INTER-AMERICAN DEVELOPMENT BANK

INDICATORS OF DISASTER RISK AND RISK MANAGEMENT

SUMMARY REPORT FOR WCDR

Program for Latin America and the Caribbean

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INFORMATION AND INDICATORS PROGRAM FOR DISASTER RISK MANAGEMENT

IADB - ECLAC - IDEA

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Program for Latin America and the Caribbean

SUMMARY REPORT FOR
World Conference on Disaster Reduction

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The reports of the program have been developed by Omar D. Cardona, technical director of the project, with the research background of the local team of experts of IDEA: Jorge E. Hurtado, Ann Catherine Chardon, Alvaro M. Moreno, Samuel D. Prieto, Luz Stella Velásquez, Gonzalo Duque. In the work have been involved some centres of excellence on risk management, in Mexico (UNAM) and Colombia (CEDERI, Universidad de Los Andes), guided by Mario G. Ordaz and Luis E. Yamín respectively. The research was completed with the technical assistance of Mabel C. Marulanda, Dora C. Suarez, Lina M. López, Juan P. Londoño, Gabriel J. Cardona, Martha L. Carreño, César A. Velásquez, Jairo A. Valcarcel, Manuel B. Puerto, Antonio Zeballos, Sandra Santacruz, Sina del Rosario Cabral and Fernándo Ramírez.

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PROLOGUE

Disaster risk management needs risk "dimensioning", and risk sizing signifies to take into account not only the expected physical damage, victims and economic equivalent loss, but also social, organizational and institutional factors. The difficulty to achieve effective disaster risk management, in part, has been the lack of a comprehensive conceptual framework of disaster risk, facilitating its evaluation and intervention from a multidisciplinary perspective. Most existing indices and evaluation techniques do not express risk in words adequate for the diverse types of decision-makers and they are not based on a holistic approach that invites intervention.

It is necessary to make risk "manifest" in different ways for the planning agencies in charge of the economy, the environment, housing, infrastructure, agriculture, or health, to mention but a few relevant areas. It is not the same, for example, to talk about risk to a mayor or a community at the local level and to a government authority of national order. If risk is not made manifest in a suitable way such that it attracts the attention of the stakeholders, it will not be feasible to move forward decidedly in the reduction of disasters.

Risk is clearly most detailed at a micro social or territorial scale. As we aggregate and work at more macro scales, details are lost. However, the decision-making and information needs at each level are certainly different. The social actors and the stakeholders are usually not the same. Therefore, appropriate evaluation tools are necessary to facilitate problem understanding and to guide decision-making; it is fundamental to understand how vulnerability is generated, how it increases and how it progressively accumulates. In addition, it is necessary to benchmark the disaster risk management "performance" to facilitate access to relevant information by decision-makers, thus facilitating the identification and proposal of effective policies and actions.

Taking into account the abovementioned issues, the objective of this program is to facilitate access to relevant information on disaster risk and risk management by national decision-makers, thus making possible the identification and proposal of effective policies and actions. The system of indicators herein proposed permits the benchmarking of each country in different periods, from 1980 to 2000, and cross-national comparisons in a systematic and quantitative fashion. It assists the move toward a more analytically rigorous and data driven approach to risk management decision-making. This system of indicators enables:

- Representation of disaster risk at the national level[1], allowing the identification of key issues relating to their characterization from an economic and social point of view.
- Risk management performance benchmarking of the different countries[1] to determine performance targets for improving management effectiveness.

This system basically attempts to represent a series of risk factors that should be reduced through public policies and actions aimed at vulnerability reduction and the maximization of the resilience and coping capacity of the population when faced with dangerous phenomenon. These factors are, in general, represented by indicators available in international data bases. Due to a lack of parameters, the need to propose some qualitative indicators measured on subjective scales is unavoidable. This is the case with risk management indicators. The weighting or pondering of some indices has been undertaken using expert opinion and informants at the national level. Analysis has been achieved using numerical techniques that are consistent from the theoretical and statistical perspectives.

Each index has a number of variables that are associated with it and empirically measured. The choice of variables was driven by a consideration of a number of factors including: country coverage, the soundness of the data, direct relevance to the phenomenon that the indicators are intended to measure, and quality. Wherever possible we sought to use direct measures of the phenomena we wanted to capture. But in some cases, “proxies” had to be employed. In general we sought variables with extensive country coverage but chose in some cases to make use of variables with narrow coverage if they measured critical aspects of risk that would otherwise be overlooked.

[1] A demonstrative application in one country has also been made to illustrate the use of this methodology at the sub-national and urban level.

INTRODUCTION

The need for a system of indicators for disaster risk management

Risk is not only associated with the occurrence of intense physical phenomenon but also with the vulnerability conditions that favor or facilitate disaster when such phenomenon occur. Vulnerability is intimately related to social processes in disaster prone areas and is usually related to the fragility, susceptibility or lack of resilience of the population when faced with different hazards. In other words, disasters are socio-environmental by nature and their materialization is the result of the social construction of risk. Therefore, their reduction must be part of decision making processes. This is the case not only with post disaster reconstruction but also with public policy formulation and development planning. Due to this, institutional development must be strengthened and investment stimulated in vulnerability reduction in order to contribute to the sustainable development process in different countries.

In order to intervene in the causal factors of risk and reduce vulnerability through the strengthening of risk management capabilities of all types, existing risk must be identified and recognized as well as the possibilities of new risks of disaster. This implies the need to dimension, measure and monitor risk with the aim of determining the effectiveness and efficiency of intervention measures, whether these be of a corrective or prospective type. Evaluation and follow-up of risk is an unavoidable step for diverse social actors and those responsible for its management. That is to say, risk must be made manifest, it must be socialized and its causes identified. Consequently, evaluation and follow up must be undertaken using appropriate and ideal methods that facilitate an understanding of the problem and that can orient decision making.

The system of indicators used herein attempts risk benchmarking using relative indicators in order to facilitate access to relevant information by national level decision makers which facilitates the identification and proposal of effective disaster risk management policies and actions. The proposed indicator system searches to represent risk and risk management at a national scale, allowing the identification of its essential economic and social characteristics and a comparison of these aspects and the risk context in different countries.

If this type of indicator model is to be easily used it must be based on the incorporation of a limited number of feasible indicators or indices which reflect aspects relevant to the formulation of actions by national level decision makers. This inevitably requires the identification of aggregated, coarse grain and averaged variables. The method offered here is of national character. However, an evaluation at the sub-national level and another at the urban level have been made, using a similar conceptual and methodological approach in order to illustrate the application of this model at the regional and local levels. The final goal of the present research program has been to fine tune and apply the methodology in a wide range of countries in order to identify different analytical aspects (economic, social, resilience etc.) which permit an analysis of the risk and risk management situation in the different countries. The integrated system proposed allows a holistic, relative and comparative analysis of risk and risk management (Cardona 2001/2004). The risk indicator program states in its project document that the work must contribute at a national level to:

a) an improvement in the use and presentation of information on risk with the aim of helping those responsible for the formulation of public policies to identify investment priorities for risk reduction (prevention-mitigation) and direct the post disaster recovery process;
b) providing the means for measuring the fundamental aspects of the vulnerability of countries when faced with natural phenomenon and their risk management capacities, as well as providing comparative parameters for evaluating the effects of their policies and investments in risk management; and
c) promote the exchange of technical information for public policy formulation and risk management programs in the region.

The research program will help fill an important information gap for national level decision making in the financial, economic, environmental, public health, territorial organization, and housing and infrastructure sectors. Countries will have a tool for monitoring and promoting the development of their risk management capacities. They will be able to observe their relative position and compare themselves to other countries in the region over time. Equally, the Inter-American Development Bank will have an important tool for orienting its policy dialogue and for programming assistance for risk management to member countries. This program will contribute to the Banks Action Plan and particularly to the promotion of its “Evaluation of methods available for estimating risk, establishing indicators of vulnerability and vulnerability reduction and stimulating the production and diffusion of wide ranging information on risks”. This links to one of its strategic fields of action: Risk information for facilitating decision making (Clark y Keipi 2000).

A measurement approach based on composite indicators

Efforts to measure risk and the effectiveness of risk management when faced with natural phenomenon, using a system of transparent, robust, representative, replicable, nationally comparable and easily understood indicators is a major challenge from the conceptual, scientific, technical and numerical perspectives. Any method used will have limitations when considered from different user perspectives. This is due in part to the complexity of what is to be measured and dimensioned and also due to restrictions as to what may be achieved. The acceptance, for example, of certain approaches and criteria with regard to simplification, comprehension and transparency in lieu of the easiness of use, the lack of data or the inherently low level of resolution of the information used, signifies the scarifying of certain scientific, technical and econometric characteristics such as exactitude and comprehensiveness. These are considered by some to be both desirable and unavoidable when dealing with risk.

Based on the conceptual framework developed for this indicator program (Cardona *et al* 2003a) a risk indicator system is proposed which represents the vulnerability and management situation of each country. Proposed indicators are transparent, relatively easy to periodically update and easily understood by public policy makers. Four components or composite indicators reflect the principal elements that represent vulnerability and show the advance of different countries in risk management. This is achieved in the following way:

1. The Disaster Deficit Index, *DDI*, measures country risk from a macro-economic and financial perspective when faced with possible catastrophic events. This requires an estimation of

critical impacts during a given exposure time and of the capacity of the country to face up to this situation financially.

2. The Local Disaster Index, *LDI*, identify the social and environmental risk that derives from more recurrent lower level events which are often chronic at the local and sub national levels. These particularly affect the more socially and economically fragile population and generate a highly damaging impact on the countries development.
3. The Prevalent Vulnerability Index, *PVI,* is made up of a series of indicators that characterize prevailing vulnerability conditions reflected in exposure in prone areas, socioeconomic fragility and lack of social resilience in general.
4. The Risk Management Index, *RMI,* brings together a group of indicators related to the risk management performance of the country. These reflect the organizational, development, capacity and institutional action taken to reduce vulnerability and losses, to prepare for crisis and efficiently recover.

In this way, the system covers different aspects of the risk problematic and takes into account aspects such as: potential damage and loss due to the probability of extreme events, recurrent disasters or losses, socio-environmental conditions that facilitate disasters, capacity for macroeconomic recovery, behavior of key services, institutional capacity and the effectiveness of basic risk management instruments such as risk identification, prevention and mitigation measures, financial mechanisms and risk transference, emergency response levels and preparedness and recovery capacity.

Seen from the numerical point of view, the *DDI* is a synthetic index that relates deductive type indicators and depends on the simple modeling of physical risk in function of a feasible extreme level hazard (scientific prevision or prediction). On the other hand, the *LDI* is a synthetic index using inductive type indicators related to the occurrence of past events with differing impact levels (memory and registers). The *PVI* as well as *RMI* are composite indices derived by aggregating quantitative and qualitative indicators. These indices have been constructed using a multi attribute technique and its component indicators have been carefully related and weighted.

The indicators and the variables used in their construction were chosen through an extensive review of the risk management literature, assessment of available data, and broad-based consultation and analysis. The following reports of this program present the details on the conceptual framework, the methodological support, data treatment and the statistical techniques used in the modeling (Cardona *et al* 2003a/b; 2004). Web page: http://idea.unalmzl.edu.co

a) "Disaster risk and risk management benchmarking: A methodology based on indicators at national level". Report of the program of indicators on disaster risk management in the Americas IADB-IDEA;
b) "Indicators for risk measurement: Methodological fundamentals". Report of the program of indicators on disaster risk management in the Americas IADB-IDEA;
c) "The notion of disaster risk: Conceptual framework for integrated management". Report of the program of indicators on disaster risk management in the Americas IADB-IDEA.
d) "Results of application of the system of indicators on twelve countries of the Americas" Report of the program of indicators on disaster risk management in the Americas IADB-IDEA.

This system of indicators has been designed to permit measurement and monitoring over time, the identification of insecure conditions and their causes, and in order to facilitate the grouping and comparison of countries using criteria related to hazard levels and the socio-economic conditions that affect vulnerability levels. The system of indicators, as outcome of the IADB-IDEA program, is a holistic approach to evaluation that will probably be increasingly accepted and used as one of the best options for representing risk and risk management situations. This is due to its flexibility, possible compatibility with other specific evaluation techniques, its complexity and lack of accuracy. Its strength rests in the ability to disaggregate results and identify factors that should be the objective of risk management actions, allowing the measurement of their effectiveness. The objective is to stimulate decision making. The concept underlying the method is one of control and not the precise evaluation of risk, a procedure and objective that is normally based on the concept of physical truth.

DDI - DISASTER DÉFICIT INDEX

This index deals with the economic loss that the analyzed country could suffer when faced with the occurrence of a catastrophic event and the implications in terms of needed resources to confront the situation. This implies a predictive analysis based on historical and scientific evidence and the dimensioning of the value of probably affected elements. This requires the definition of some arbitrary reference point in terms of the severity or period of return of dangerous phenomenon. This risk factor must be modeled in the most objective fashion taking into account existing restrictions as regards information and knowledge. The *DDI* captures the relationship between the demand for contingent economic funds and the economic losses that the public sector must assume and the economic resilience present in this sector, which corresponds to the availability of internal and external funds for restituting affected inventories.

$$DDI = \frac{MCE\ loss}{Economic\ Resilience}$$

Estimation of probable losses

Potential losses were calculated using a model that takes into account different hazards (which are calculated in probabilistic form according to the historical registry of the intensity of the phenomena) and the actual physical vulnerability of the elements exposed to such phenomena. This analytical and prospective model does not use the registry of losses (deaths and affected) in historical disasters but rather the intensity of the phenomena. From an actuarial perspective we must avoid making risk estimations in inductive form, based on previous damage statistics over short time periods. Modeling must be deductive both in evaluating the occurrence of high consequence and low probability events and in evaluating the levels of vulnerability of the exposed elements. Details of the technical foundations of the models used may be found in the methodology document (Cardona et al 2004). We attempted the same procedure as is used by the insurance industry where a reference point is established for calculating feasible losses, known as the Probable Maximum Loss, PML (ASTM 1999, Ordaz 2002) and whose period of return is fixed arbitrarily. In this case a Maximum Considered Event, *MCE,* has been defined for which it is relevant to plan corrective or prospective actions that allow a reduction of the possible negative consequences for each country or sub-national unit under analysis. The economic loss or demand for contingent funds (the numerator of the index) is obtained from the modeling of the potential impact of the *MCE* for three return periods: 50, 100 and 500[2] years, equivalent to 18%, 10% and 2% probability of exceedance in a period of 10 years of exposure.

