their own insurance agents), who tend to favour placing coverage with foreign insurance firms from the United States or Europe who are not locally registered.

In contrast, the segment of small property owners within the least developed sectors lack access to coverage because they either do not understand or comply with the insurance policy mechanism. Many of them simply expect government assistance will help them to deal with a crisis. Others decide to insure themselves, assuming that what they save in terms of insurance premiums will be enough to pay repair costs although in most instances such savings turn into working capital.

Governments face the challenge of promoting structural measures for reducing the vulnerability of low-income housing. To that end they must make full use of the arsenal of tools available for reducing hazards and make clear up to what point the government's responsibility ends and that of the communities begins. This strategy demands a two-track focus in which government funds for mitigation works are made available to those communities in exchange for their explicitly committing to a policy of limited insurance coverage that would allow them to protect themselves if they follow proper vulnerability reduction practices.

In the Caribbean, insurance has traditionally been weighed toward reinsurance. Close to 70% of premiums and risks correspond to reinsurance. Local insurance firms, however, regard revenue transfers for premiums collected as a commission paid to reinsurance firms for managing the customers' business.

iv) Mexico. Insurance penetration remains relatively low in all segments of insurance as coverage accounts for

only 1.9% of Mexico's GDP. Growth in sales of coverage against natural disasters has been minimal and although Mexico is exposed to high seismic and hurricane risk, 70% of micro, small and medium-sized enterprises and 97% of homes are not insured against such phenomena. Only major corporations employ such policies.

A mere 3% of privately owned homes have insurance coverage. Mortgage loans automatically include an insurance policy and close to 40% of existing home coverage consists of such mortgage-linked policies (which offer protection for the insurer to recover outstanding mortgage balances but not the homeowner). Homeowners fail to take out insurance against natural disasters because they are unaware of the great variety of options at accessible prices that are available or because they simply do not see it as a priority.

In any event, the country is better prepared today to cope with emergencies produced by natural catastrophes. Twenty years ago several federal government ministries found themselves without insurance against earthquake damage, which is now legally mandated.

Natural conditions expose the country to different hazards depending on the region, a reality that regulations should take into account. In the Federal District and the state of Guerrero the government is required to maintain insurance coverage against telluric movements, but no such requirement exists in states such as Tamaulipas, Nuevo León and Yucatán, where the chances of earthquake damage are remote.

Catastrophe bonds are new risk-prevention instruments. They are similar to reinsurance (firms that assume part off the financial risk of the original insurer) because they protect the primary insurer against excess losses. They offer the added advantage of making funds immediately available in the event of an emergency. Twenty years after the quakes that inflicted massive damage on Mexico City, Mexican financial authorities designed a bond to help cover part of the damage that might be caused by an earthquake of similar or greater magnitude than that of 1985.

In 2006 the Finance Ministry issued 160 million dollars worth of the bond covering the risk of an earthquake with a rating above 7.5 points on the Richter scale occurring in the region in and around Mexico City. Their purpose is to immediately replace the FONDEN resources earmarked for attending to the civilian population affected by an earthquake and eventual reconstruction work. The value of the bond soars in response to specified trigger conditions (when a seismic event of a specific magnitude and location occurs). Current instrumentation and theories for determining the size and locating the epicentre of a quake are not free from uncertainty. They may produce varying readings depending on the techniques used or if they are calculated using data from different stations, which can lead to serious legal consequences. There is very limited global experience with catastrophe bonds that have been triggered, so the effectiveness of the coverage they provide has yet to be tested.

The bond is divided into two series: 150 million dollars of Class A notes and 10 million dollars of Class B securities. Over a period of three years investors are paid every six months a yield of LIBOR + 230 basis points for the Class A issue and LIBOR + 235 basis points for the Class B. The bonds represent a cost to the Mexican state of roughly 8 million dollars annually. This is a common investment instrument for private firms but is a first for Latin American governments.

The Interior and Finance Ministries are working to issue similar bonds (bringing the total to as much as 450 million dollars) providing coverage of seismic events that rate higher than 6 points on the Richter scale with proceeds going toward providing emergency response in other regions of the country exposed to telluric movement.

Mexico has made significant progress in regulating catastrophe coverage policies. A rule issued in 2000 specifies the way to estimate risk in terms of maximum probable losses (MPL). MPL are used to determine the reserves that must be set aside for the portfolios of each insurance company against catastrophe losses. Companies with healthy portfolios benefit by enjoying lower reserve requirements. At present, the CNSF and the *Asociación Mexicana de Instituciones de Seguro* (AMIS) are developing a similar arrangement for insurance covering hydro-meteorological risk.

There is insurance for protecting the contributions states and municipalities must make to FONDEN in the event of disasters. Only seven out of 32 states have taken out such coverage to date, a sign of just how little

prevention continues to weigh on the policy priorities of state governments in general.

Mexico has had farm insurance since 1963, which is managed by the *Aseguradora Nacional Agrícola y Ganadera*. In 1990 Agroasemex was formed as a state institution for promoting private participation in providing insurance to the industry. The agricultural and livestock sector can choose from two modes: a conventional policy issued by private insurance firms and an insurance fund recognized by Agroasemex. This latter option was established so that producers may cover their own losses from catastrophic natural events, and are legally obligated to reassure through Agroasemex or other companies. Under either mode, the federal government subsidizes premiums through Agroasemex. The subsidy is granted directly to the insurance firms and the amount varies depending on the region and type of crop. There has been considerable growth in the number of hectares under disaster insurance coverage.

v) Nicaragua. In recent years the government has played an important role in reducing vulnerability by identifying areas that are risk prone and regulating their use, but the market of insurance and reinsurance has not contributed substantially to disaster prevention or mitigation. Information on risk, hazards and vulnerabilities is not taken into account or is only given marginal importance when drawing up insurance policies. In addition, a high percentage of the most vulnerable segments of the population lack any insurance coverage whatsoever.

Norms that regulate insurance and reinsurance employ criteria that increase the security of risk transference. The National Risk Management Plan promotes a series of financial protection activities. The SINAPRED Executive Secretariat and the Finance Ministry coordinate a project designed to improve the conditions under which public property in insured and conduct joint campaigns with the insurance firms for promoting a culture of insurance at all levels of the population.

According to a 1999 law, the Department for Banks and Other Financial Institutions assures that the industry is properly abiding by insurance regulations, demanding that on a monthly basis firms file activity reports, conduct audits, and list their risk reserves, among other items.

There is a growing trend toward insuring public goods –regulated under a 1984 law– and there is an increasing use of bidding procedures for acquiring such policies. Among the very few public recently constructed buildings that are insured are those of the Foreign Relations Ministry (MINREX), the Presidency of the Republic and the *Empresa Nicaragüense de Telecomunicaciones* (ENITEL). Second-tier hospitals have buildings that are 30 years old on average and they enjoy only minimal maintenance, which has apparently complicated efforts to insure such facilities.

By contrast, there is a significant degree of risk transference in the private sector which reflects the wide range of catastrophe and property-loss policies available, but there is no clear idea of how much of this coverage is actually underwritten.

The relationship between insurance and reinsurance firms appears to be optimal. Everything that is insured in the country is covered by re-issuers. All claims were fully paid in the wake of both Hurricane Mitch and the Masaya earthquake. Mortgage insurance policies are also available. While they only pay the outstanding mortgage balances in the event of a disaster induced loss, this at least assures that a part of the financial services industry is not wiped out when a disaster occurs.

Insurance companies operating in the country lack the complete information needed to conduct a valuation of their risk portfolios and demonstrate to reinsurance firms the extent of their true exposure, which is a precondition for acquiring reinsurance at reasonable costs. Therefore, insurance and reinsurance companies must invest in the production of the sort of detailed information they need for such purposes. To that end they require the most detailed cartographic risk, hazard and vulnerability information that has been itemized in great detail using a cartographic data based that includes the frequency of damage at specific sites by the different types of hazards. At present, the industry is implementing a project on maximum probable losses whose results should help bolster the institutional fortitude of private insurance firms. The end goal is to allow insurance firms to effectively increase the penetration of disaster insurance coverage.

INISER is the leading source of insurance and reinsurance coverage in Nicaragua. It is an autonomous

TABLE 17. PRINCIPAL CHARACTERISTICS OF FINANCIAL DISASTER RISK MANAGEMENT					
	Colombia	**Chile**	**Jamaica**	**Mexico**	**Nicaragua**
Catastrophe Funds	A National Catastrophe Fund exists but is seriously limited. NCF funding has come from very unstable sources and government funding has fallen as a percentage of public revenues.	No fund exists for covering disaster situations. The President of Chile is authorized to use budgeted funds or reassign funds designated for other purposes.	No adequate fund exists for the handling of risks, so the necessary resources are obtained by diverting funds from other programmes. The effectiveness of the National Disaster Fund (NDF), created in the wake of hurricane "Gilbert", is quite limited.	The country has a disaster fund (FONDEN) for emergencies, rehabilitation and reconstruction. Recently two other funds were created for attending to damage at the state and municipal levels.	A National Catastrophe Fund exists that is unregulated and may only be used to support those affected in a disaster situation. The Presidency of the Republic may authorize the transfer of funds from existing projects.
Financing mitigation and prevention activities	The National Disaster Fund has assigned a significant percentage of activities to prevention (more than 60%)	The Finance Ministry decrees the reassignment of funds for prevention	No risk reduction funds exist.	FIPREDEN and FOPREDEN are programmes aimed at implementing prevention measures.	An IDB refundable financing mechanism exists for risk identification, prediction and mitigation operations.
Risk transference	Penetration of catastrophic insurance is limited. The law requires that state property be insured.	Catastrophic insurance penetration is significant only in the case of major firms, and is limited throughout the rest of the private sector.	Most government assets are not insured, but there is gradual movement toward a greater culture of insurance.	Insurance penetration is relatively low compared to the scale of the economy. The financial authorities launched a catastrophe bond for seismic event coverage.	Through its National Risk Management Fund SINAPRED promotes financial protection, especially for improving the coverage terms of insurance for state goods.

state agency that is authorized to issue all manner of life and property policies. INISER has played a major role in offering compensation for losses related to accidents, natural disasters and catastrophes.