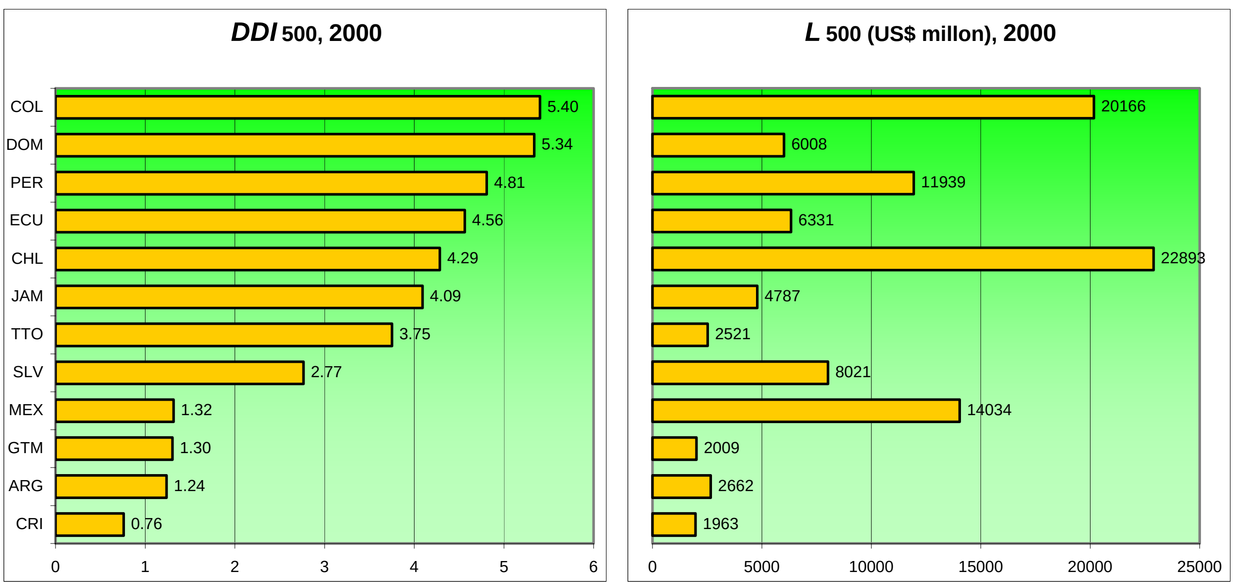
One piece of data that is very useful for risk assessment is the expected annual loss, *L,* which is defined as the expected loss value in any one year. Also it is known as the pure or technical premium. This value is equivalent to the annual average investment or saving that a country would have to make in order to approximately cover losses associated with future major events.

[2] The majority of existing construction codes takes as a basis the maximum possible intensity of events in approximately a 500 year time period. Especially important civil constructions are designed for maximum intensity events of several thousand years. However, the majority of buildings and public works constructed in the 20th century have not been designed to these security levels.

Possible funds available to government

Economic resilience (the denominator of the index), on the other hand, represents the possible internal and external funds available to government, in its role as a promoter of recovery and as owner of affected goods, at the moment of the evaluation. Access to such funds has restrictions and associated costs and these must be estimated as feasible values according to the macroeconomic and financial conditions of the country. In this evaluation the following aspects have been into account: the *insurance and reassurance payments* that the country would approximately receive for goods and infrastructure insured by government; the *reserve funds for disasters* that the country has available during the evaluation year; the funds that may be received as *aid and donations*, public or private, national or international; the possible value of *new taxes* that the country could collect in case of disasters; the *margin for budgetary reallocations* of the country, which usually corresponds to the margin of discretional expenses available to government; the feasible value of *external credit* that the country could obtain from multilateral organisms and in the external capital market; and the *internal credit* the country may obtain from commercial and, at times, the Central Bank, when this is legal, signifying immediate liquidity. The *DDI* captures the relationship between the demand for contingent economic funds and the economic losses that the public sector must assume and its economic resilience, which corresponds to the availability of internal and external funds for restituting affected inventories. When the *DDI* is greater than 1.0 this means the economic incapacity of the country to cope with extreme disasters even where indebtedness is carried to a maximum. The greater the *DDI*, the greater the gap.

Figure 1. DDI and probable maximum loss in 500 years

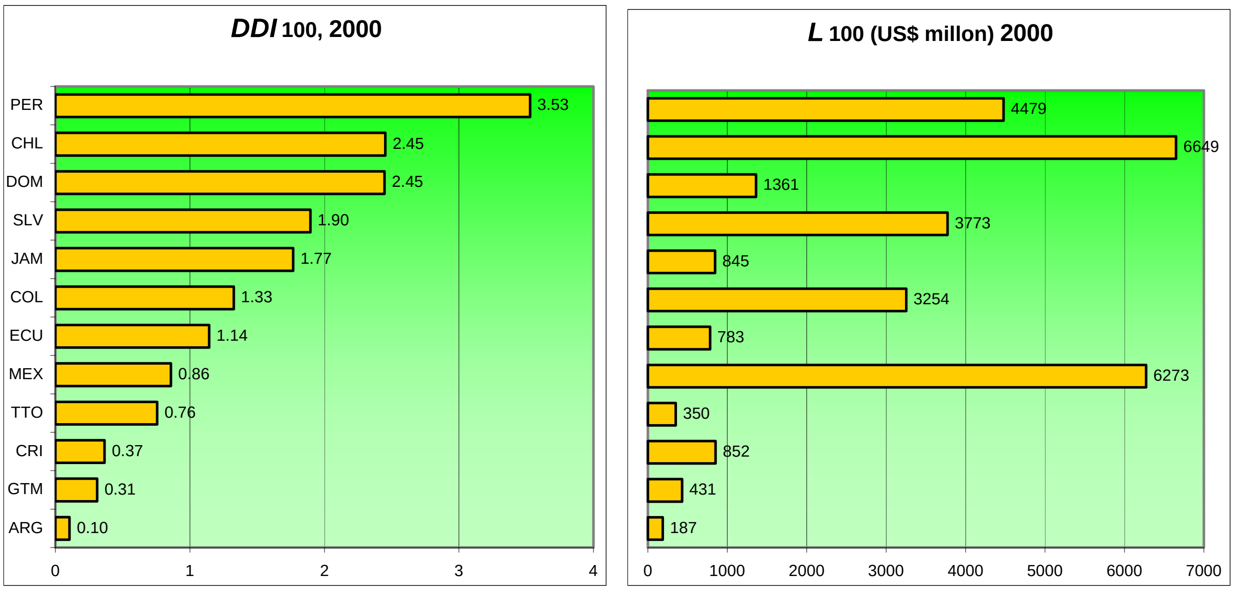


If constrictions for additional debt exist, this situation implies the impossibility to recover. The left side of figure 1 presents the *DDI* for countries in 2000 with a *MCE* with a 500 year period of return (2% probability of occurrence in ten years). To the right, the maximum loss, *L*, for the government[3] is presented for the same period.

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

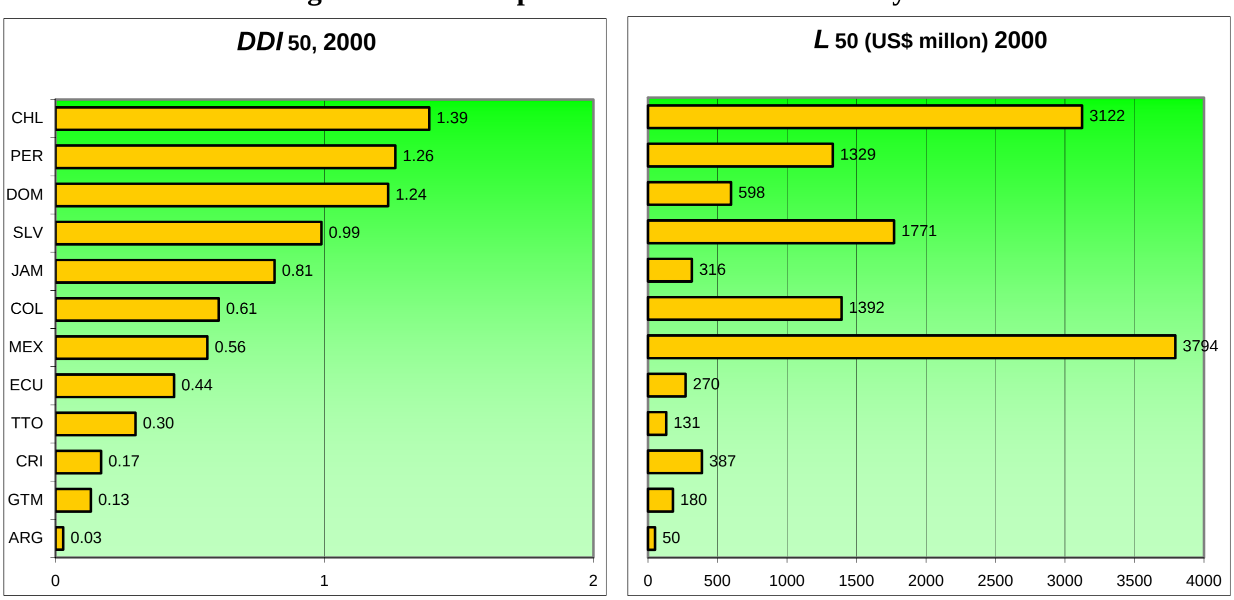
With the exception of Costa Rica all countries have a *DDI* greater than 1.0. The most critical situation is faced by Colombia with a *DDI* of 5.4 when faced with a loss of 20.2 billions of dollars. Figure 2 records the *DDI* and the potential losses in countries when faced with an event with a 100 year period of return. (5% probability of occurrence in ten years).

Figure 2. DDI and probable maximum loss in 100 years



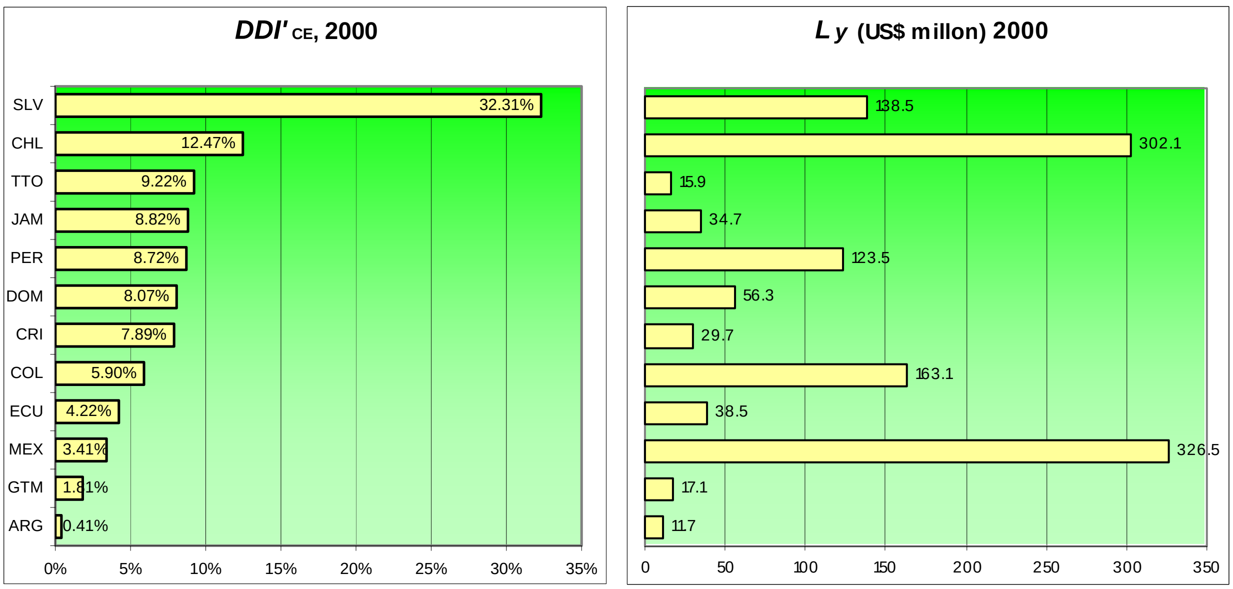
In this case the situation is still critical as regards access to reconstruction funds for seven of the twelve countries analyzed. The other five countries register a *DDI* below 1.0 but disaster impact would be very high particularly in the case of Mexico. Figure 3 registers the *DDI* and the potential losses when faced with an event with a 50 year period of return (18% probability of occurrence in ten years).

Figure 3. DDI and probable maximum loss in 50 years



The macroeconomic situation of four countries is still critical if this high probability event should occur. The potential losses are significantly high even though there is greater economic resilience in 8 of the 12 countries. In a complimentary manner and in order to help place the DDI in context a collateral indicator, *DDI'*, is proposed that illustrates which portion of the Capital Expenditure of a country corresponds to the expected annual loss or the pure risk premium. That is to say, what percentage of the investment budget would be needed to annually pay for future disasters. To the left of figure 4 the DDI'_{CE} for countries in 2000 is presented. To the right the annual expected loss, *Ly*, for government, is presented.

Figure 4. DDI' and annual probable loss



El Salvador shows the highest *DDI* in relation to capital expenditure. The annual payment for future disasters signifies 32% of such investment. Chile follows in importance with 12.5%. Only four countries would have values below 5% of the investment budget.

This type of indicators would allow national level decision makers to understand the budgetary implications for the country and the need to consider this type of information in financial and budgeting procedures (Freeman *et al* 2002b). These results ratify the need to explore economic measures for insuring public and private assets, the creation of reserves based on adequate loss estimation criteria, the contracting of contingency credits and, particularly, as regards the need to invest in structural and non structural prevention and mitigation in order to reduce potential damage and losses and the future economic impact of disasters.

LDI - LOCAL DISASTER INDEX

The objective of this index is to represent the proneness of a country to lower level or small scale disasters and the type of impact these have on local development. Such an index attempts to represent the spatial variability and dispersion of risk in a country as a result of small and recurrent events. This approach considers the significance for a country of the recurrent occurrence of small scale events that rarely enter international, or even national, disaster data bases, but which pose a serious and accumulative development problem for local areas and, given their overall probable impacts, for the country as a whole. Such events, which may be the result of socio-natural processes associated with environmental deterioration (Lavell 2003a/b), are associated with persistent or chronic events such as landslides, avalanches, flooding, forest fires, droughts and also lower scale earthquakes, hurricanes and volcanic eruptions.

In that many different types of event are registered in the DesInventar data base, we classified these in six different categories: geodynamic internal and external phenomena, hydrological, atmospheric, technological, and biological (Cardona *et al* 2004, appendix 12). However, in order to simplify with regard to the external geodynamic phenomena these were referred to colloquially as *landslides and debris flows* and internal phenomena were referred to as *seismo-tectonic*. Hydrological and atmospheric phenomena were grouped and referred to colloquially as *floods and storms*. In the same way, technological and biological phenomena have been known as *other* events. Therefore, the data base was standardized such as to take account of three variables: i) deaths, ii) number of affected and iii) direct losses –represented as the economic value in housing and crops– for four types of event: i) landslides and debris flows, ii) seismo-tectonic events, iii) floods and storms, and iv) other events. Due to this the indicators we propose for the *LDI* must be based fundamentally on numbers of deaths, affected persons and destroyed housing. We believe it to be convenient to sum the number of affected with the homeless given that in some countries one or the other denomination is used to depict the same thing. We also sum destroyed and affected housing, where an affected house is taken to be equivalent to 0.25 destroyed houses. The reposition of any destroyed house corresponds to the average cost of a social housing unit during the period of analysis. On the other hand, we propose that the value of one hectare of crops should be calculated on the basis of the weighted average price of usually affected crop areas, taking into account expert opinion in the country at the time of analysis.

The *LDI* is an index that captures simultaneously the incidence and uniformity of the distribution of local effects. That is to say, it accounts for the relative weight and persistence of the effects attributable to phenomena that give rise to municipal scale disasters. The *LDI* is made up of three sub indicators calculated with data from DesInventar on the numbers of dead and affected persons and losses in the municipalities and caused by the three generic types of event identified: landslides and mud flows, seismic-tectonic events, floods and storms and other events. The losses have been calculated in accord with average replacement costs of destroyed or damaged housing and the average cost of crops affected at the municipal level.

The higher the *LDI*, the greater the regularity in the magnitude and distribution of effects between all the countries municipalities due to the different types of hazard. Figure 5 shows the total *LDI* for countries in 2000 obtained by summing the three components related to deaths, affected and losses.

Figura 5. Total LDI

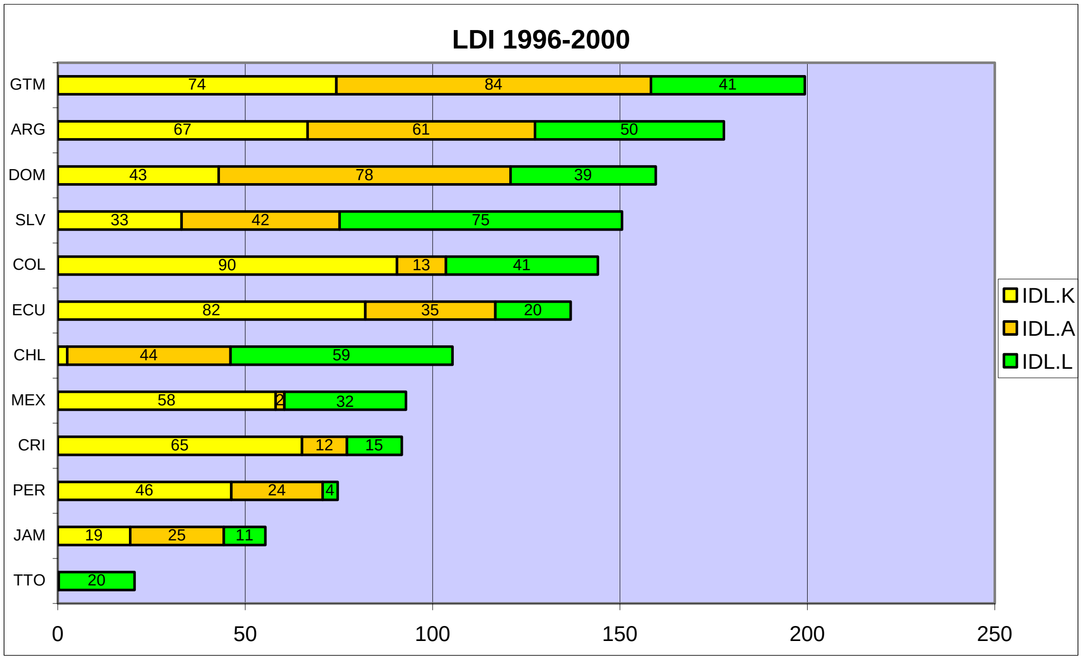
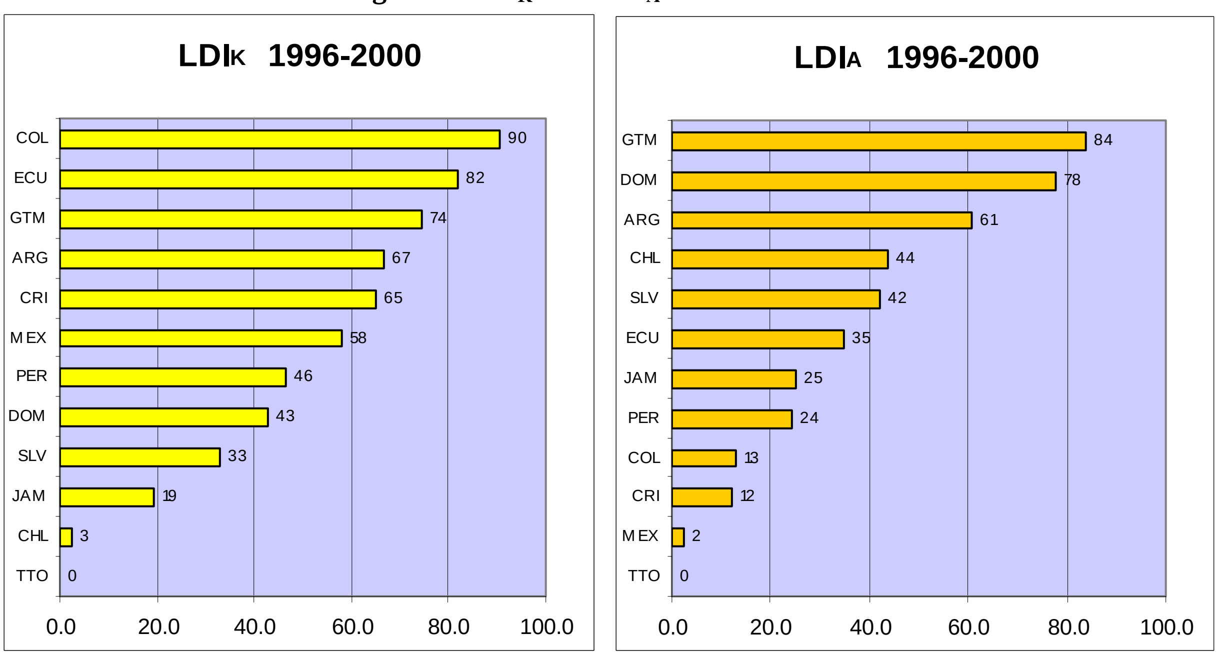


Figure 6 on the left, presents the indicator calculated for the period between 1996 and 2000 based on number of deaths, LDI_K, and to the right using figures on the numbers of affected, LDI_A.

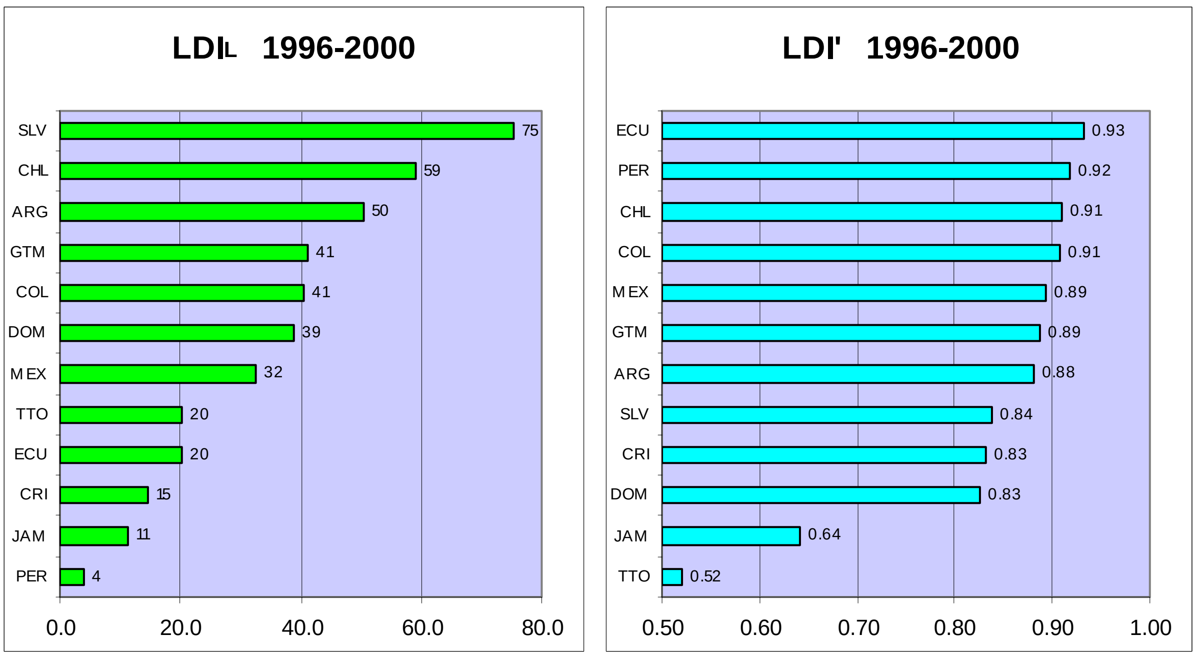
Figure 6. LDI_K and LDI_A for the countries



During this period Colombia and Ecuador show a greater incidence and regularity in the distribution of deaths between municipalities, whilst Guatemala and Dominican Republic show this for the number of affected. During this period disasters occurred that generated innumerable landslides and floods in a large number of municipalities in these countries. Colombia was affected by an earthquake in the coffee axis area in 1999 and by extensive flooding in the north of the country in 1995 and 2000. Guatemala was affected by hurricane Mitch and Dominican Republic by hurricane George in 1998.

In complimentary fashion, a *LDI'* has been calculated that takes into account the concentration of loss effects (direct physical damage) at the municipal level summed for all the events in all countries. This indicator demonstrates the disparity of risk within a country. Figure 7, to the left, presents the *LDI* calculated with figures for loss during the period 1996 to 2000. To the right the *LDI'* is shown for the same period.

Figure 7. LDI_L and LDI' for the countries



The LDI_L shows in relative form that during this period the losses in El Salvador were more similar and distributed between all the municipalities than in other countries. This signifies less variability of risk in the country. The *LDI'* shows that in countries such as Ecuador, Peru, Chile and Colombia a lower percentage of municipalities concentrate the majority of loss during the period. An *LDI'* of 0.93, 0.92 and 0.91 signifies that 10% of municipalities concentrate 85, 80 and 75% of losses respectively.

These indices are useful for economic analysts and sectoral officials, related to the promotion of rural and urban policy development, because they can detect the persistency and accumulation of effects of local disasters. They can stimulate the consideration of risk problems in territorial planning at the local level and the intervention and protection of hydrographic basins, and they can justify resource transfers to the local level with specific goals of risk management and the creation of social security nets.

PVI - PREVALENT VULNERABILITY INDEX

This index characterizes prevailing vulnerability conditions reflected in exposure in prone areas, socioeconomic fragility and lack of social resilience; aspects that favor the direct impact and the indirect and intangible impact in case of the occurrence of a hazard event. This index is a composite indicator that depicts comparatively a situation or *pattern* in a country. Given the importance of the concept of vulnerability, we propose for comparative evaluation. The characterization of inherent vulnerability conditions (Briguglio 2003b) serves to reiterate the relationship between risk and development (UNDP 2004). This is so to the extent that the vulnerability conditions that underlie the notion of risk are, on the one hand, problems caused by inadequate economic growth and, on the other hand, deficiencies that may be intervened via adequate development processes. Therefore, although the indicators proposed reflect recognized development aspects (Holzmann and Jorgensen, 2000; Holzmann 2001) they are presented here in order to capture the different circumstances that favor the direct physical impacts (exposure and susceptibility) and indirect and at times intangible impacts (socio-economic fragility and lack of resilience) of probable physical events (Masure 2003; Davis 2003). *PVI* is an average of these three types of composite indicators:

$$PVI = (PVI_{Exposure} + PVI_{Fragility} + PVI_{Lack\ of\ Resilience})/3$$

Indicators used for describing exposure, prevalent socio-economic conditions and lack of resilience have been formulated in a consistent fashion (directly or in inverse fashion, accordingly), recognizing that their influence explains why adverse economic, social and environmental effects are consummated when a dangerous event occurs. Each aspect is a set of indicators that express situations, causes, susceptibilities, weaknesses or relative absences affecting the country, region or locality under analysis and in favor of which risk reduction actions may be oriented. Indicators have been identified based on figures, indices, existing rates or proportions that derive from reliable data bases available worldwide or in each country.

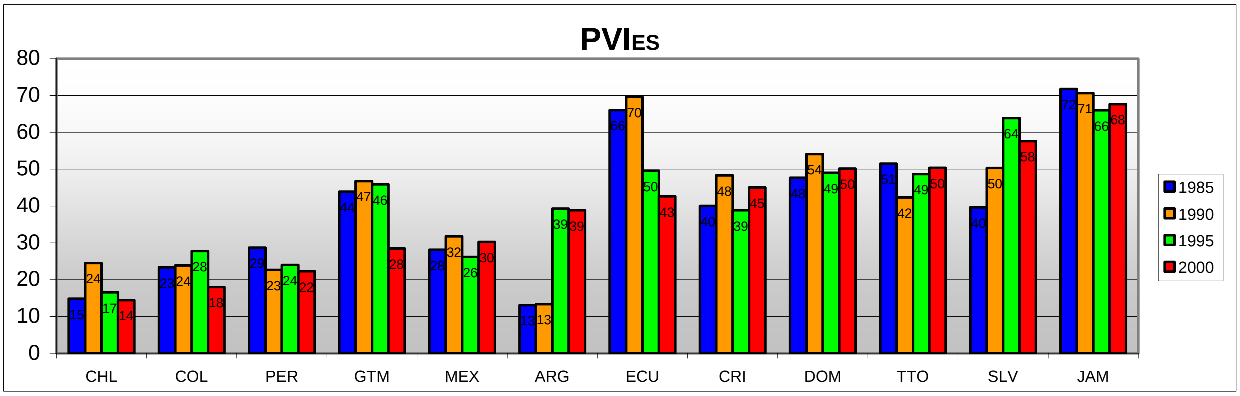
Indicators of Exposure and Susceptibility

In the case of exposure and /or physical susceptibility, ES, the indicators that best represent this are susceptible population, assets, investment, production, livelihoods, essential patrimony, and human activities (Masure 2003; Lavell 2003b). Other indicators of this type may be found with population, agricultural and urban growth and densification rates.