To summarize, penetration of catastrophic insurance is relatively low in four of the five countries studied but plays an important role in Chile although it is circumscribed to only the largest insurance firms. In all instances earthquake insurance is much more common than policies related to hydro-meteorological phenomena. In Colombia, Mexico and Nicaragua the law demands that public property be insured. But much of Colombia's public infrastructure is not covered. The law in Mexico does not yet apply at the municipal level and in Nicaragua only incipient progress has been made in acquiring such coverage, but the government has launched campaigns along with the insurance industry to promote a culture of insurance among all segments of the population. Everything that has been insured in Nicaragua is covered by reinsurance. INISER is an autonomous state agency that is authorized to issue all manner of life and property policies, and has played a major role in relation to natural disasters and catastrophes

Chile lacks a policy of requiring insurance coverage on public infrastructure, but the concessionaries tend to take out insurance because they are legally obligated to assure ongoing public access to such services. The only government assets that are covered in Jamaica are seaports and airports, but new contracts point to a trend toward more expanded coverage. Jamaica's tourism infrastructure is insured as is that of Mexico.

Mexico is the only one of the five countries that has introduced a catastrophe bond (for up to 450 million dollars) providing coverage for seismic events with a reading above 7.5 on the Richter scale as a way of attending to emergencies in those regions most susceptible to telluric movement.

TABLE 18. INSTITUTIONAL STRUCTURE

Topic	Colombia	Chile	Jamaica	Mexico	Nicaragua
Legal framework	The legal framework emphasizes prevention and decentralization on an inter-sectorial level and coordination	The structure is not well integrated and is based on legal bodies for the various exposed systems.	All phases of activities are directed by ODPEM, an operational office of the National Disaster Committee (NDC), comprised of representatives from all sectors.	There is a very complete and suitable set of norms and regulations. Urban land-use planning is weak and compliance is minimal.	A complete and modern legal framework. Emergency attention is disconnected from other management phases. Scant compliance with land-use and zoning rules.
Institutional coordination	There are technical and operational components on a national level. The various public sector agencies work in a coordinated manner.	The ONEMI is focused on emergency response and public information campaigns. The management system is delegated to the institutions responsible for each sector and has performed well in recent disasters.	It is a priority issue and there is a good degree of coordination between institutions and the various levels of government.	All sectors of the federal government have operational plans for emergency response and recovery that have been working with increasing efficiency. Coordination between sectors could be better.	Good coordination between the various sectors of SINAPRED. The system lacks human and economic resources, and is dependent on international aid.
Participation by other actors	Private participation has not been very active. An exception was the participation of the business sector in the reconstruction programme for the 1999 earthquake.	Basic services are privatized and the execution and financing of the various phases of risk management are left up to private consortia.	The prioritizing of the subject, the actions taken, private sector participation and public preparation have all improved since hurricane Ivan in 2004.	The armed forces play a decisive role in emergency response tasks but there is scant private sector participation.	Private sector participation is weak while the armed forces efficiently play a major role.

The governments of Colombia and Mexico have devised insurance policies to protect the farm sector against crop damage arising out of meteorological contingencies. In both instances, such coverage against crop losses is subsidized. Those of Colombia also cover farm infrastructure losses as well. In contrast, Chile's booming agricultural export industry lacks any state-promoted insurance, leaving each farmer or enterprise to individually negotiate terms of coverage with insurance firms.

Table 17 lists the most fundamental aspects of financial management for all five countries.

5. INSTITUTIONAL STRUCTURE AND GENERATING INFORMATION FOR RISK MANAGEMENT

All five countries implement their main disaster management tasks in significantly different ways. These differences make it all the more interesting to make comparisons for the lessons that can be drawn from such varied experiences. We have broken down the main facets of this problem into five parts, for which we will first offer a summary for each country and then make a comparative analysis of each topic. Table 18 summarizes the most notable characteristics of each of the five countries' institutional structure

Chile is the country with the least structured disaster management system, leaving each ministry with the responsibility for all phases of risk management. Responsibility even for the country's principal vital systems is left in the hands of the private interests holding the concessions to such infrastructure.

Mexico and Nicaragua have the most complete legal management structures, although not all bodies completely fulfil all their responsibilities. The true scope

of activities by Nicaragua's SINAPRED is severely limited by budget constraints.

All the countries tend to leave responsibility for disaster risk management in the hands of local governments, who frequently lack the economic, technical and structural resources for effectively acting; this is an issue that is particularly critical for the smallest and weakest municipalities. Colombia is notable for its degree of decentralization and has been successful in some of its largest cities. Jamaica appears to have been most efficient in management on a local (parish) level.

Almost all of the countries maintain a formal or real separation between the emergency response systems and that of reconstruction-prevention. Mexico is probably the country that best integrates both parts although the system still suffers from a certain lack of coordination.

Generally speaking there seems to be little correlation between management and its formal structure as it would appear to be more dependent on the country's degree of political development and the extent to which local or national governments function effectively.

One problem that appears to a lesser or greater degree in all of the countries studied is a paucity of experienced personnel working on an ongoing basis in disaster related tasks as there remains a generalized problem of high turnover in such posts.

a) Organization for risk management

This section describes the structure of each country's national system and legal framework for risk management. We will comment on the efficacy of those structures, the extent to which the planned system has been out into practice, and the possible evolution or modification of the organization and its ranking in government hierarchy.

i) Colombia. The legal framework established in 1989 (following the Armero disaster) with the creation of the National System for Disaster Prevention and Attention (SNPAD). The emphasis is on prevention, decentralization (at the state, departmental and municipal levels), inter-sectorial work and coordination (through inter-sectorial committees). It recognizes the various social aspects of disasters. On a national level there is both a technical and an operational branch; the two apparently function independently of one another; the first is engaged in planning and technical support, and the second has the features of a civil defence system.

It is based on the national disaster prevention plans that have been adopted since 1998, with considerable influence from the National Department of Planning, a body that defines and manages the national budget. Public agencies are engaged in an active and coordinated manner. The system relies heavily on municipal organization, which means that it depends greatly on local governments for a wide array of human and economic resources. The most notable cases are those of Bogotá and Medellín, which wield considerable resources.

Although changes have been made to the organigram, the basic system remains in place and functions properly, especially on the national level and in some major cities. Initially SNPAD was under the direct control of the President of Colombia, thereby assuring that it would be viewed as a governmental priority. Later it became part of the Interior Ministry and became somewhat more bureaucratic. In summary, the issue remains a top priority and the system functions well on a national level and in some major cities, though not in all provinces and municipalities. The legal framework is very complete and in line with modern guidelines with emphasis on prevention and mitigation.

ii) Chile. The structure is poorly integrated and outside the criteria recommended by international bodies. It is based on specific normative bodies for each sector in charge of the various systems that are exposed to risk and the main management actions. It exists on a national, regional and municipal level. The main sectors are: Housing and Urban Planning, which is in charge of the regulatory plans including urban zoning and risk prevention measures; Public Works, which looks after vulnerability reduction and infrastructure; Agriculture and Healthcare, which are in charge of their respective areas of concern. The National Organization of Emergencies and Mitigation (ONEMI), which is a department of the Interior Ministry, is focused on attending to the emergency and the distribution of information to the public, although it exerts other functions in various phases of civil defence. It charts risk maps and plans for issuing warnings/alerts and vulnerability reduction, as well as for attending to emergencies and drawing up

damage statistics. There does not appear to be much coordination with the sectors, which have their own emergency response plans.

Relations between the public and private sectors in risk management issues are regulated by management mechanisms that are legally underpinned by an array of measures and initiatives that have been incorporated into laws, decrees, norms and regulations for risk reduction in its various spheres since the decade of the 1920s. These have been managed by a number of institutions depending on their area of interest and sectorial intervention.

One part of risk management in Chile is in private hands and it extends to telephony, water, transport (air, land and maritime) and electricity, among others, which have been concessioned almost entirely to private interests. In each case there is a corresponding state agency in charge of making sure that the norms that regulate such services are respected. When a disaster occurs, the government makes sure the concessioned services are maintained. Private consortia are in charge of the elaboration and execution of plans for the various phases of risk management as well as their funding and obtaining the necessary coverage.

The management scheme for sectorial institutions has remained in tact for many years and has proved to be efficient. Factors contributing to its positive performance include the existence of strict norms and a tradition among actors of abiding by such norms.

iii) Jamaica. All phases of disaster-related activities are directed by the Office of Disaster Prevention and Emergency Management (ODPEM), a department of the Ministry of Land and Environment and an operational arm of the National Disaster Committee (NDC), which is presided over by the Prime Minister and comprised of representatives of all sectors. The NDC has sub-committees in charge of drawing up plans and supervising their correct execution. There is a National Disaster Plan that details risks, strategies and procedures and which has local affiliates that attend to specific problems at the community level. This organization has remained in tact for many years and appears to be functioning effectively. This is a priority issue for the central and local authorities, who coordinate well. Since 2004's hurricane the issue and numerous related actions have gained prominence among the government's priorities. The NDC lacks a budget of its own, but its decisions are executed by representatives of the multiple sectors that belong to that body.

iv) Mexico. The formal structure is very complete. The National Civil Defence System (SINAPROC) was created following the 1985 earthquake and has been fine tuned, but remains unchanged since then. The structure extends from the federal to the state and municipal levels, and enjoys the participation of the private sector; each level reproduces the national one but on a smaller scale. The President of Mexico presides over the SINAPROC, but it is managed by the Interior Ministry by way of the National Coordinating Body for Civil Defence (CNPC), which is a deputy ministry. The functioning of the system is supervised by the National Council on Civil Defence, where all of the relevant actors are represented; the council mainly convenes to organize disaster response. The CNPC coordinates and supports the activities of all sectors in the various levels with three general leadership bodies: Civil Defence, which coordinates the state and municipal offices, CENAPRED, which is in charge of the techno-scientific support, diffusion and training activities, and FONDEN, which administers the disaster fund. All of the related federal government agencies have their own civil defence plans; the involved ministries have the operational plans for attending to emergencies and recovery, which are functioning with increasing efficiency. There is a trend toward a decentralization of responsibilities and tasks in which states and municipalities (the country has more than 2,400 municipalities, many of which are small and strapped for resources; more than half have civil defence units) are handed more responsibility. In the event of major disaster impact, the federal government directly takes charge of activities and their financing.