- ES1. Population growth, avg. annual rate (%)
- ES2. Urban growth, avg. annual rate (%).
- ES3. Population density, people/5 Km2
- ES4. Poverty-population below US$ 1 per day PPP
- ES5. Capital stock, million US$ dollar/1000 km2
- ES6. Imports and exports of goods and services, % GDP
- ES7. Gross domestic fixed investment, % of GDP
- ES8. Arable land and permanent crops, % land area.

These indicators are variables that reflect a notion of susceptibility when faced with dangerous events, whatever the nature or severity of these. "To be exposed and susceptible is a necessary condition for the existence of risk". Despite the fact that in any strict sense it would be necessary to establish if the exposure is relevant when faced with each feasible type of event, it is possible to assert that certain variables comprise a comparatively adverse situation where we suppose that natural hazards exist as a permanent external factor, even without establishing precisely their characteristics. Figure 8 shows the PVI_{ES} by country and period.

Figure 8. PVI for exposure and susceptibility



Indicators of Socio-economic Fragility

Socio-economic fragility, *SF*, may be represented by indicators such as poverty, human insecurity, dependency, illiteracy, social disparities, unemployment, inflation, debt and environmental deterioration. These are indicators that reflect relative weaknesses and conditions of deterioration that would increase the direct effects associated with dangerous phenomenon (Cannon 2003; Davis 2003; Wisner 2003). Even though such effects are not necessarily accumulative and in some cases may be redundant or correlated, their influence is especially important at the social and economic levels (Benson 2003b).

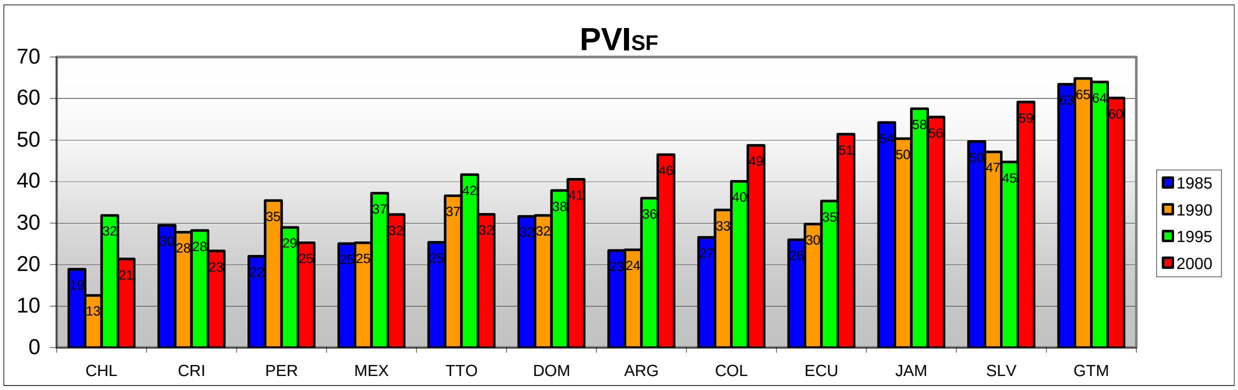
- SF1. Human Poverty Index, HPI-1.
- SF2. Dependents as proportion of working age population
- SF3. Social disparity, concentration of income measured using Gini index.
- SF4. Unemployment, as % of total labor force.
- SF5. Inflation, food prices, annual %
- SF6. Dependency of GDP growth of agriculture, annual %
- SF7. Debt servicing, % of GDP.
- SF8. Human-induced Soil Degradation (GLASOD).

These indicators are variables that reflect, in general, an adverse and intrinsic predisposition[4] of society when faced with a dangerous phenomenon, what ever the nature and intensity of these events (Lavell 2003b; Wisner 2003). "The predisposition to be affected" is a vulnerability

[4] Also referred to as inherent vulnerability by Briguglio (2003b) That is to say, socio-economic conditions of the communities that favor or facilitate negative effects by adverse physical phenomena.

condition although in a strict sense it would be necessary to establish the relevance of this affirmation when faced with all and individual feasible types of hazard. Nevertheless, as is the case with exposure, it is possible to suggest that certain variables reflect a comparatively unfavorable situation, supposing that the natural hazards exist as a permanent external factor irrespective of their exact characteristics. Figure 9 shows the PVI_{SF} by country and period.

Figure 9. PVI for socio-economic fragility



Indicators of Resilience (lack of)

The lack of resilience, *LR*, seen as a vulnerability factor, may be represented at all levels by means of the complementary or inverted[5] treatment of a number of variables related to human development levels, human capital, economic redistribution, governance, financial protection, collective perceptions, preparedness to face crisis situations, and environmental protection. This collection of indicators on their own and particularly where they are disaggregated at the local level could help in the identification and orientation of actions that should be promoted, strengthened or prioritized in order to increase human security (Cannon 2003; Davis 2003; Lavell 2003a/b; Wisner 2003).

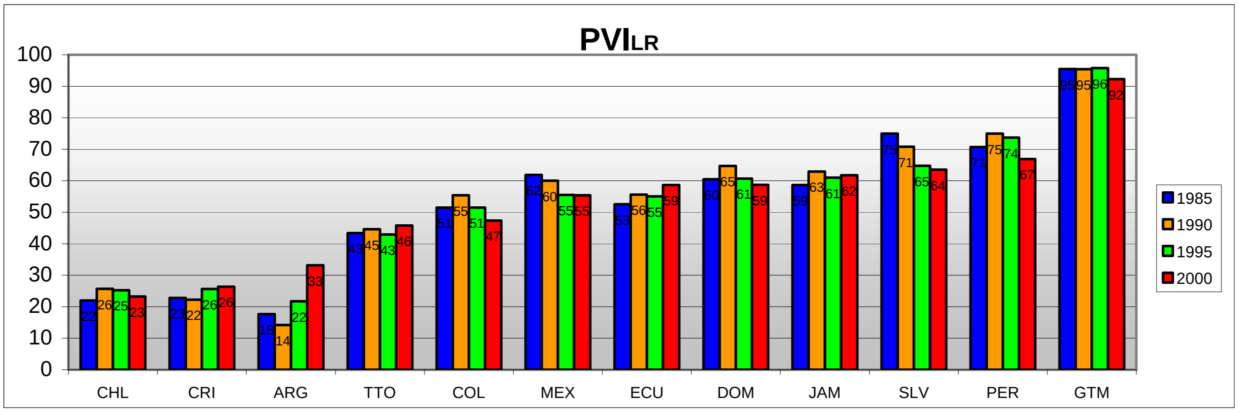
- LR1. Human Development Index, HDI [Inv]
- LR2. Gender-related Development Index, GDI [Inv]
- LR3. Social expenditure; on pensions, health, and education, % of GDP [Inv]
- LR4. Governance Index (Kaufmann) [Inv]
- LR5. Insurance of infrastructure and housing, % of GD [Inv]
- LR6. Television sets per 1000 people [Inv]
- LR7. Hospital beds per 1000 people [Inv]
- LR8. Environmental Sustainability Index, ESI [Inv]

These indicators are variables that capture in a macro fashion the capacity to recover from or absorb the impact of dangerous phenomena, whatever their nature and severity (Briguglio 2003b) "To not be in the capacity to" adequately face disasters is a vulnerability condition, although in a strict sense it is necessary to establish this with reference to all feasible types of hazard. Nevertheless, as with exposure and fragility it is possible to admit that certain economic and

[5] The symbol [Inv] is used here to indicate a reverse or inverted dealing of the variable ($\neg R = 1 - R$).

social variables (Benson, 2003b) reflect a comparatively unfavorable situation supposing that natural hazards exist as permanent external factors without establishing their precise character. Figure 10 shows the IVP_{LR} by country and period.

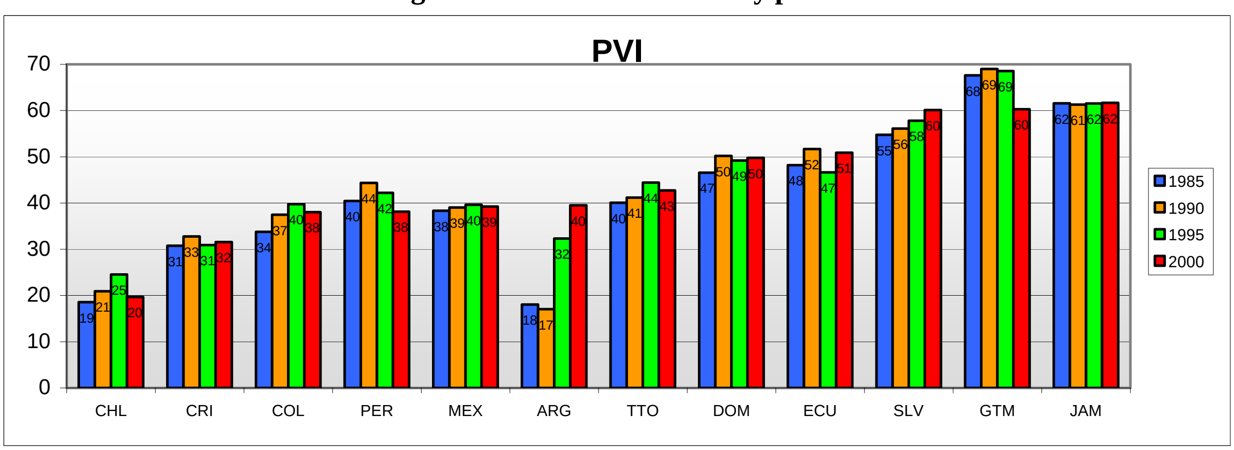
Figure 10. PVI due to lack of resilience



From the figures 8-10 one may conclude that the smallest countries, such as Jamaica, El Salvador, Dominican Republic, Trinidad and Tobago and Costa Rica systematically present greater PVI_{ES}. Argentina, Mexico, Costa Rica, Trinidad and Tobago, and El Salvador all present a relative increase over time. In the other countries one may conclude that there has been a slight decrease. Guatemala, El Salvador and Jamaica present a relatively high and more or less similar PVI_{SF} for all periods. Ecuador, Colombia, Argentina and Dominican Republic show a remarkable increasing in the rhythm of the PVI_{SF}. Other countries, like Trinidad and Tobago, Mexico, Peru, Costa Rica and Chile, present a slight decrease in their socioeconomic fragility over the last years. Guatemala, Peru and El Salvador present the greater values for the PVI_{LR}, although the value has diminished slightly during the last few years. Chile, Costa Rica and Argentina present greater resilience.

Figure 11 shows the *PVI* for the countries between 1985 and 2000.

Figure 11. PVI for countries by period

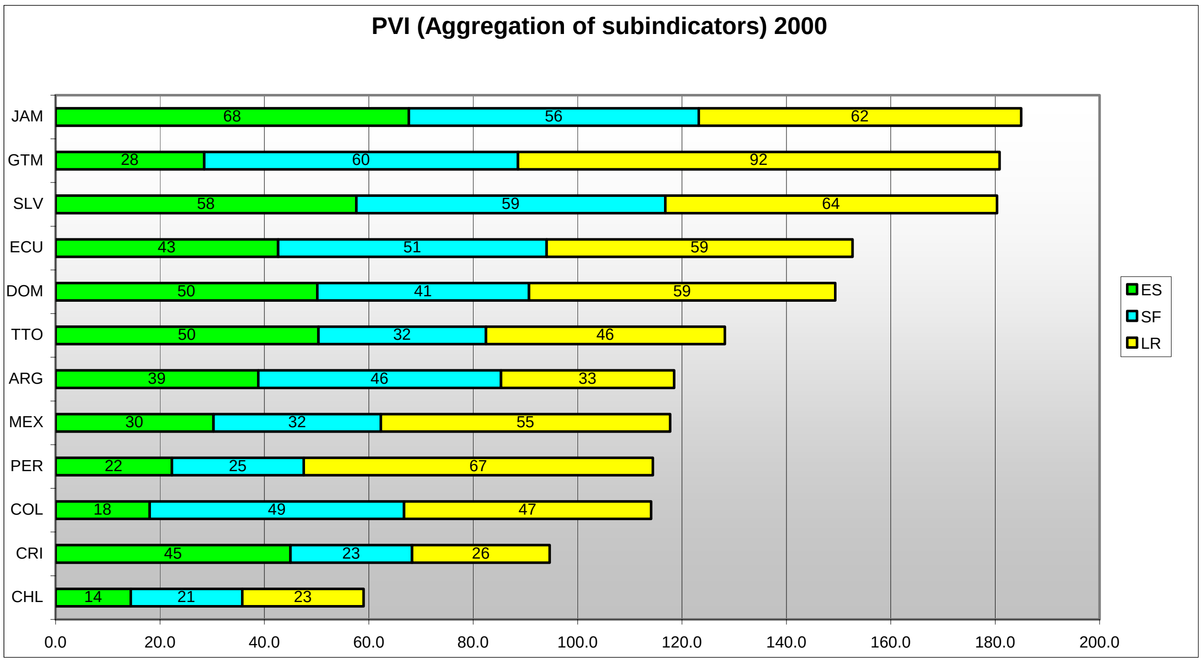


Although in 2000 Jamaica presents the highest value, that has been more or less constant throughout the years, Guatemala is the country that has presented the highest values from 1985.

Also high values of *PVI* in El Salvador appear where a clear tendency of increase throughout the years is detected. Other countries with remarkable values are Ecuador and Dominican Republic, whereas Chile, Costa Rica and Colombia present low values of *PVI*. Is important to emphasize the case of Argentina, because it was the country that during several periods had have the lowest *PVI*, nevertheless in the last years this value practically were duplicated.

Figure 12 illustrates the value of *PVI* for the countries in 2000 obtained by summing the three components related to exposure-susceptibility, social fragility, and lack of resilience.

Figure 12. Total PVI (aggregated)



On the whole, the *PVI* reflects susceptibility due to exposure degree of the physical goods and people; this favors the direct impact. Besides, it reflects the social and economic fragility conditions that favor the indirect and intangible impact. And, also, it reflects the lack of capacity to absorb the consequences, for responding efficiently and for recovering. A reduction of these types of factors as a result of a sustainable process of human development and explicit policies of risk reduction are one of the aspects that must be given special attention.

The participation of *PVI* in the system of indicators is justified to the extent that the execution of effective prevention, mitigation, preparedness and risk transfer actions help reduce risk whilst their absence or insufficiency leads to increases in risk. This evaluation may be useful for ministries of housing and urban development, environment, agriculture, health and social well-being, economy and planning. It is emphasized the relation between risk and development, but it is visible the convenient pointing out the risk reduction measures, due to the development actions do not reduce automatically the vulnerability.

RMI - RISK MANAGEMENT INDEX

The objective of this index is the measurement of the *performance* of risk management. In all cases this type of measure has been considered subjective and arbitrary due to their normative character. That is to say, they lack reference points. This implies establishing a scale of achievement levels. (Davis 2003; Masure 2003) or determining the “distance” with respect to certain objective thresholds or the achievements of some leader country taken as a point of reference (Munda 2003). For the formulation of *RMI* have been taken into account four public policies:

a) Risk identification, *RI* (that comprises the individual perception, social representation and objective assessment);
b) Risk reduction, *RR* (that involves the prevention and mitigation);
c) Disaster management, *DM* (that comprises response and recovery); and
d) Governance and Financial protection, *FP* (that is related to institutionalization and risk transfer).

Eight indicators have been proposed for each public policy. Together, these serve to characterize the risk management performance of a country. The *RMI* is the average of the four composite indicators:

$$RMI = (RMI_{RI} + RMI_{RR} + RMI_{DM} + RMI_{FP})/4$$

The valuation of each indicator was achieved using five performance levels: *low, incipient, appreciable, notable,* and *optimum*. These correspond to a range of 1 to 5, low to high. These correspond to defined levels of performance (standard tables) for each respective public policy. This methodological approach permits the use of each reference level simultaneously as a “performance target” and therefore allows for comparison and identification of results or achievements. Governments should attempt to direct their efforts at formulation, implementation, and policy evaluation according to these performance targets.

Indicators of Risk Identification

The identification of collective risk generally includes the need to understand individual perceptions and social representations and provide objective estimates. In order to intervene in risk it is necessary to recognize its existence[6], dimension it (measurement) and represent it by means of models, maps, indexes etc. that are significant for society and decision makers. Methodologically, it includes the evaluation of hazards, the different aspects of vulnerability when faced with these hazards and estimations as regards the occurrence of possible consequences during a particular exposure time. The measurement of risk seen as a basis for

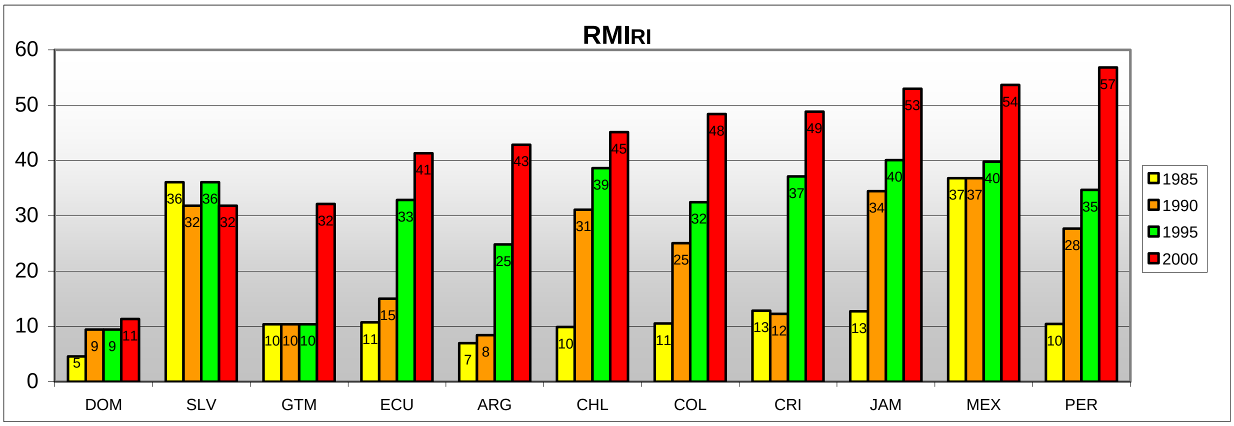
[6] That is to say, it has to be a problem for someone. Risk may exist but not perceived in its real dimensions by individuals, decision makers and society in general. To measure or dimension risk in an appropriate manner is to make it apparent and recognized, which in itself means that something has to be done about it. Without adequate identification of risk it is impossible to carry out anticipatory preventive actions.

intervention is relevant when the population recognizes and understands that risk. The indicators that represent risk identification, *RI*, are the following:

- IR1. Systematic disaster and loss inventory
- IR2. Hazard monitoring and forecasting
- IR3. Hazard evaluation and mapping
- IR4. Vulnerability and risk assessment
- IR5. Public information and community participation
- IR6. Training and education on risk management

Figure 13 shows the RMI_{RI} by country and period.

Figure 13. RMI related to risk identification



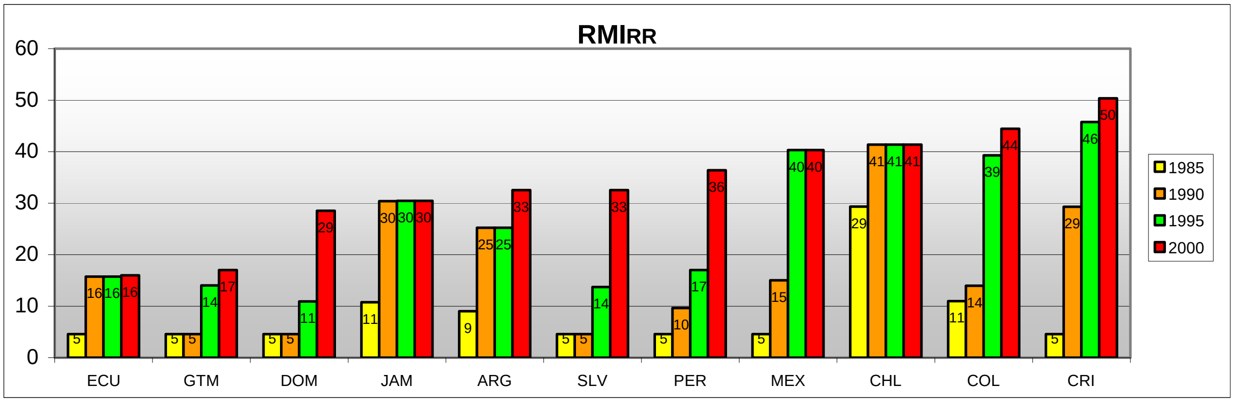
Indicators of Risk Reduction

Risk management aims particularly to reduce risk. In general, this requires the execution of structural and non structural prevention-mitigation measures. It is the act of anticipating with the aim of avoiding or diminishing the economic, social and environmental impact of potentially dangerous physical phenomena. It implies planning processes but, fundamentally, the execution of measures that modify existing risk conditions through corrective and prospective interventions of existing and potential future vulnerability, and hazard control when feasible. The indicators that represent risk reduction, *RR*, are the following:

- RR1. Risk consideration in land use and urban planning
- RR2. Hydrographic basin intervention and environmental protection
- RR3. Implementation of hazard-event control and protection techniques
- RR4. Housing improvement and human settlement relocation from prone-areas
- RR5. Updating and enforcement of safety standards and construction codes
- RR6. Reinforcement and retrofitting of public and private assets

Figure 14 shows the RMI_{RR} by country and period.

Figure 14. RMI related to risk reduction



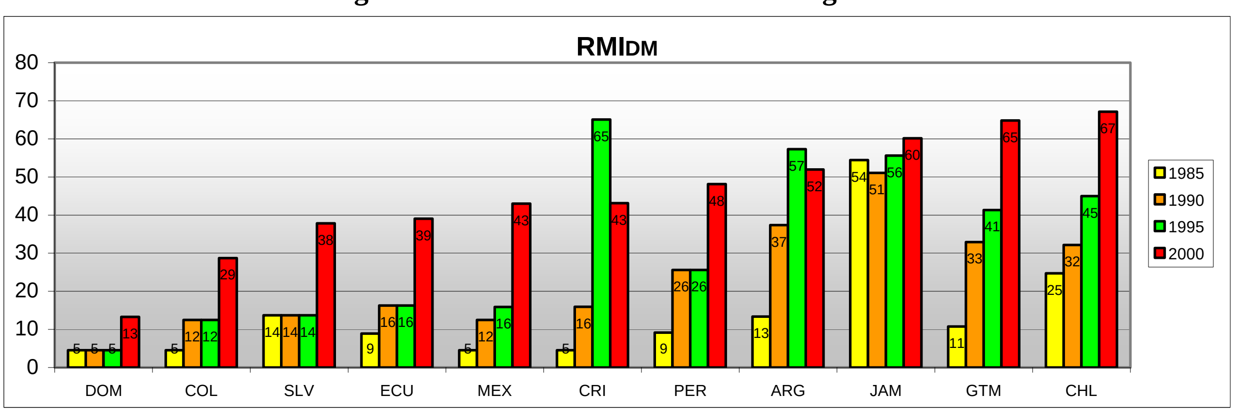
Indicators of Disaster Management

Disaster Management should provide appropriate response and recovery post disaster and depends on the level of preparation of operational institutions and the community. This public policy searches to respond efficiently and appropriately when risk has been materialized and it has not been possible to impede the impact of dangerous phenomena. Effectiveness implies organization, capacity and operative planning of institutions and other diverse actors involved in disasters. The indicators that represent the capacity for disaster management, *DM*, are the following:

- DM1. Organization and coordination of emergency operations
- DM2. Emergency response planning and implementation of warning systems
- DM3. Endowment of equipments, tools and infrastructure
- DM4. Simulation, updating and test of inter institutional response
- DM5. Community preparedness and training
- DM6. Rehabilitation and reconstruction planning

Figure 15 shows the RMI_{MD} by country and period.

Figure 15. RMI related to disaster management

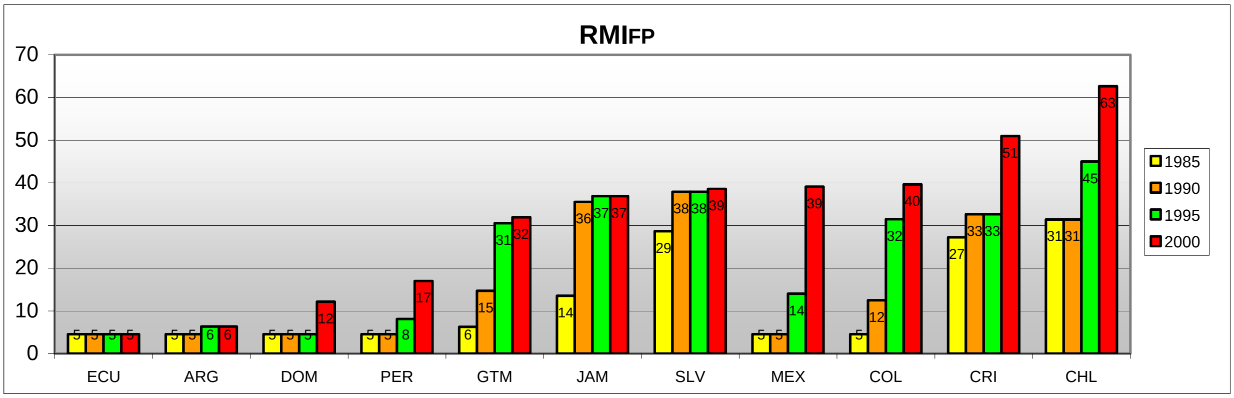


Governance and financial protection is fundamental for the sustainability of development and economic growth in a country. This implies, on the one hand, coordination between different social actors that necessarily are guided by different disciplinary approaches, values, interests and strategies. Effectiveness is related to the level of interdisciplinarity and integration of institutional actions and social participation. On the other hand, governance depends on an adequate allocation and use of financial resources for the management and implementation of appropriate strategies for the retention and transference of disaster losses. The indicators that represent governance and financial protection, *FP*, are the following:

- FP1. Interinstitutional, multisectoral and decentralizing organization
- FP2. Reserve funds for institutional strengthening
- FP3. Budget allocation and mobilization
- FP4. Implementation of social safety nets and funds response
- FP5. Insurance coverage and loss transfer strategies of public assets.
- FP6. Housing and private sector insurance and reinsurance coverage

Figure 16 shows the RMI_{FP} by country and period.

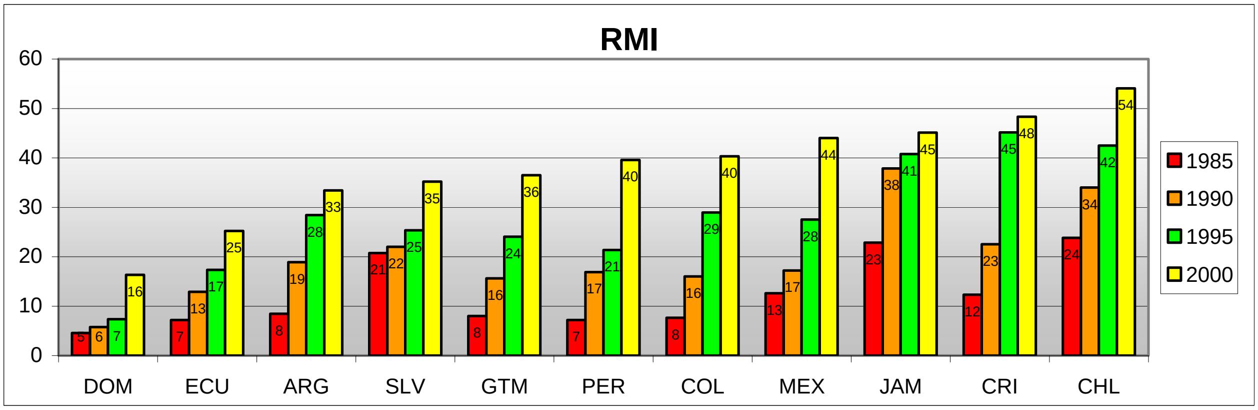
Figure 16. RMI related to financial protection and governance



Figures 13 and 16 show that Mexico Peru and Jamaica have achieved much in terms of risk identification. Most countries show important advances in this indicator. Costa Rica and Colombia show the greatest advances in risk reduction and they are followed by Chile and Mexico. As regards disaster management, in 2000, Chile, Guatemala and Jamaica showed the greatest levels of achievement although in the mid 90s, Costa Rica, Argentina and Jamaica showed notable levels in relative terms. It is with regard to disaster management that most advance is shown in the region. Finally, Chile and Costa Rica show most advance in financial protection and governance, followed by Colombia and Mexico. It is with regard to this aspect that countries in general show least advance.