SINAPROC's legal framework is contained in the 2000 General Civil Defence Law. Its operational guidelines and goals are defined as part of the country's six-year plans. The system is very complete on the federal level and in most states, but not in a majority of the municipalities.

Zoning and land-use rules are weak and often are ignored, even in major cities. While some national laws exist that regulate the use of certain areas and

resources, such as the National Law on Water, their enforcement, like in the case of the land-use rules, is up to the municipalities. There is considerable social pressure and efforts by interest groups that lead to the emergence of human settlements in high risk conditions, especially in areas prone to flooding and mudslides. Building codes are also a municipal issue, but some states have also adopted building code laws that are generally followed by municipal governments. Enforcement mechanisms, however, do not work properly. Marginal housing (unauthorized self-construction) continues to account for a substantial portion of all housing, although its weight has diminished somewhat in recent years owning to the massive scope of affordable housing programmes.

The system has been consolidating over the course of its 20 years of existence and has become a fixture of government planning. The most widely recognized agencies are FONDEN and CENAPRED as well as the armed forces owing to their high profile participation in emergency response and recovery. The media gives a good deal of attention to disasters, but its focus is concentrated almost exclusively on emergencies. Attention to financial protection has increased in recent years, but it is far from attaining desirable levels. The system's weaknesses and limitations are related to an accelerated turnover of experienced personnel; a chronic shortage of funds and human resources; the fact that steps are just now being taken to extend civil service to those engaged in civil defence, which marks an important step in the professionalization and modernisation of institutions related to civil defence; however, this shift is still in its infancy so much remains to be done to establish career criteria for public servants in this field. There has been scant attention paid to matters of prevention and mitigation; in terms of prevention activities, there is a good performance on the level of getting out information, conducting studies and setting up warning mechanisms. We expect a greater contribution from FOPREDEN in this regard. Mitigation is not contemplated within the risk management system. On a state and municipal level, civil defence has been established with a view that extends beyond disaster risk to contemplate various aspects of public security (fires, traffic accidents and safety measures in public spaces). Progress has been made in producing hazard maps and some states now have risk atlases.

v) Nicaragua. Law 337 put into place since 2000 a complete and coherent legal framework. SINAPRED is the normative and coordinating body and it responds directly to the Presidency of Nicaragua. Attending to emergencies is the job of the Special Operations Commission that the Army coordinates. SINAPRED coordinates the Sectorial Working Commissions (which manage their own plans for various stages of management) and both departmental and municipal committees, which are in charge of their own plans. Disaster prevention forms part of development plans and environmental policy. Considerable progress has been reported in making resources available to the municipalities so that they can take charge of disaster response and social risk management (linked to poverty reduction). In 2002 a Zoning Law for disaster risk reduction was adopted, but its influence is only formal. The urban development plans that contemplate hazards are not applied in most municipalities. They have not even managed to relocate settlements in hazardous locations such as those on the hillsides around Lake Managua. SINAPRED has a minimal budget. Each Sectorial Working Commission is in charge of a government department's prevention efforts and forms part of the Technical Committee presided over by SINAPRED.

There is a very complete and updated National Building Code that has yet to be implemented and there are no effective means of enforcement. Close to 85% of housing was self-built and much of the engineered or formal building is done by poorly trained builders who ignore the codes.

It is necessary to professionalize risk management and the personnel involved. Only some bodies work efficiently and permanently such as the Special Operations Commission. INETER has had an outstanding performance. SINAPRED lacks resources and suffers from high personnel turnover, which is also the case with the sectorial linkage bodies. The question of disasters has assumed much greater national importance sine hurricane Mitch. There is now in place a very complete and well articulated formal organization; however, resources are scarce and the system relies heavily on international assistance, which has been abundant.

b) Participation of the various actors in risk management

This section analyses the participation of the private sector, non governmental organizations and the armed forces, as well as coordination between the various sectors.

i) Colombia. SNPDAC is very open to social institutions and the private sector participating in its committees, but private sector involvement has been largely limited to a few specific cases. The technical contributions of universities and professional associations and the activities of relief and aid associations in emergency response have proven important. The business sector played an important role in the reconstruction programme in the coffee growing region following the 1999 quake, but in general, the business, banking and insurance sectors have not played a very active role within the system.

ii) Chile. The private sector participates primarily as the party in charge of operating some systems with risk management plans and in keeping with regulatory norms. In this way the private sector participates at various levels including public information and preparation. The armed forces play an important role in emergency response. The civilian population participates in the emergency committees.

iii) Jamaica. The organigram contemplates the participation of the private sector and NGOs in the committees. Community committees play a major role in various phases. Participation has increased significantly in both instances following 2004's hurricane Ivan. Improvements have also been registered in the extent to which both companies and the general public are prepared for dealing with disasters. The armed forces have a proven record of participating as a major force in attending to emergencies.

iv) Mexico. Private sectors participate very actively including the banking and insurance industries, operators of vital services such as telecommunications, and both local and national media services. Certain NGOs are very active especially in attention to emergencies, recovery and reconstruction. The armed forces play a decisive role in emergency response activities, including the alert, evacuation, rescue and shelter steps, but normally do not become involved in caring to maintain order and safety, tasks that they leave up to local public security forces.

v) Nicaragua. Private sector participation appears to be minimal except from international NGOs. The armed forces play a significant role in emergency response and recovery.

c) Organization for attending to the various phases of disaster management

In this section we will deal with the efficacy and functioning of the various phases of emergency response, recovery and reconstruction. We will also evaluate the extent to which mitigation measures are adopted during the reconstruction phase.

i) Colombia. The *Comité Operativo Nacional* has made considerable advances in emergency management. Well articulated response plans for the various phases have been put into place on a national level and in some cities, but the smaller municipalities remain poorly prepared.

There appears to be a negative tendency on the level of creating special bodies for implementing the recovery and rehabilitation programmes, but such response has been successful in recent events. The municipalities have development plans and land-use and building codes that include mitigation actions, but many are not properly applied. Bogotá and Manizales offer an example to follow given their numerous vulnerability reduction actions in water and drainage services and installations, as well as in relocating settlements from high risk areas. A new law on the need to reinforce indispensable buildings (basically hospitals), has only been partially applied. Each year both the central government and some of the larger municipalities have included budget items for such tasks. Many inspections have been conducted of buildings and specific installations and priorities have been established for investing in mitigation, but there is no evidence to date that such efforts have led to a significant reduction of risk or that they are sustainable. Only in the largest cities such as the capital of Bogotá have effective and permanent programmes.

ii) Chile. The sectorial structure and ONEMI work hand in hand. A National Emergency Plan has been adopted for responding to disasters; ONEMI sets the guidelines and the sectors implement them. This or-

ganization generally reacts to emergency situations in keeping with pre-established legal procedures that have been established for each institution, operating in keeping within its specific area of responsibility.

An initial diagnosis of the situation is undertaken by the affected municipalities under the direction of communal and regional emergency officials. During this phase the efforts of the municipalities are focused on satisfying the population's basic needs. In cases in which shelter infrastructure are too damaged to be used the most common recourse is to use prefabricated housing and tents that are distributed by a municipal agency.

The recovery and reconstruction stages are also a sectorial responsibility. ONEMI ceases to play a role once the emergency has passed. Recovery plans are implemented by the sectors involved based on the budgets for each cabinet-level agency and with special disbursements from the central government. The private sector that operates many services and considerable infrastructure is responsible to attend to any problems that arise with those assets and to have the coverage necessary for covering any losses.

iii) Jamaica. Both authorities and the public have displayed a good capacity for emergency response. Plans exist for alerting the population during the frequent emergencies they experience although doubts remain as to how well they will work in the event of disasters of extraordinary magnitude. Emergency simulation drills are frequently held. Some case studies suggest that the population is reticent about quickly responding to evacuation instructions and only responds to appeals to move to shelters when events reach intense levels.

Recovery from lesser disasters has proved to be efficient, but in the case of larger-scale disasters the country continues to rely most on international assistance. The authorities emphasise mitigation, especially the identification of vulnerable buildings and measures aimed at correcting that situation, but there is a lack of proper procedures in this regard.

Throughout the entire risk management system preparation is much weaker in the case of earthquakes than for hurricanes and flooding probably given the limited frequency of seismic events, whose threat, however, should not be overlooked.