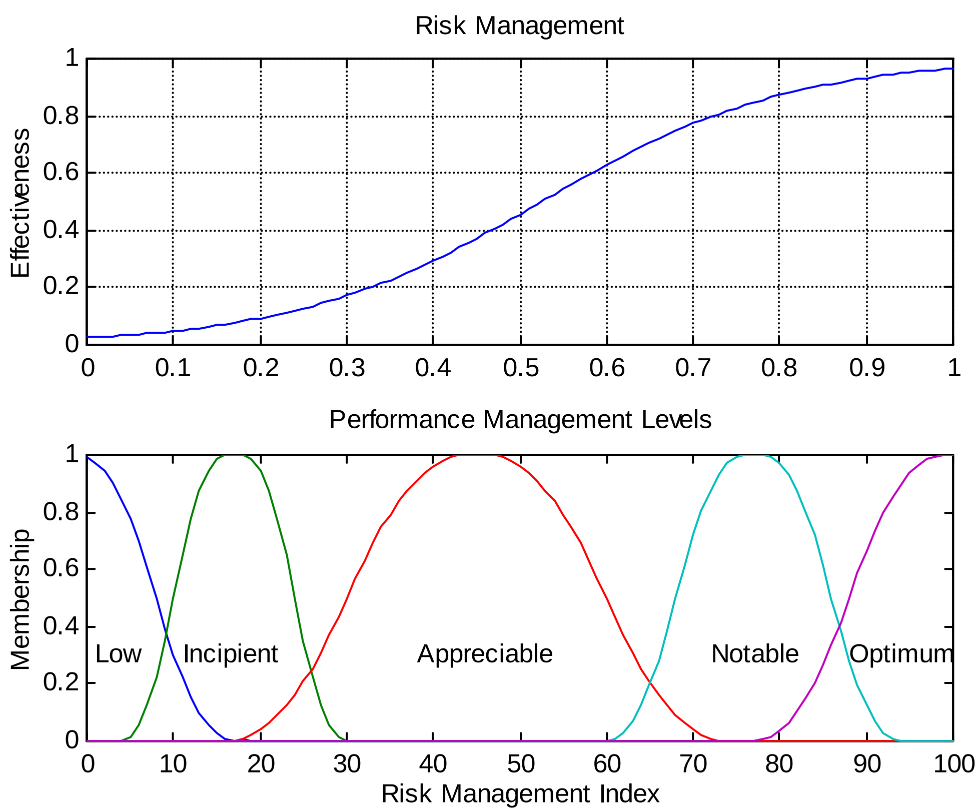
Figure 17 shows the figures of RMI for the countries between 1985 and 2000.

Figure 17. RMI for countries by period



The majority of countries have improved with regard to the *RMI*. All started at a very low point and despite the advances made the average *RMI* shows only incipient achievement. The Dominican Republic and Ecuador show low achievements in risk management. In those countries that show the most advance, Costa Rica and Chile, the *RMI* only reaches the level of "appreciable". Figure 18 shows the risk management behavior according to the method used.

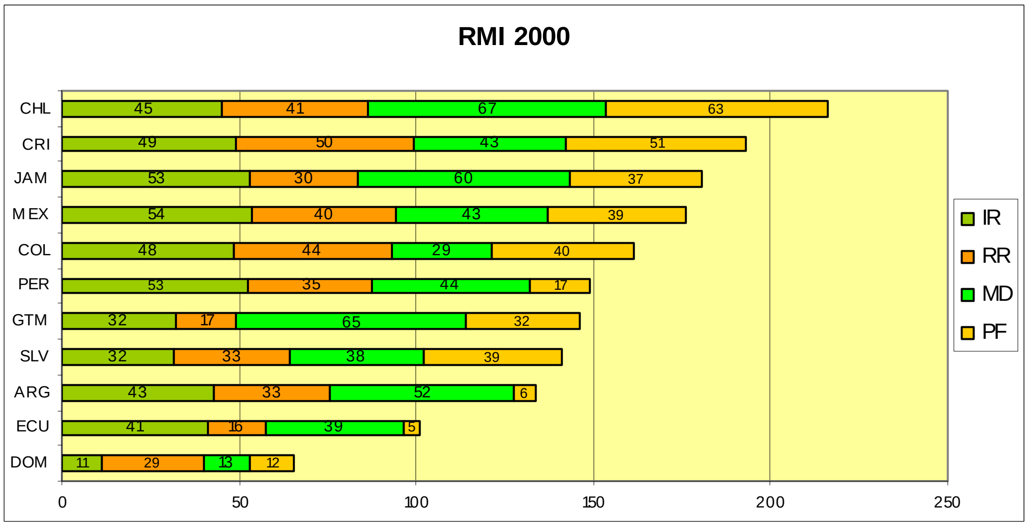
Figure 18. Risk management behavior and the form of the functions for each performance level.



According to the theory that supports the method used (Carreño et al 2004) the probable effectiveness of risk management in the majority of cases does not get above 60%. In general the effectiveness is between 20 and 30%. This is very low when compared to required effectiveness. The low level of efficacy of risk management that may be inferred from the *RMI* values for this group of countries is confirmed by the high risk levels represented in the *DDI,* the *LDI* and the *PVI* over the years. In part the high risk levels are due to the lack of effective risk management in the past.

Figure 19 illustrates the value of *RMI* for the countries in 2000 obtained by summing the four components related to risk identification, risk reduction, disaster management and financial protection.

Figure 19. Total RMI (aggregated)



The weights and evaluations were undertaken in the majority of countries by risk management authorities. These evaluations would appear to be overly generous when compared to those undertaken by local external experts. The latter would appear to be more objective and sincere. The first type of evaluation was adhered to here but external evaluations are considered to be very pertinent and perhaps over time are the more desirable if undertaken in coordinated and concerted fashion, thus eliminating status quo factors in evaluations.

INDICATORS AT SUB-NATIONAL LEVEL

Even though the development of an indicator for the sub-national level was not originally contemplated, as a demonstrative example also it was developed a system of indicators that allows a categorization of risk levels within a country. Usually countries are divided administratively and politically into Departments, States or Provinces. These are subject to differential levels of autonomy depending on the levels of political, financial and administrative decentralization existing in different countries. The formulation of the system of indictors that allows individual or collective evaluation of sub-national levels was achieved using the same concepts and approaches outlined for the national level. Colombia was the country selected to make the pilot application. All results for the indicators and for different periods are included in the report of Barbat and Carreño (2004a).

The variables and indicators for this sub-national level would be similar to those at the national level, but may require modifications considered appropriate in accord with the spatial scale of the sub national and urban units. In the case of national level calculations of the *MCE* one would take the single most catastrophic event conceivable. However, this event is only the most critical of a series of events that could affect different areas of the country. Maximum probable impacts in these areas will not necessarily be associated with the same type of hazard event identified for the national level. This makes sub-national analysis even more difficult. On the other hand, such sub national events would not occur simultaneously.

Analysis at the sub-national level allows national decision makers to evaluate and compare the risk levels in different areas of the country. Most surely other critical contexts will be identified which though not reaching the levels implied in the *MCE* at the national level, could approach these and demand resources that the national level would have to assume to a great degree. On the other hand, this type of sub-national analysis is useful to sub-national decision makers helping them to identify key risk problems and identify actions that they must take on their own or in coordination with the national levels. Such sub-national level analysis requires greater effort and levels of information and scale resolution. However, it is convenient to undertake such analysis as it offers national and sub-national decision makers a tool that is useful in defining public policies and planning needs in order to reduce risk in the different regions of the country.

What might be different between *DDI* analysis at national and sub-national levels is that resources may exist at the sub-national level in order to cover response and reconstruction needs. To the extent greater fiscal decentralization exists and the Maximum Probable Event is smaller than at the national level the responsibility assumed by the sub national level will possibly be greater. This type of evaluation is thus of great importance to decision makers in order for them to predict or plan for the social and economic implications faced by sub-national decision makers and those that need to be coordinated and agreed with national levels.

Such an index as *LDI* is of equal use at the sub-national level because it allows us to identify how susceptible the area is to lower level disasters and the impacts this signifies for local and municipal development. This index allows us to obtain a notion of the spatial variability and dispersion of risk within a sub-national unit resulting from smaller and recurrent events. From the risk management angle this type of information could contribute to orienting advisory capacities and support resources to municipalities, in accord with the history of past events and impacts. Many municipalities have not recovered from previous events when they are affected by another event which may not be considered relevant at the national or even sub-national levels, but which signifies a constant erosion of local development gains and opportunities. This type of context must be identified given that recurrent small scale disasters notably increase the difficulties of local development. Such events usually affect the livelihoods and means of subsistence of poor populations thus perpetuating their levels of poverty and human insecurity.

Figure 20 shows the *DDI* for year 2000 and for a *MCE* of 500 years of return period in 32 departments of Colombia. This example of the evaluation of *DDI* was obtained taking into account only the economic resilience of each department and without participation of national government.

Figure 20. DDI_{500} for the departments of Colombia in 2000

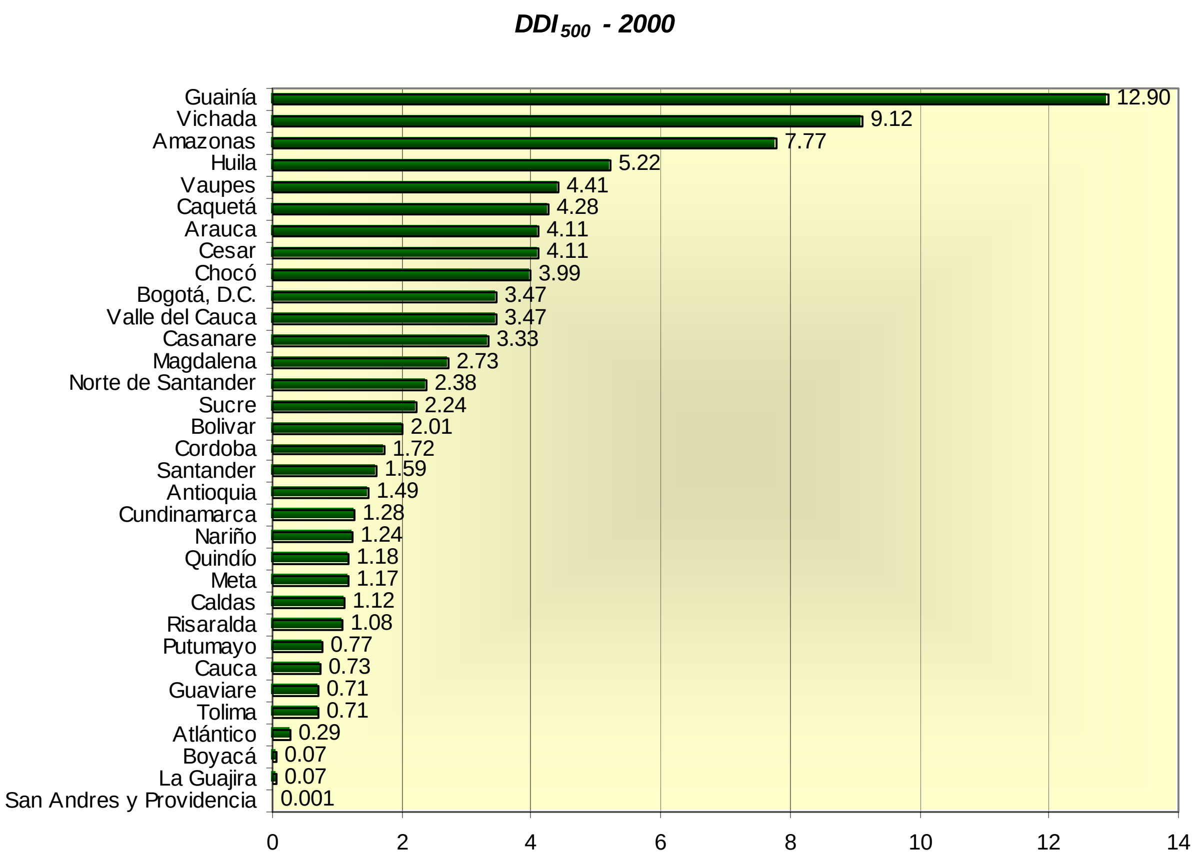
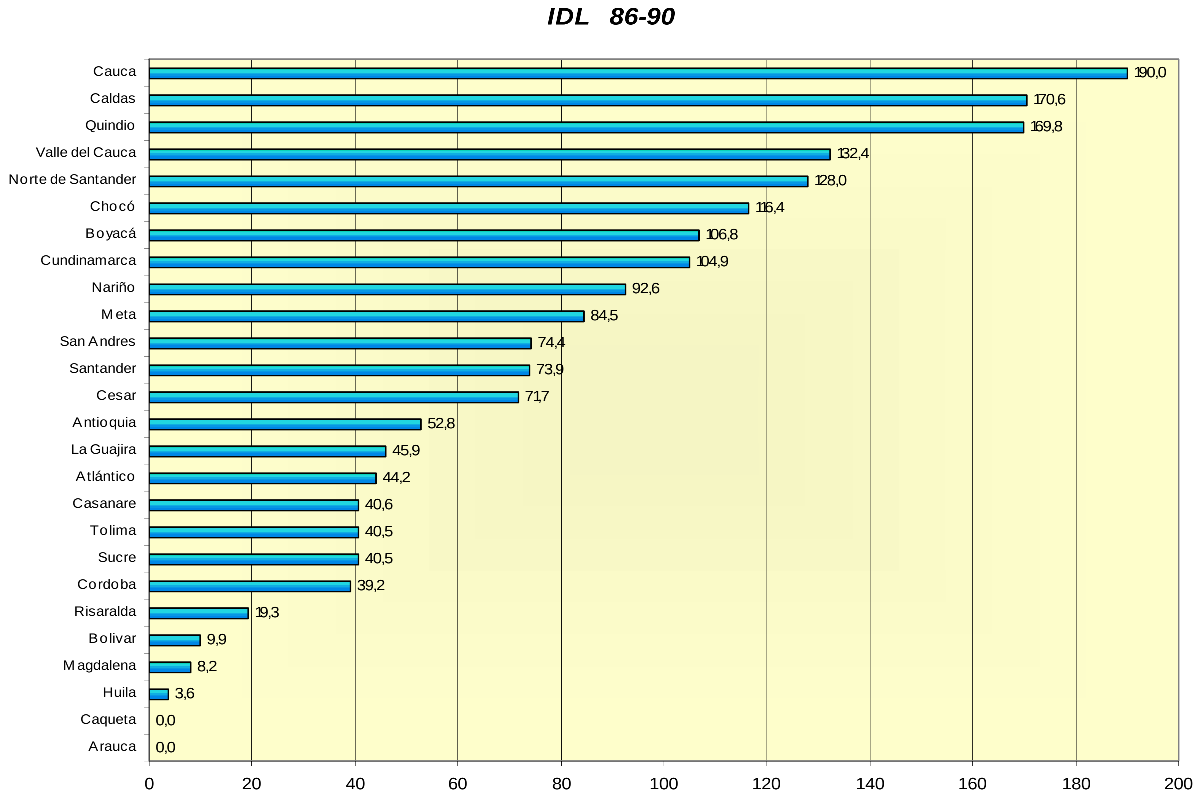


Figure 21 illustrates the aggregated value of *LDI*, evaluated between 1986 and 1990. Figure 22 displays an example of the *PVI* for each department of Colombia assessed in 2000.

Figure 21. Aggregated LDI for the departments of Colombia, 1986-1990



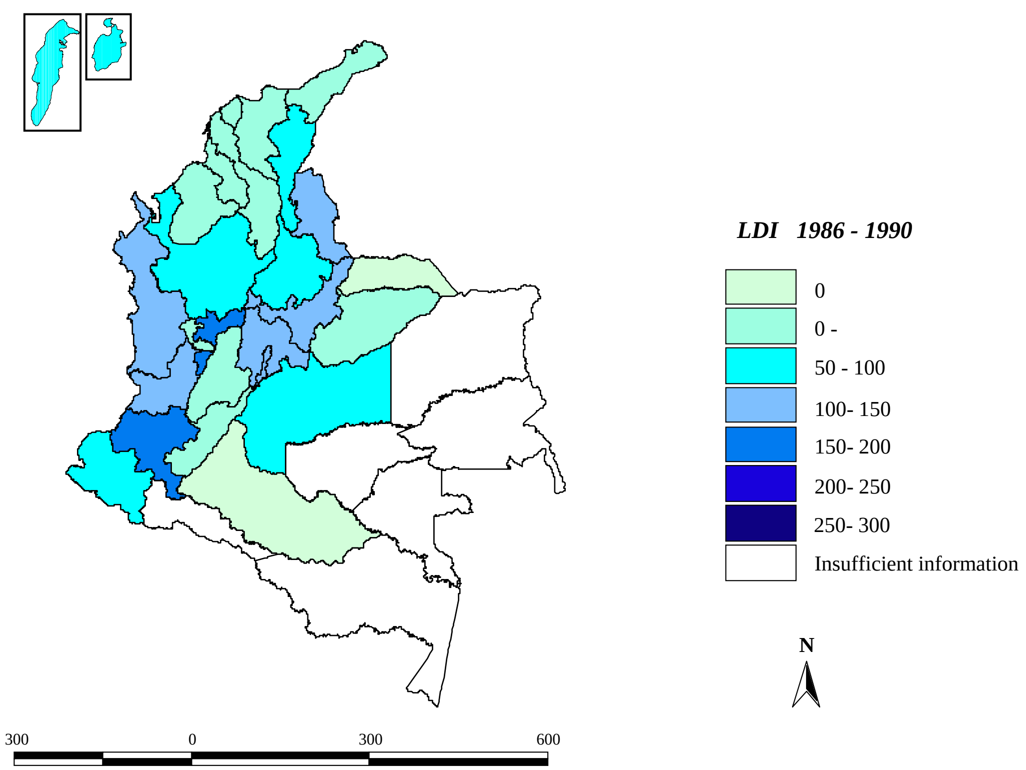
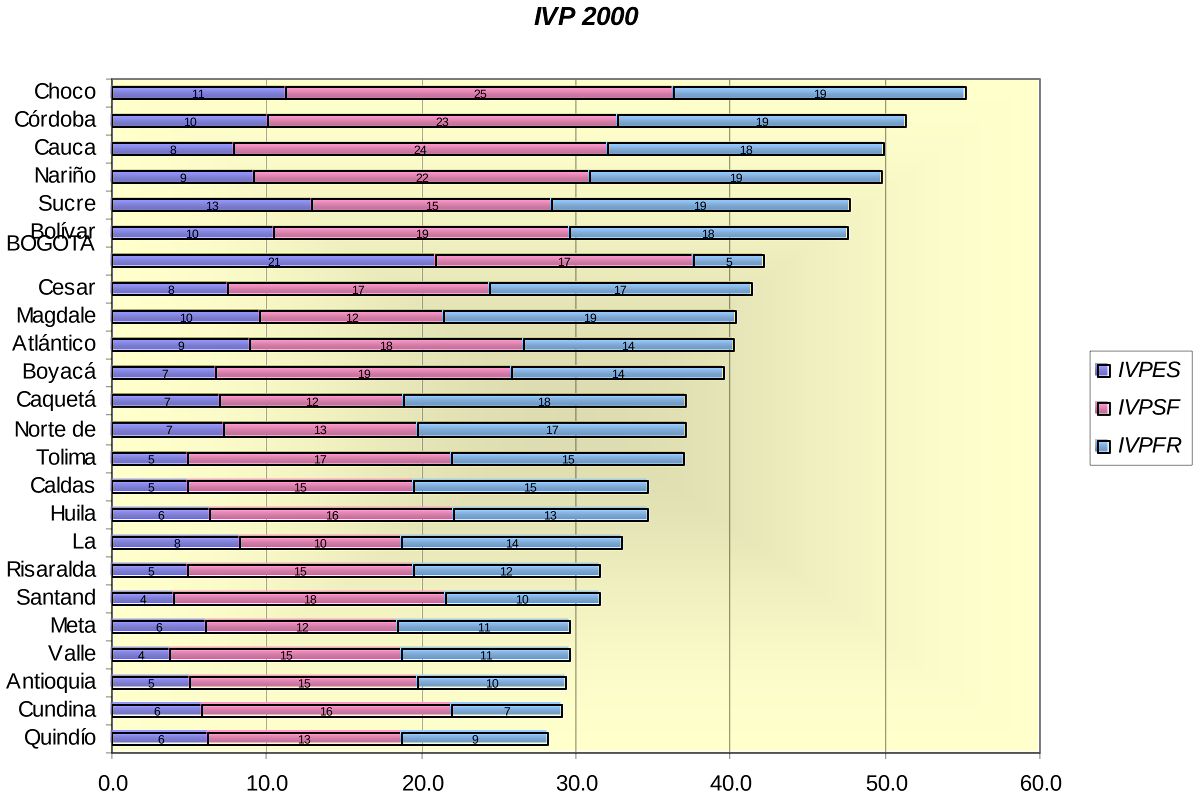
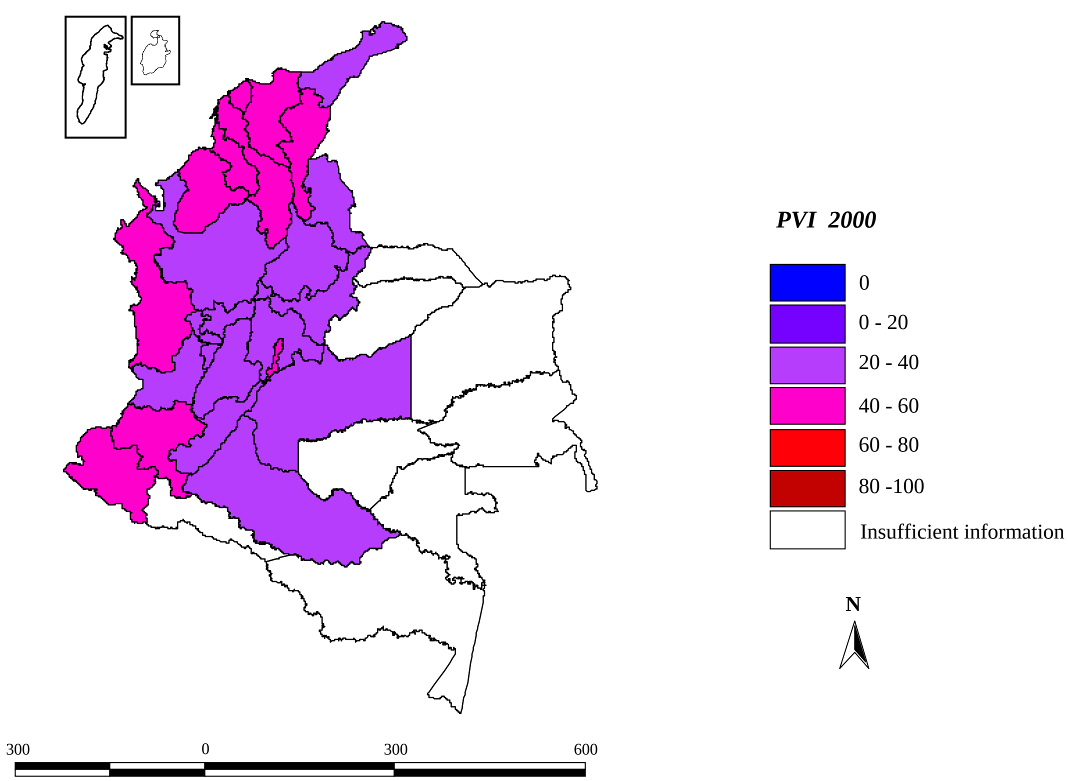


Figure 22. Aggregated PVI for the departments of Colombia, in 2000





INDICATORS AT URBAN LEVEL

It is also possible to undertake risk analyses using indicators within urban metropolitan areas. These are usually made up of administrative units such as districts, municipalities, communes or localities which will have different risk levels.

Dropping down the spatial and administrative scale the need for evaluations within urban-metropolitan and large cities is also desirable. Taking into account the spatial scale at which urban risk analysis is undertaken, it is necessary to estimate or to have the scenarios of damage and loss that could exist for the different exposed elements that characterize the city (buildings, infrastructure, installations etc.). The *MCE* for the city would allow us to evaluate in greater detail the potential direct damage and effects and, then, prioritize the interventions and actions that are required in each area of the city in order to reduce risk.

The indicators to be used at this level of analysis are similar to those used at other levels but in this case we agree to estimate an Index of Physical Risk (hard) and a Factor of Impact, based on (soft) variables associated to the social fragility and the lack of resilience of the context, to obtain by this way an Index of Total Risk for each unit of analysis. These indicators require greater levels of resolution than those used at the national or regional level and they are oriented in favor of variables of particular interest at the urban level (Cardona and Barbat 2001; Barbat 2003a/b). In other words, it was developed a methodology that combines the representation made by the *DDI* and the *PVI*, used at national and sub-national levels.

It is important to indicate here that the most critical situation for the urban area as a whole could be related to a phenomenon that is different to that which could cause the most serious impacts in a particular area of the city. This makes analysis difficult because we would have to make estimations for various hazards given that risk and hazard could vary notoriously spatially (as is demonstrated by micro-seismic and flooding studies). However, using historical information one can identify the hazard that in general would cause the most critical impact in the whole city and make comparisons of risk based on this point of reference.

The type of evaluation proposed for the urban level was applied as a demonstrative way in Bogotá, Colombia, with the idea of illustrating the type of results that could be obtained and, consequently, the type of risk management activities that are most appropriate. For this type of example it was necessary to identify a case where the information required was easy to obtain and where hazard and physical risk studies have been made in advance and with an adequate level of refinement and resolution. A summary of the results is included in the report of Barbat and Carreño (2004b).

For the illustrative example the seismic hazard was considered the worse threat. Seismic risk evaluation of Bogotá, D.C., from a holistic perspective, was obtained starting from the potential scenario of losses. This allowed defining indicators of damage and direct effects for each unit of analysis, in this case called locality or district. For each of these units an indicator of Physical Risk was obtained, R_F,, as result to consider the possible consequences in terms of deaths, injured, destruction area and damage in lifelines. Based on a set of indicators related to social fragility and lack of resilience, that characterize each unit of analysis, the factor of indirect impact, was obtained. This factor takes values between 0 and 1.

The values to evaluate the factor of indirect impact are computed for each locality of the city, using a set of nonlinear (sigmoidal) functions to involve the input values of the indicators to an impact factor. In addition, a weight has been assigned to each factor using the Analytic Hierarchy Process (AHP). Figure 23 illustrates the indicators and their weights, and figures 24 and 25 are examples of functions to obtain impact factors.

Figure 23. Indicators of physical risk, social fragility an lack of resilience and their weights

Ind	*Description*	*w*
F_{RF1}	Damaged area	31
F_{RF2}	Number of deceased	10
F_{RF3}	Number of injured	10
F_{RF4}	Ruptures in water mains	19
F_{RF5}	Rupture in gas network	11
F_{RF6}	Fallen lengths on HT power lines	11
F_{RF7}	Telephone exchanges affected	4
F_{RF8}	Electricity substations affected	4

>> R_F **Physical risk**

Ind	*Description*	*w*
F_{FS1}	Slums-squatter neighborhoods	18
F_{FS2}	Mortality rate	4
F_{FS3}	Delinquency rate	4
F_{FS4}	Social disparity index	18
F_{FS5}	Population density	18
F_{FR1}	Hospital beds	6
F_{FR2}	Health human resources	6
F_{FR3}	Public space/shelter facilities	4
F_{FR4}	Rescue and firemen manpower	3
F_{FR5}	Development level	9
F_{FR6}	Preparedness/emergency planning	9

>> F **Impact factor**

>> $R_T = R_F(1 + F)$

Figure 24. Impact factor as a function of population density

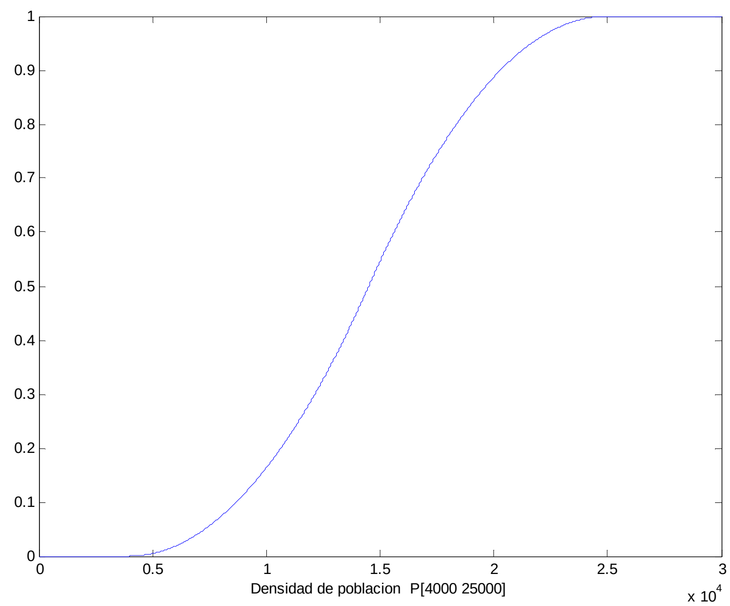
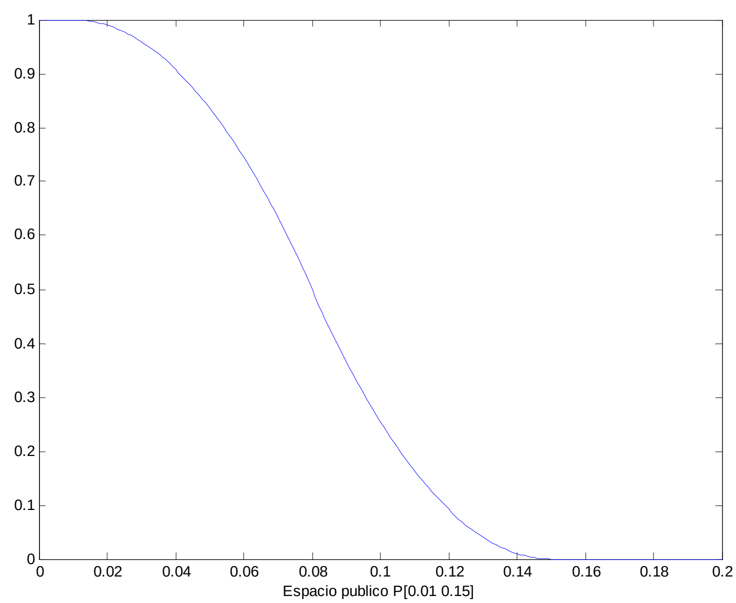


Figure 25. Impact factor as a function of public space available



Figures 26-29 presents the results of the holistic estimation of seismic risk in Bogotá using indicators.