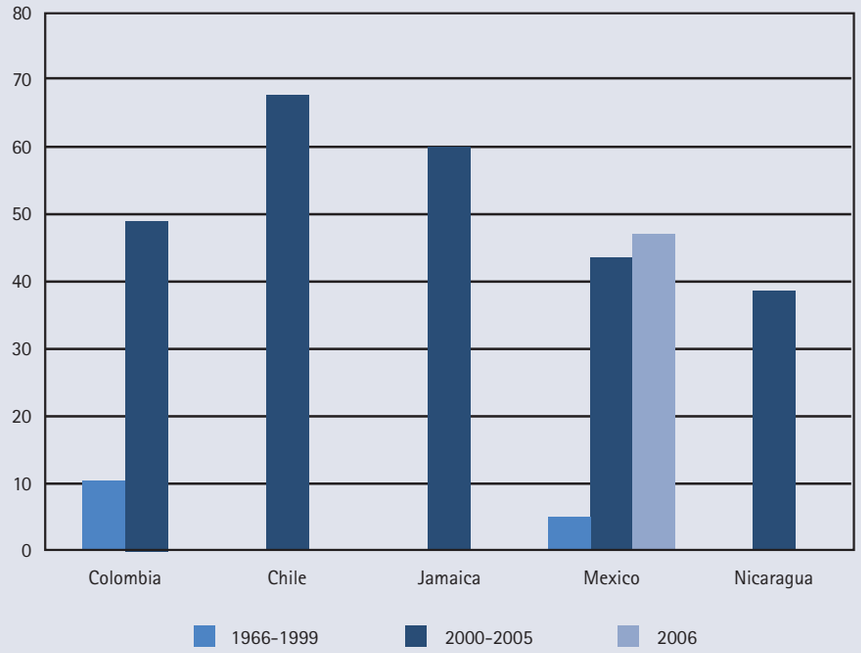
iv) Mexico. During the emergency attention phase, the first line of response consists of municipal and state governments, and often a significant degree of participation on the part of the local population; when their capacity is exhausted the federal government intervenes, almost always in the form of the armed forces. In the case of hurricanes, warning and attention mechanisms are activated rapidly and in an organized manner. The federal government agencies involved in such tasks have well practiced emergency plans and inventories of basic inputs. The bodies playing a particularly significant role include the Defence, Healthcare, Communications and Transport ministries, and the Federal Electricity and National Water commissions. The role of emergency response agencies is clear on paper, but in practice problems with coordination tend to arise.

During recovery, sectors generally intervene in an efficient manner to re-establish basic services; materials such as laminated roofing, wood and cement are provided so that inhabitants of affected housing can repair their homes. FONDEN provides reimbursement of resources for these activities. The Development Social Ministry uses these resources to rebuild, repair and relocate affected housing; to that end the ministry relies on local census data, booths for directly attending to the public and, frequently, by directly involving the affected population by hiring them in reconstruction job programmes (PET).

The reconstruction phase often lacks an initial technical damage assessment that could serve as the basis for channelling resources from FONDEN. It is frequently the case that local authorities magnify damage assessments, which leads to conflicts with federal officials that can delay the delivery of needed resources. In the event of severe damage efforts are made to introduce vulnerability reduction actions in anticipation of future events, such as improvements in building materials and techniques for housing, and relocation to lower-risk sites. Frequently, however, temporary measures are not followed up with permanent ones.

v) Nicaragua. Emergency attention appears to be effective. The army coordinates all the public safety agencies in their endeavours. There is a lack of coordination between the working commissions in charge of the various recovery and reconstruction efforts. A national

Figure 9. DISASTER MANAGEMENT INDEX COMPARISON



response plan is needed for articulating activities and laying the bases for coordinating sectorial plans and, above all, for providing resources for quick response and personnel training. Well structured programmes exist for these phases, but there is an inadequate level of national funding allotted for their execution. Mitigation actions exist only in the case of works with international funding. In the recovery phase problems with housing must take a back seat to infrastructure.

d) Disaster risk management capacity indicators

We will now discuss the Disaster Management Indicator (DMI)[43] developed in the second component of the programme,[44] with emphasis on the factors that most influenced each country's score and how they have evolved between readings. Figure 9 summarizes the results of the five countries.

i) Colombia. The substantial improvement achieved in the DMI between 1986 and 2003 recognizes the importance that the issue has assumed and the efficacy of the mechanisms adopted for emergency response and reconstruction.

ii) Chile. A DMI of 67 for 2000 was the highest reading that year for any of the five countries largely in recognition of Chile's record of strong management performance amid major earthquakes.

iii) Jamaica. A DMI of 60 for 2000 was based on the country's capacity for emergency response and recovery as well as the extent to which the public had been prepared to confront disasters.

iv) Mexico. The factors that have most influenced the country's improved readings are improved efficiencies on the level of emergency response and in recovery. The factors standing in the way of further improvement are a lack of enforcement of urban land-use, zoning and building codes and the limited extent to which a lack of mitigation measures are adopted in reconstruction.

43 The DMI measures performance in disaster risk management on the level of disaster response and recovery. These tasks are considered part of disaster risk management in this study.

44 http://idea.unalmzl.edu.co

v) Nicaragua. The country scored a DMI of 38 for 2006, a low reading that is largely because Nicaragua's disaster management capacity is so dependent on foreign aid.

Differences in the DMI readings of the five countries do not appear to reflect the appreciation of the situation offered by the consultants who conducted the national case studies. This disparity apparently reveals a basic methodological weakness as many subjective decisions affect the way in which values are assigned to basic parameters.

e) System performance in the face of extreme events

Although the results of the case are conditioned by the gravity and probability of a major event as well as the extent of the affected zone, it is also worth briefly mentioning the main weaknesses and strengths that were detected on the level of risk management.

i) Colombia. In a severe earthquake affecting Bogotá, there would be a considerable shortfall in the capacity for rescue, fire fighting and hospital attention. Recovery and reconstruction programmes remain weak with no guarantee that they will be implemented either quickly or efficiently.

ii) Chile. The scenarios studied correspond to the worst earthquakes on record in the country. For such events emergency attention has been good but the same cannot be said of reconstruction. It was decided that reconstruction would likely be better than before thanks to improved organization and reduced vulnerability due to improved construction techniques and standards.

iii) Jamaica. In the event of a category 5 hurricane we can expect that basic services for attending to the emergency would be strongly affected, particularly transportation, hospital attention and the distribution of food and aid. Doubts remain as to whether the public would massively respond to evacuation instructions and whether planned shelters would be capable of providing necessary attention.

iv) Mexico. A major earthquake off the coast of Guerrero would produce massive economic losses and so many victims that emergency response capacity would be overwhelmed on the level of hospitals, rescue and recovery of basic services, above all in Acapulco and Mexico City.

v) Nicaragua. Amid a scenario similar to that of the earthquake of December 1972, damage in Managua would be very high owing to a lack of building maintenance and the continued use of deficient structural systems, particularly in housing. The rescue problems would be similar to those of 1972 owing to a lack of public safety and due to fires. The most significant difference would be on the level of hospital services.

IV. CONCLUSIONS

1. DISASTER RISK AND MANAGEMENT SYSTEMS IN COUNTRIES STUDIED

The five countries chosen for this study display considerably varied degrees of economic and human development. At the same time their societies are exposed to various types of hazards owing to their geographic location, physical characteristics and the uneven vulnerability levels arising out of distribution inequalities as well as the differing degrees to which proper risk management policies have been brought to bear. For these same reasons we can regard these five countries as a representative simple of the situations to be found in the region.

In most of these countries the amount of losses has tended to grow, but recent evaluations suggest that the same cannot be said about the number of those killed or injured in disasters. The proportional drop in the number of human victims reflects the increasingly positive effect of improved warning, evacuation and rescue systems, but such progress has yet be replicated on the level of endeavours aimed at lowering the physical vulnerability of assets at risk and of risk transfer mechanisms.

Average disaster losses per inhabitant vary from a low of 4 dollars a year in Colombia to a high of 26 dollars in Nicaragua. The other three countries report similar averages (between 11 and 12 dollars a year per person). While such losses in four of the countries fell far short of accounting for 1 per cent of per capita GDP, in Nicaragua they totalled 3.2%

These figures confirm that disasters in small countries can stall national economic development but would have a comparatively smaller impact on the national economies of large countries as only a small percentage of their national territory and population would likely be affected even when the local economic and social impact were extremely severe.

There are notable, proportional variations in the number of deaths from disasters experienced from country to country. The number in Colombia and especially in Nicaragua as a percentage of the total population are higher than those of the other three countries and easily outstrip the regional average. The high number of victims in Colombia apparently is due to the unusual presence in that country's statistics of deaths from lesser disasters.

There are also considerable differences between the institutional forms countries of the region have adopted for purposes of risk management. Chile is notable for the poorly structured state of its disaster management system, leaving to several cabinet-level ministries the individual responsibility of managing risk in its various phases. This includes those holding private concessions to manage the main vital sys-

tems, which are responsible for both *ex ante* and *ex post* prevention actions. The government's efforts are concentrated on issuing norms and guaranteeing that they are respected. Jamaica has a simple structure and the greatest degree of integration between the central and community levels. Colombia, Mexico and Nicaragua have the most structured systems in line with international recommendations, but institutional and economic limitations greatly impair the functioning of the system in Nicaragua.

Such diversity makes it difficult to define typologies in these countries' recent evolution and actions. A measure of the efficiency of the analysis of the results of the different strategies over time can be achieved by comparing the natural phenomena that have taken place and their socioeconomic impact. On that level, Chile probably has turned in the strongest performance. Generally speaking, there seems to be little correlation between management and its formal structure as it would appear to be more dependent on the country's degree of political development and the extent to which local or national governments function effectively.

In almost all of the countries there exists a formal or real separation between the system for attending to emergencies and the one in charge of reconstruction-prevention. Mexico is probably the country that has best integrated both tasks although the system suffers from a certain lack of coordination between the sectors in charge of these tasks.

One problem that appears to a lesser or greater degree in all of the countries studied is a paucity of experienced personnel working on an ongoing basis in disaster related tasks. There remains a generalized problem of constant turnover in both the technical and administrative posts. The weakening of technical teams at the main public sector institutions has undermined the capacity for attending to the main prevention and mitigation tasks.

In a number of countries responsibility a focus on decentralization has led to disaster risk management being increasingly entrusted to local governments, which frequently lack the necessary economic, technical and structural resources for effectively taking the necessary action, a critical weakness especially in the case of the smallest and weakest municipalities. In contrast, some of Colombia's largest cities have impressively developed their risk management systems.

The case studies' indicator readings for risk management performance reveal that all of the countries made progress between 1985 and 2000. This corresponds to the period in which all of the countries created their formal risk management structures except for Nicaragua, which established it as part of the improvements made in the wake of hurricane Mitch in 1998. Since 2000 progress has been marginal. The most significant indicator gains since then have been on the level of the performance of emergency response systems while much less pronounced gains have been achieved in the performance readings of prevention and especially mitigation. Chile is noteworthy for the low vulnerability of its main systems, which is apparent in the limited consequences suffered as a result of major events; this largely reflects a greater degree of compliance with norms and good prevention practices.

2. INFORMATION FOR RISK MANAGEMENT

a) Information for risk analysis and reduction

All of these countries have made considerable headway in improving the availability of information on disaster risk, especially with regard to hazards. Mexico and Colombia have the largest number of institutions in charge of compiling and recording natural hazards. Access to information is free in all of the countries, except en Chile, which also faces a problem in that information is disperse and lacks systemization. The publication of catalogues and inventories of past events is generally handled in a very careful manner in all of the countries, but none of them have matched the efforts of CENAPRED in Mexico.

Very encouragingly, the microzonification of seismic regions appears to have become common practice in major cities. It is important to carry through with these efforts so that this type of progress translates into regulations at the state and municipal levels such as those we have witnessed in cities such as Cali, Mexico City and Acapulco.

Decision makers have access to numerous catalogues of past events as well as well as hazard maps

although these tend to offer little detail on the local level. With the exception of seismic ones, hazard maps are qualitative. Local information is much more limited. The consultants report that hazard studies tend to be of a high quality.

Vulnerability studies are generally less common and of a lesser quality than research focused on hazards and are more useful for academic than operational purposes. It is surprising that more attention is not paid to such matters given the extent of vulnerability in many structures. This field of research warrants a look aimed at determining how to generate better qualitative and quantitative risk information with which to design improved prevention and financial management programmes.

Risk studies in the region that are based on risk indexes or estimates of economic losses for return periods are limited by the quality of the information available and the complexity of the phenomena involved. Such studies are sponsored by institutions such as the IDB and the World Bank and government entities. Those in charge of such research are generally academic institutions and government entities in charge of disaster prevention.

The risk studies of Mexico and Nicaragua are prepared by prevention and disaster risk management institutions and form part of medium- and long-term development plans. The information produced is of good quality although that of Nicaragua is not distributed on a governmental level. Chile's risk studies are primarily motivated by the occurrence of extreme events and tend to overlook the study of possible disasters in potentially hazardous zones with prolonged periods of silence from the phenomenon in question. The study in Jamaica did not report the existence of risk studies.

The experts have noted technical and methodological weaknesses in the conduction of risk studies that they attribute to a lack of a framework of reference. Nevertheless, there is optimism about the improvement observed in this situation as several consistent studies have been completed. There is a general appreciation of the frequent failure to reflect risk information in norms or regulations and not even in development plans.

The analysis of the RMI_{RI} indexes (on risk information) proposed by the second component of the project shows that in general, the indicators used to estimate the index have improved. The highest RMI_{RI} reading is that of Jamaica (estimated at 63 for 2003). It is followed by that of Chile at 60, Mexico 57, Colombia 40 and Nicaragua 30. These results are not congruent with the evaluation of the information obtained from the case studies of this report. One of the greatest discrepancies is posed by Jamaica: a country with one of the greatest informational weaknesses has the highest RMI_{RI}. The explanation of these disparities appears to be the use of indicators that rely on subjective judgements.

There are doubts as to the usefulness of national risk atlases and national hazard maps in cities and municipalities. The level of detail needed for local studies locales is not always contained in large-scale maps. Meanwhile, the spatial-temporal variation of vulnerability demands that the risk maps be constantly updated.

The choice of critical scenario used in the case studies was based on the analysis of record of the historical events and knowledge of the natural phenomena that threaten those centres with the greatest concentrations of population and infrastructure. In some countries they chose the phenomena that historically had produced the greatest losses per event.

Silence areas (or seismic gaps) and geological fault lines that have led to past events were postulated in the case of seismic events. All of the countries analysed reported that seismic events have led to severe disasters and regard them as potential critical events. The seismic events posed would affect the national capitals of each of the countries except in Chile. Jamaica, Mexico and Nicaragua show that hurricanes have caused considerable losses in recent history. Only Colombia includes rain-induced flooding as an accumulated phenomenon that can be seen as critical.

Although the studies of extreme events in the analysed countries were limited to a common methodological framework, they displayed differences in the probability of the event occurring, which could be explained by the differences in information. In almost all of the cases, the scenarios implied consequences that surpassed disaster management capacity in several aspects, including the financial one. Information for determining the spatial distribution of vulnerabilities, especially in relation to hurricanes, is another weakness that came to light.

Case study estimates on losses and population exposed were based on reliable and accessible information that is freely available except in some instances in Chile. The main problem reported during this phase of analysis was a lack of detail in the information for estimating losses such as a paucity of data on building materials and under appraisals of infrastructure costs. Informational voids were also encountered when calculating the number of people affected by the lateral disaster effects (climatic, lack of medical attention, fires, content action and post-disaster psychological effects).

Estimated losses account for between 6% and 23% of total event exposure. Except in Chile, losses to the extreme event were considerable (those of Mexico reached 3% of GDP). This can be explained because the area of influence of the events chosen in Chile excluded the main cities. The authors do not believe that events affecting large cities should be ruled out.

b) Information for disaster risk management capacity

Mexico and Nicaragua are noteworthy for having set up centres for the generation, compiling and distribution of specific information for the risk management system and the population. The centres of this type that have been set up on a regional basis for smaller countries [CEPREDENAC for those in Central America and CDERA for those of the Caribbean] have also made a significant contribution. Colombia and Chile lack such centres as such information is produced by academic institutions or on behalf of government agencies. Support from international bodies or the realization of studies and the production of information for disaster management has generally been important, especially for Nicaragua and Colombia.

There has been a good degree of acceptance of information by decision makers and users in general; however frequently there are calls for simplified but more precise and detailed instruments for detecting risk, as well as complaints that the information is not always available in a timely manner or in an accessible form.

In some of this programme's national workshops mention was made of the problem of repeating similar studies only to produce contradictory results, which leads to confusion between decision makers. Great importance is assigned to the need for the existence of institutional centres whose information is recognized by all interested parties.

The information generated from the managing of risk has concentrated on hazards. There is an even more pronounced lack of information regarding vulnerability and mitigation in general. Information on structural measures are to be found in the texts and norms of related special fields; however most of the available technologies have been developed in more advanced countries and are not necessarily proper for the countries of the region. There is a need to adapt available technologies and develop other original ones.

Often, norms governing mitigation works, zoning and land-use regulations simply do not exist or are obsolete, but the greatest problem is that they are frequently ignored and the authorities lack mechanisms for assuring their enforcement.

The monitoring of hazardous phenomena and public alert systems, especially with regard to major meteorological phenomena, have improved considerably but generally lack the ability to detect local effects that magnify event intensity and risk conditions. Another problem is the lack of maintenance of monitoring networks due to economic and technical problems, which leads to their abandonment after only a few years.

Significant progress has been made in getting the information out to the population. Public bodies and NGOs have made major efforts to inform about risk and self-protection measures. The communications media have been of great help with informational campaigns.

Despite such accomplishments, public opinion surveys reveal that the overwhelming majority of the population feels that it is not well informed and many of those polled say they have never been provided with any information on this subject. These responses largely reflect a lack of penetration by public informational campaigns. The public tends to display a limited ability to retain this type of information so such campaigns need to be repeated periodically.

Public information for public distribution regarding self-protection focus on measures needed during the preparation phase and the emergency. Efforts to

encourage mitigation actions in relation to the risk of non-engineered construction (particularly vulnerability reduction of self-built homes) have generally proven to have limited success. In most instances, housing damaged by earthquakes is rebuilt using techniques that are similar to those previously employed.

c) Information for financial risk management

The sources of information for documenting the financial management of disasters are varied and generally suffer from major voids. There is generally a lack of follow-up with regard to post-disaster actions. Data on the recovery of insurance payments is among the hardest to come by.

The risk responsibility policies of the countries range from those in which the central government assumes a high percentage of risk, those where the private sector copes with the losses while the government deals with financing emergency expenses or reassigns funds originally assigned to other programs, and those in which international cooperation has become the principal source of financing although the government continues to assume its responsibilities. The extent to which risk transfer measures have penetrated also varies from country to country. However, it was revealed that the absence of central funds can be efficiently compensated for if locales authorities and government agencies have been afforded predetermined budget resources for attending to the eventual effects of catastrophes.

The existence of a central fund is often not reflected at the state, provincial or municipal level or matching-fund requirements are usually imposed as a condition for such local entities to access the federal fund. Both factors can weigh unfavourably on the continuity of social programmes in those entities whose funds are channelled into disaster response.

Many nationwide calamity funds are frequently used for rebuilding public sector property that it would have been advisable to insure. By drawing down the funds for such purposes, authorities abandon the responsibility of responding to the needs of the least protected segments such as non farm, informal sectors, which generally suffer the greatest disaster effects.

Only a minimum amount of resources are earmarked *ex ante* for disaster prevention and mitigation programmes. When funds are budgeted for such purposes they only account for a fraction of those allotted for emergency response.

Practically no cost-benefit studies have been conducted regarding mitigation investments that could considerably reduce disaster impact. Such studies are essential for achieving political support for obtaining funding for mitigation investments.

Catastrophic insurance and reinsurance penetration varies greatly from country to country but remains at modest levels despite the frequency of major disasters. Not all countries legally require that public property be insured. Within the private sector, such coverage is only common among major companies and corporations, especially in the tourism sector.

There is an increasing availability of coverage against seismic and hydro-meteorological threats to the farm sector, but the lowest-income and informal segments obtain only limited coverage or none at all.

3. METHODOLOGIES EMPLOYED BY THE PROGRAMME; THEIR VALIDITY AND USEFULNESS

a) Analysis of extreme scenarios

One of the main problems arising out of the development of an extreme-scenario methodology consists of determining the return period for the chosen events. Depending on the phenomena, determining its frequency of occurrence or exceedence becomes a rather subjective exercise, meaning that results are not comparable. Only in the cases of Colombia and Mexico, which have the most risk information, was it possible to justify the return periods.

Significantly, the case studies revealed that the disaster management systems of four of the analysed countries would probably be overwhelmed by an extreme event. This conclusion suggests two possibilities: that the methodology must be adapted to the demands of the extreme event or that the emergency response systems are designed in a less-than-conservative manner. The jury is still out on the exact return period that should be set for the various parts of the disaster management system as the consequences of failure vary depending on the system component in question.

The results of most of the extreme-event studies that were contemplated in the case studies are alarming in that they suggest that management capacity would be dramatically surpassed in some sectors such as hospitals and the supply of essential public services.

b) Analysis of economic losses

The importance of correctly applying a correct methodology for estimating the socioeconomic impacts of disasters to risk management goes without saying. We do wish, however, to stress the following points. Such an approach:

- Provides the authorities with elements for better judging how to disburse resources while taking into account the risks to which the different regions of each country have historically been exposed.
- Assumes the development of standardized procedures for evaluating and measuring the economic and social effects of disasters, contributing to the configuration of a systematic recording of their occurrence and effects.
- Supplies historical knowledge of the sites most damaged by natural phenomena or that pose the greatest risk to the public. In this way, it makes it possible to set priorities in the design and application of effective prevention measures. It also contributes to a safer localization of human settlements.
- Constitutes an important historical precedent for cost-benefit analysis regarding possible investments in mitigation and prevention.
- A historical analysis of the characteristics and socioeconomic impact of disasters is an important, if not crucial factor to the preparation of hazard maps, and supplies elements of vulnerability that are basic to the preparation of any national risk atlas.
- While timely evaluations of the socio-economic impact of disasters help governments to delineate reconstruction plans and estimates the extent of the foreign assistance needed, retrospective studies help orient risk management plans as well as long-term prevention and mitigation investments.
- The long-term, annual, average of fatalities and its breakdown on a regional level as well as data on the number of those injured or who suffered losses will supply elements necessary for estimating the number of shelters and the investment in healthcare, shelter and sanitation installations necessary to satisfy disaster demand in at-risk regions or on a national level.

V. RECOMMENDATIONS

1. FOR THE RISK MANAGEMENT DECISION MAKERS IN THE COUNTRIES OF THE REGION

a) Regarding disaster management strategies

DIAGNOSIS	RECOMMENDATION
Risk reduction should form part of developmental rather than emergency agendas.	• Adopt 'Hyogo Framework for Action' guidelines for promoting a culture of prevention and reducing disaster risk with an eye toward sustainable human development. • Promote: a) the strengthening of local capacities, b) the participation of all sectors, c) the use of resources endogenous to the countries, territories and communities involved. • Base disaster-risk reduction on the reality of the communities, taking into account the environment, the natural habitat and the people as the principal resources for achieving processes.
An efficient risk management system requires the participation of practically all sectors and levels of government. Participation can be achieved through a wide variety of organizational plans including those that imply tight government-public coordination and those that afford civil sectors almost total independence.	• Coordinated interaction between institutions, financial mechanisms, norms and policies must be achieved in order to arrive at an efficient operation with a holistic approach incorporating central and local government agencies, the general public, and business. • A key ingredient in an efficient management is to establish clearly defined lines of authority for each actor, as well as jointly agreed-upon, coordinated action plans.
The public risk (disaster) management system sometimes lacks the necessary hierarchy within the institutional organigram needed to assure that this issue becomes a national priority and that the measures and actions that are adopted are quickly and efficiently implemented.	• Management-system agencies must be granted the authority needed to coordinate the actions of the various sectors involved.
The management system, especially at a local level, frequently lacks personnel with the necessary training and experience for handling the various tasks involved in risk management.	• The management system must be armed with career professionals and avoid the common problem of constant turnover among technical personnel assigned to fundamental tasks.

b) Regarding information for risk analysis and reduction

DIAGNOSIS	RECOMMENDATION
Decision makers lack access to some information regarding risk issues and aspects of mitigation measures. The information that is available is not always prepared in the terms that decision makers require.	• The various phases of risk management, whether related to prevention or response, should be based on identifying and analysing risk. • It is useful to set up working groups between those generating and those using information with which to define product scope and content and for orientation on the best way to employ them. Vulnerability studies of critical infrastructure are fundamentally needed as the basis for implementing risk-reduction based rehabilitation programmes.
There is a frequent lack of funds necessary for the production, up-dating and distribution of information, especially in the case of resources for monitoring networks.	• Specific sources of financing must be established for the production and distribution of information needed for risk management, as well as rules and mechanisms for partially recovering such costs.
The information generated by differing groups of specialists is frequently incompatible, leading to confusion among decision makers. There have been positive experiences with integrating risk information in national or regional centres, but positive information flows have also been achieved in the absence of such centres.	• Proper terms of reference must be defined conducting national, regional and local risk studies for validating study results before they are employed in management activities. • Coordination agreements between information generators must be established as a way to avoid informational dispersion, duplication and incompatibility.

- The efforts Colombia and Mexico have made to achieve a system of information generation and risk monitoring should stand as an example for the other countries of the region.

c) Regarding the institutional structure of disaster risk management systems

DIAGNOSIS	RECOMMENDATION
Most countries of the region have developed a proper body of laws to back their institutional structure for handling disasters, but the standards related to risk reduction, especially the laws and plans on land management and building standards, have not always been fully developed or updated. Of even greater concern is the frequency with which such codes and standards are ignored.	• It is important to establish proper procedures to assure standards dealing with land management and building safety are correctly applied and enforced. It is essential to establish permanent vulnerability-reduction campaigns for both formal buildings self-built constructions. One key ingredient is making available information on appropriate technologies written for poorly skilled people.
Hydro-meteorological disaster risk is on the rise in the poorest communities because of factors such as human settlements being located in high-risk areas, the extent of environmental destruction and a lack of adequate infrastructure	• Programmes are needed for the building, improvement and maintenance of protection works against flooding and landslides in communities. • Attention must be paid to minor-disaster risks, which require detailed studies of local hazard and vulnerability conditions.
Structures that are critical to emergency response such as roads and other means of communication and hospitals are not always in conditions that would help assure that they would be in working order following a disaster.	It is important to launch maintenance and rehabilitation programmes for vital systems with the proper technical and financial support. Of particular importance is the execution of hospital rehabilitation programmes for guaranteeing that such facilities are up and running during disasters.

d) Regarding financial disaster risk management

Calamity funds

DIAGNOSIS	RECOMMENDATION
Calamity funds have proven to be very unstable and their resources are disproportionate to the historical needs associated with disaster impact.	• Assure steady resource flows and define the extent of the funds based on experience and the sectors to which the fund is expected to prioritise support.
The money from such funds is not always readily available.	• A balance should be maintained between the speed with which such funds are to be made available and the necessary rigor with which they must be applied.
A significant portion of the disaster funds are applied toward rebuilding public sector infrastructure, which legally or for practical reasons should be covered by insurance.	• Assign fewer resources from disaster funds to the rebuilding of public works and prioritize their use in attending to damage in the least protected segments such as non farm, informal sectors.
Often the central fund is not organized on the state, provincial or municipal level and access to the federal fund is frequently restricted to those who can assure matching funds.	• Assure that central disaster funds are replicated at a municipal or provincial level. Establish matching-fund requirements that are realistically within the realm of possibility of such local entities.

Ex-post financing

Relative importance of prevention actions

DIAGNOSIS	RECOMMENDATION
Very little funding is earmarked ex ante for disaster prevention and mitigation programmes. When resources are budgeted for such purposes, they account for a small fraction of the funds assigned for dealing with emergencies.	• Expand the funds available for prevention and mitigation activities. • Provide additional support for infrastructure maintenance programmes, especially for critical installations such as hospitals as their weaknesses have made exceedingly more expensive or complicated to assure such infrastructure. • Encourage progress on vulnerability studies, particularly on strategic installations for which there are convincing reasons to allot adequate resources for prevention and mitigation work. • Promote the financing of cost-benefit studies for mitigation projects on basic installations.

Catastrophic insurance

DIAGNOSIS	RECOMMENDATION
Catastrophic insurance is moderately available in the case of earthquake coverage, but not so for other types of natural phenomena.	• Promote the development of insurance for hydro-meteorological phenomena. • Given the difficulties local governments have in raising enough funds for catastrophic insurance, the central government could assume a percentage of the premiums in order to make it possible to acquire such policies. • Setting aside a percentage of calamity funds for such policies would be a very good investment.
In some countries laws requiring that public infrastructure be insured are ignored, especially in the case of provincial or municipal buildings.	• Work to assure that public infrastructure must be insured so as to reduce the financial impact of disasters.
There is a general lack of reliable and up-dated inventories of public sector property.	• Support funding for up-dating inventories of public sector property and infrastructure that they can be reliably insured.
Catastrophic insurance is very expensive in the region, in part due to the frequency of disasters but also due to specific practices in the selling of insurance	• The public sector should try to achieve economies of scale in assuring its real estate. Premiums can prove excessively high when each government agency separately takes out insurance on their infrastructure. • Island nations or countries with a limited degree of financial development should study the possibility of joining forces with other governments in the region with the idea of taking out insurance on a regional level, thereby diversifying risk and lowering the weight of the global reinsurance market on the region.

Historical series on disaster socio-economic impact

DIAGNOSIS	RECOMMENDATION
Only a few countries in the region have banks of continuous and real-term data on the socio-economic impact of disasters.	• Promote the creation of evaluation bodies within the risk-management institutional structure. • Solid data banks on the socio-economic impact of disasters broken down by type of disaster and without regional overlap are indispensable for the design of proper financial policy.

Disaster of extreme proportions

DIAGNOSIS	RECOMMENDATION
None of the countries studied had the financial capacity to cope with events of extreme proportions	• Study the possibility of establishing a resource pool for catastrophic insurance with the regional or sub-regional financial organizations or institutions that allow one of the member countries to cope with an eventual extreme disaster.

2. THE ROLE OF INTERNATIONAL AGENCIES

Financial and international donor institutions should conduct projects and actions for improving the availability and quality of information for risk management and in this was diminish the negative impact of disasters. Below we list some suggestions in this regard.

- Effectively prove that determine that in the development of prevention and mitigation projects that proper attention is given to security in disaster situations and that the measures necessary for risk mitigation have been taken.
- Improve the efficacy of coordination mechanisms between the technical support teams that international bodies offer so as to avoid a duplication of efforts and obtain compatible results that can support the national strategy.
- Promote the development and distribution of methodologies and techniques for developing risk information systems that properly take into account hazards and vulnerabilities. Promote regional or sub-regional workshops on this issue in the countries that have made the greatest advances, such as Colombia and Mexico, and distribute their experiences.
- Contribute to the standardization of terms used in risk management so as to facilitate cross-country comparisons.
- Develop methodologies for evaluating progress in prevention actions within a country's risk management policies.
- Provide technical support to the countries so that they may, in the most favourable terms, expand on catastrophic risk transference through insurance and reinsurance.
- Make known damage evaluation methodologies (that of ECLA and others) employing common criteria that make it possible to compare and integrate results.
- Finance vulnerability studies and criteria for the rehabilitation of critical installations.
- Promote the use of cost-benefit studies for mitigation investments and the development of related methodologies.
- Finance mitigation works in those countries that are relatively least developed.
- Provide support, above all for the least developed countries, so that the results of related studies are put into practice, including support for the extended operation for the systems that have already been developed (monitoring networks, alert systems, and informational systems).

3. PROPOSAL FOR FURTHER PROGRAMMES ON THIS TOPIC

The diagnosis made in this programme on the level of risk management information needs in the countries of the region reveal some methodological differences that could be overcome with additional studies promoted by the same international development agencies. The main projects in this regard would include:

- Standardize risk information and its components. This would not involve imposing unified methodologies and products, but rather agreeing on common criteria for producing information needed in relation to the various types and scales of disaster phenomena, as well to the socio-economic conditions in affected zones.
- Improve risk indicator and management methodologies. This demands simplifying the processes for obtaining the various indexes while at the same time achieving more reliable results. The main objective in applying the methodology should be to measure index variations over time and encourage index progress while correcting management deficiencies.
- Standardize risk information and its components.
- Improve the methodology for extreme event scenarios. Scenarios constitute a useful tool for detecting disaster-management needs and deficiencies. The main challenges of the current methodology primarily involve the volume and complexity of the required information. It is useful to think of simplified procedures for local scenarios that base contingency plans on more detailed contingency plans and methods

for events with a broad area of influence with which to evaluate national or regional strategies for the financial management and operational handling of disasters.

- Produce and make widely known vulnerability reduction techniques for low-resource communities. The development of appropriate technologies should be associated with broader programmes that tend to promote the socio-economic development of communities.
- Conduct cost-benefit studies that help to decide which part of catastrophic infrastructure risk should be transferred to the insurance market and which should be assumed by the government.

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REFERENCES

A. Lavell (2002), *Local risk management: Ideas and notions relating concept and practice*, CEPREDENAC-PNUD, 2003.PNUMA, 2000, as quoted in the document: Disasters and Human Settlements. Situation in the Caribbean Basin, UN-HABITAT.

Argudo J., F. Bravo, and R. Yela (1992), *Metodología para la reducción de la vulnerabilidad seismica de Escuelas y Bibliotecas en Guayaquil*.

Baraqui, Jaime (2004), "Aspectos Metodológicos y de Estrategias", document from the IDB/CEPAL Project, May 12.

Bitrán, Daniel (2006), "Evolución Retrospectiva del Impacto Socioeconómico de los desastres y consideraciones metodológicas para llevarla a cabo". http://www3.cepal.org.mx/iadb-eclac-project/05.html.

_____ (2006), "Metodología abreviada de evolución de daños" . http://www3.cepal.org.mx/iadb-eclac-project/05.html.

Boroschek, Rubén (2006), "Estudio Nacional de Chile", Project IDB-CEPAL Programa de información para la gestión de desastres. Componente 1. Información a través de estudios casos piloto http://www3.cepal.org.mx/iadb-eclac-project/05.html.

Cardona, Omar Darío (2005), "Indicators of Disaster Risk and Risk Management: Program for Latin America and the Caribbean. IDB, Special Report, Department of Sustainable Development. Washington D.C. http://idea.unalmzl.edu.co.

CENAPRED, "Características e Impacto de los Principales Desastres ocurridos en la República Mexicana", Vols. 3, 4, 5, 6 and 7.

_____ (1994), "Atlas Nacional de Riesgos", Dirección de Protección Civil, Mexico's Interior Ministry, Editorial Mac, S. A. de C. V., Mexico.

_____ (2003), "Guía Metodológica para el Análisis del Peligro, Vulnerabilidad, Riesgo y Pérdidas Causadas por Desastres Naturales o Antropogénicos y su Reducción y Prevención", Instituto de Ingeniería de la UNAM and Mexico's Interior Ministry.

_____ (2004), "Guía Básica para la Elaboración de Atlas Estatales y Municipales de Peligros y Riesgos". Serie Atlas Nacional de Riesgos.

CEPAL (2005), "Estudio Económico para América Latina".

_____ (2003), "Handbook for estimating the socio-economic and environmental effects of disasters", ECLAC.

_____ (2006), "México: Evolución Económica durante 2005 y Perspectivas para 2006".

_____ (2000), "Desastres, un tema de desarrollo: La reducción de la vulnerabilidad frente a los desastres", CEPAL-México, March.

Coordinación Técnica (2005), "Evalución de escenario extremo" http://www3.cepal.org.mx/iadb-eclac-project/05.html.

_____ (2005), "Analytical Framework for National Case Studies", http://www3.cepal.org.mx/iadb-eclac-project/05.html.

D. Guha-Sapir, D. Hargitt and P. Hoyois (2004), *Thirty Years of Natural Disasters 1974-2003: the Numbers*, CRED/UCL Presses.

Delnet Program (2006), Specialization in Sustainable Local Development and Disaster Risk Reduction - Theoretical Framework, Delnet ILO/ICT.

_____ (2006), "Disaster Risk Reduction: A Call to Action", at Delnet Journal – ILO International Training Centre @local.glob (No. 3). Complete version at: http://www.itcilo.org/delnet.

DRM (World Institute for Disaster Risk Management) (2003), "Evaluation of Inter-American Development Bank's Operational Policy on Natural and Unexpected Disasters", September.

IDB/ECLAC Project (2007), "Basic Methological Document", http://www3.cepal.org.mx/iadb-eclac-project.

IADB (2005), "Bank Action Plan for Improving Disaster Risk Management 2005-2008." Washington, DC IDEA.

IADB–ECLAC–IDEA (2004), "Disaster Risk and Management Indicators", Manizales, Colombia, April 2004. http://idea.unalmzl.edu.co.

IDB (2000), "Facing the Challenge of Natural Disasters in Latin America and the Caribbean: An IDB Action Plan". Washington, DC.

International Federation of Red Cross and Red Crescent Societies, *World Disaster Reports*, several years.

Ordaz, Mario (2006), "Estudio Nacional de Mexico", Project IDB-CEPAL, Programa de información para la gestión de desastres. Componente 1. Información a través de estudios casos piloto 2006 http://www3.cepal.org.mx/iadb-eclac-project/05.html.

Reinoso, Eduardo (2006), "Estudio Nacional de Nicaragua", Project IDB-CEPAL, Programa de información para la gestión de desastres. Componente 1. Información a través de estudios casos piloto http://www3.cepal.org.mx/iadb-eclac-project/05.html.

Smith, David (2006), "Jamaica Country Report", IDB-ECLAC Information and Indicators Programme on Disaster Risk Management. Component 1. Risk information through national pilot case studies, http://www3.cepal.org.mx/iadb-eclac-project/05.html.

UNDP (2004), A Global Report – Reducing Disaster Risk: A Challenge for Development. Geneva.

United Nations (2002), Living with Risk, a global review of disaster reduction initiatives, Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR), Geneva, July.

Wagner, J-J, A. Kreimer, F. Romero and M. Hernandez (2001), "Benchmarking of Countries with the Natural Hazard Apparent Vulnerability Indicator", World Bank, Washington, D.C.

Yamín, Luis Eduardo (2006), "Estudio Nacional de Colombia", Project IDB-CEPAL Programa de información para la gestión de desastres. Componente 1. Información a través de estudios casos piloto, http://www3.cepal.org.mx/iadb-eclac-project/05.html

APPENDIX I

GLOSSARY

Emergency relief/response. The provision, attention to or management of an emergency situation includes plans, structures and systems for coordinating the actions of the government with those of non governmental organizations, groups of volunteers, civil organizations and international aid for responding to emergencies in the broadest sense.

Disaster. An event that is generally sudden and unexpected that causes damage, losses and a temporary paralysing of activities in a specific area, and which affects a significant portion of the population. Depending on the specific phenomenon that cased the event, disasters can be classified into two groups: those caused by natural phenomena and those that are a result of human activity. The main primary effects of a disaster include the loss of life and injuries, the loss of goods, damage and the interruption of basic services, damage to infrastructure, the social and physical disorganization of a community and organic and behavioural disturbances in peoples' lives. The social disorganization that ensues for an extended period of time following an event is manifest in a deterioration of living conditions, and a lack of employment or under-employment opportunities. In short, it is expressed by a deterioration of the general quality of life.

Critical scenario. A hypothetical situation in which an event of great intensity or vast area of influence unfavourably affects a specific region or human settlement. Critical scenarios are identified based on the distribution of exposed goods, vulnerabilities and hazards in the region under analysis. Given that some factors that determine the scenario vary by the seasons or hours, it is necessary to anticipate the moment at which the most adverse conditions will coalesce.

Risk management. According to the most widely accepted definition this consists of "the systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters" (United Nations' International Strategy for Disaster Reduction).[45] Risk management includes actions and policies implemented in by countries in order to avoid or reduce the loss of life, goods, infrastructure and environmental habitat to disasters. A strategy for lowering risk should, therefore, be focused on managing each and every component that determines risk. Its tools are the analysis, operational management and financial management of risk.

45 *Living with Risk, a global review of disaster reduction initiatives*, Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR), Geneva, July 2002.

Financial management of risk. All of a country's policies for assigning financial resources for reducing risks and impact prior to when a disaster occurs, the resources needed dealing with emergency response, rehabilitation and reconstruction once the event occurs, and the application of mechanisms that tend to reduce the financial effects on a country through risk transference

Disaster risk management. The operational handling of risk management strategies. This category extends from a variety of activities that must be conducted during the **pre-disaster** phase or prevention activities as well as those related to the **post-disaster** or attention and reconstruction phases. For each of these it is necessary to have available the information needed by decision makers, for the general public that might be affected, and the information media.

Mitigation. Structural and non structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards such as:[46]

Prevention and mitigation works. Hydraulic works for the prevention of flooding and drought, canals for diverting water flows, storm drains and other fluvial defences, contention walls and similar constructions), as well as vulnerability studies of strategic installations and vital lines or plans to implement them

Non structural mitigation measures. Non-engineered measures that reduce vulnerability to hazards: land-use planning and management regulations; building codes and their enforcement; zoning according to degree of hazards; reforestation of costal areas and hill/mountainsides; government educational and training efforts, and public involvement in mitigation works

Hazard. The degree to which a place or human settlement is threatened by natural phenomena or other types of events over a specific period of time. Hazards can be classified by their origin: natural, technological and social. The complexity and interrelation of the phenomena that may pose such threats lead to nuances in deciding the manner hazards should be designated and classified

Risk perception. Peoples' perceptions of the risk they run. The objective of a risk perception study is to delineate the sectors of society based on their degree of risk perception and eventually to compensate for any weaknesses in perception with useful information regarding past events in the living memory of community members. The methodology for these studies may be based on polling techniques and surveys

Emergency planning. All of the measures needed for the efficient handling of a crisis produced by a natural phenomenon. The principal aspects consist of contingency plans for scenarios; preparation and resources for attending to emergencies; evacuation plans and shelters, the role of the armed forces and non governmental organizations; budgeting for emergencies. Other provisions involve assuring the presence of alternative routes, redundancies in the healthcare system and the provision of water for sanitation systems.

Preparedness. All those activities and measures taken in advance to ensure effective response to the impact of disasters, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations. This involves the existence of observation, forecasting, public-warning systems and networks for measuring hydro-meteorological, geological and anthropogenic hazards and fluid communications systems that reach the most remote communities

Prevention. The combination of activities designed to avoid the frontal impact of hazards and means to minimize related environmental, technological and biological disasters. Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters when it is combined with public awareness and education campaigns on disaster risk reduction that help to reshape attitudes and behaviour so as to promote a 'culture of prevention'".[47]

Risk. The results arising out of the interaction of hazard, vulnerability and exposure. This interaction makes for the possibility of harmful consequences or expected losses (economic, physical, social and environmental) amid certain sectors of society. A risk is said to exist

46 *Living with Risk,* ISDR.

47 *Living with Risk,* ISDR

when a possibility of such losses arises as a result of all three factors coalescing.

Value or Exposure. The dimension and cost of a region's goods that might be susceptible to losses from a threat. Such exposure extends to infrastructure, the populace, economy and production. Determining the value of exposure becomes more complicated depending on the size and diversity of a region.

Physical vulnerability. System propensity to suffer damage and losses owing to interaction with potentially hazardous external and internal processes. This is a relative property depending on the characteristics of each system and its susceptibility to the type of threat to which the system is exposed.

Social vulnerability. Propensity of human communities to suffer damage from a specific hazard depending on a series of socioeconomic, psychological and cultural factors. Social vulnerability to natural phenomena is greatest among the poorest people in developing countries owing to a lack of information and resources with which to take the appropriate measures.[48] Within this group, children, women and the elderly are seen as being the most vulnerable.[49]

48 During the June 2001 earthquake in Arequipa, Peru, the 16 people who were pulled out to sea when the first wave receded could have saved themselves if they had been familiar with how tsunamis work.

49 Most of those who died from the Kobe earthquake belonged to these groups.

APPENDIX II

SOURCES OF INFORMATION USED IN THE ANALYSIS OF EXTREME EVENTS FOR THE CASE STUDIES

Colombia

- Poblaciones de las principales ciudades, Censo 2005, DANE.
- Mapa de Seismic threat, Normas seismics colombianas de 1998.
- Área construida de the cities capitales colombianas 2003, ERN Colombia.
- Mapa de microzonification seismic de Bogotá, UNIANDES.
- Vulnerability functions de las structures, Universidad de los Andes, CEDERI, ERN Colombia.
- Mapa Nacional de Zonas Inundables, IDEAM.
- Datos catastrales, prediales and de cultivos.
- Table de Costo Unitario por Metro Cuadrado de Construcción.
- Estudio "Strategy de transferencia, retención and mitigation del seismic risk en edificaciones indispensables and de attention a la comunidad del Distrito Capital de Bogotá", CEDERI.
- Estudio "Estimación de economic losses para diferentes scenarios de riesgo en public and private buildings en Bogotá and analysis economic del riesgo residual en el Distrito Capital de Bogotá, ERN Colombia.

Chile

- National Population and Housing Census, Instituto Nacional de Statistics.
- Censo Agropecuario, Instituto Nacional de Statistics and ODEPA.
- Encuesta Nacional de Industria, ENIA Instituto Nacional de Estadística.
- Statistics Hospitalarias del Ministerio de Healthcare, MINSAL.
- Information cartográfica digital, Comisión Nacional de Riego.
- Type of Housing Según Material Predominante en Paredes, National Population and Housing Census. INE, 2002.
- Producto Interno Bruto Regionalizado, 1996-2004, Banco Central.
- Number of Housings Según Daño v/s Materialidad de la Housing
- http://siis.reconstrucciontarapaca.mideplan.cl/

Jamaica

- Mapa de flooding del Río Cobre, Underground Water Authority.
- Criterio and conocimiento de the consultants acerca de las vulnerabilities existentes en la

infrastructure (de housing, de healthcare and vital lines) and en el comportamiento de la sociedad en previous events.

Mexico

- Statistics sobre el economic impact de los disasters, Centro Regional de Information sobre Disasters, CRID.
- Distribución de la población por entidad federativa 2005, INEGI.
- Mapa tectónico de Mexico, Servicio Sismológico Nacional.
- Zonas de ruptura de los grandes sismos de este siglo, Servicio Sismológico Nacional.
- Curvas de calibration de aceleraciones típicas propuestas por Ordaz et al, 1999.
- Damage statistics en edificios de la Ciudad de Mexico durante el sismo del 19 de septiembre de 1985, Noreña et al, 1989.
- Distribución del number of housings por tipo, Conteo Nacional de Población and housing, INEGI.
- Sistema RS-MEXVer. 2.1 desarrollado por ERN Ingenieros Consultores, S.C.
- Zonas seismics en el D.F. and Acapulco, Asociación Mexicana de Institutions de Seguros, AMIS.
- Zonificación Geotécnica del D.F. Serie Impacto socioeconomic de los disasters de Mexico. Characteristics del Impacto socioeconomic de los principales disasters ocurridos en Mexico en el periodo 1980-99.
- Camas de hospital dispuestas por ciudad. INEGI, Healthcare, Resources materiales para la healthcare.
- Zonas potenciales para la generación and recepción de tsunamis. Serie Fascículos "Tsunamis", CENAPRED.
- Index de Hazard por sustancias inflamables, Atlas Nacional de Riesgo.
- Ubicación espacial de la red, sitios de reparación luego del sismo de 1985 and mapa de hundimiento medio anual, Atlas Nacional de Riesgos.

Nicaragua

- Datos catastrales
- Estudio *Seismic vulnerability de Managua,* DRM-ERN and coordinado por la ES-SINAPRED.
- Mapa de Maximum acceleration of land, Revisión and Actualización del Reglamento Nacional de Construcción –INETER 2004.
- Mapa de index de marginalidad social por departamentos, Presidencia de la República.