Figure 26. Physical risk index for the localities of Bogotá

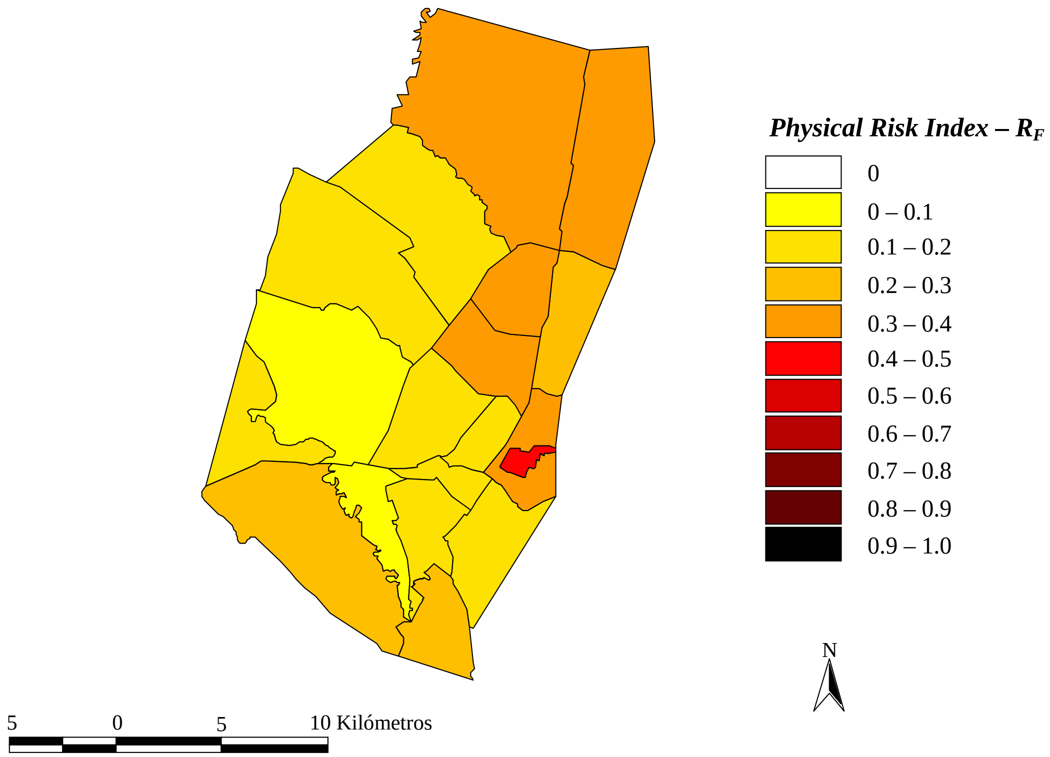


Figure 27. Values and ranking of the localities according to the physical risk index

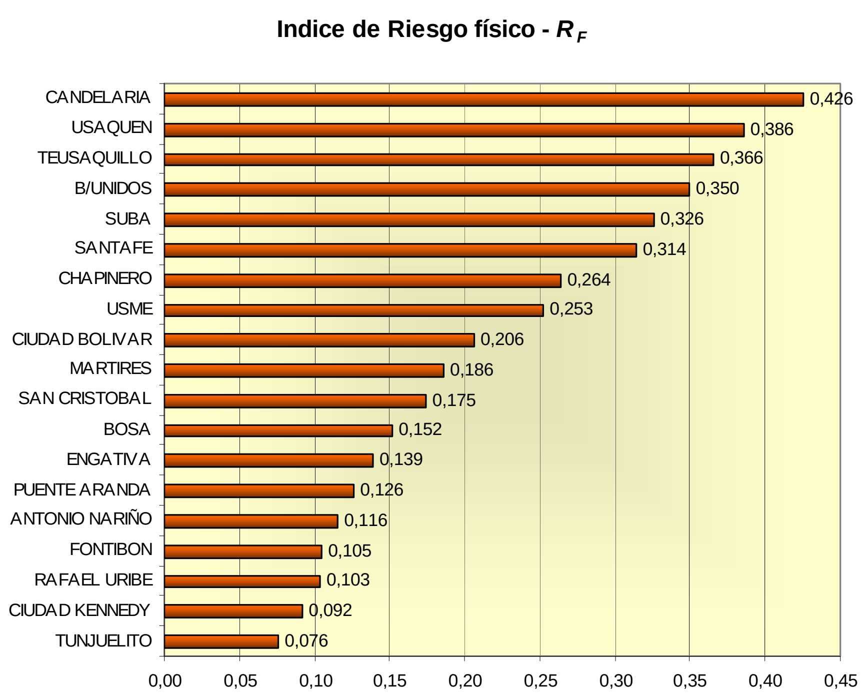


Figure 28. Total risk index for the localities of Bogotá

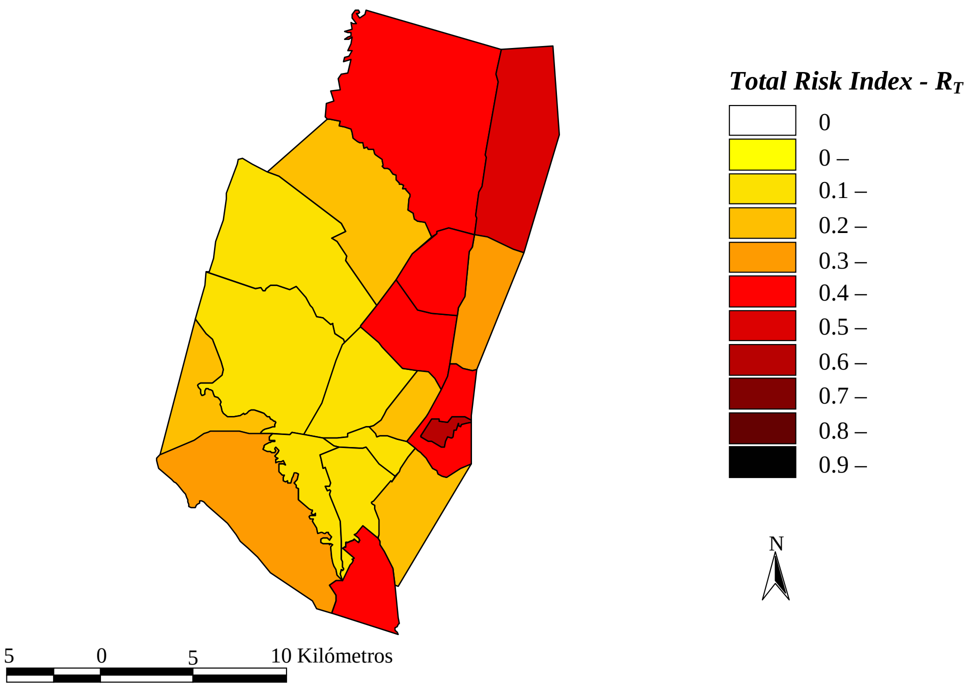
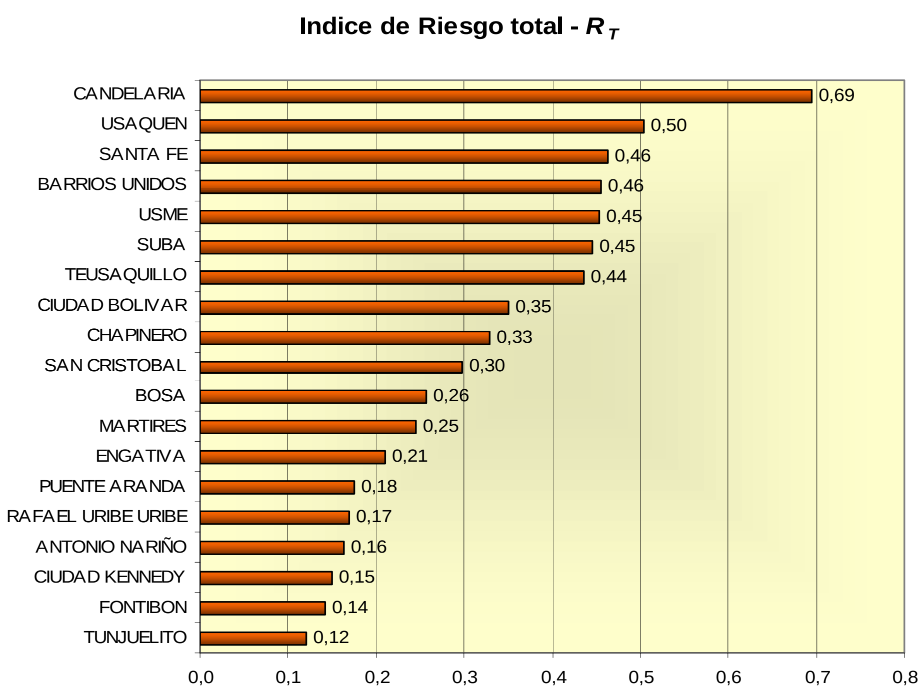


Figure 29. Values and ranking of the localities according to the total risk index



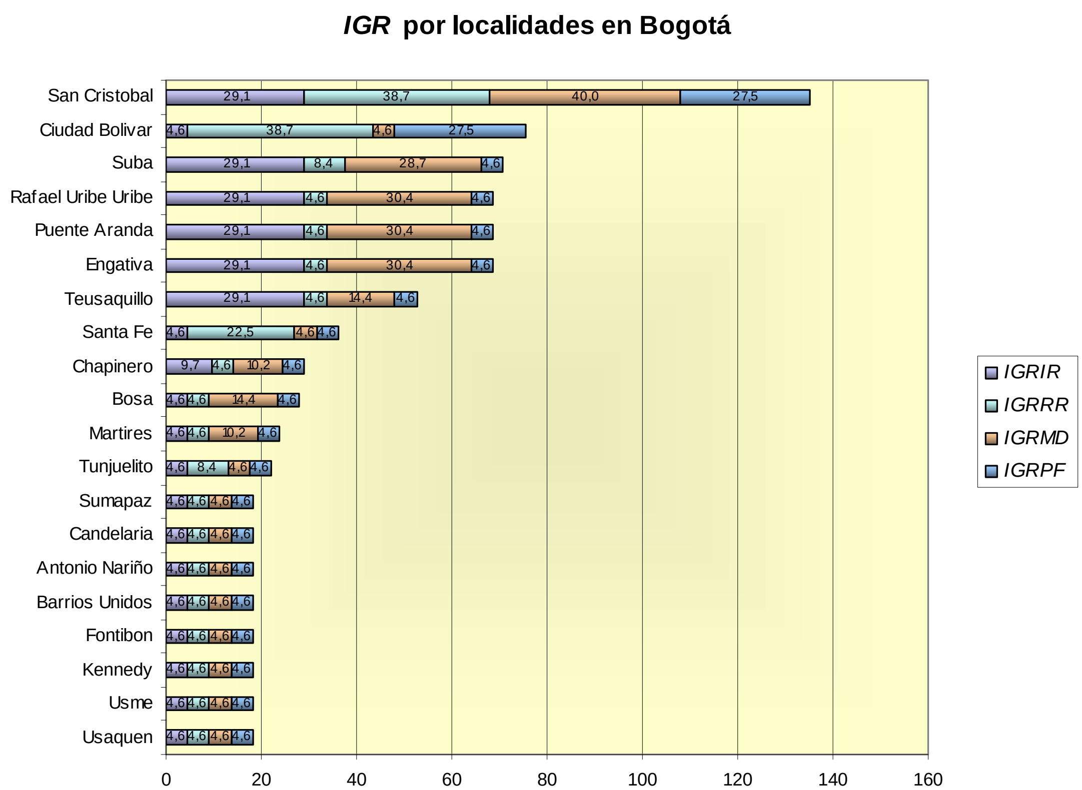
For the estimation of the *RMI* we convened the participation of people of the Directorate of Prevention and Attention of Emergencies of Bogotá and external experts. The sub-indicators on risk identification (RI), risk reduction (RR), disaster management (DM) and financial protection and governance (FP), as well as the weights using the AHP were described according to their experience and knowledge. Table 1 presents the results of the *RMI* for Bogotá.

Table 1. RMI for Bogotá

Indicator	1985	1990	1995	2000	2003
RMI_{RI}	4,6	13,9	35,6	56,2	67,1
RMI_{RR}	11,0	13,9	13,9	46,1	56,7
RMI_{DM}	4,6	8,3	8,3	24,0	32,3
RMI_{FP}	4,6	57,5	54,8	57,6	61,4
$RMI_{average}$	**6,2**	**23,4**	**28,1**	**46,0**	**54,4**

In addition, it was attempted to make the same study to evaluate the *RMI* in each locality of the city, following and using the same functions. Figure 30 shows the results obtained for 2003.

Figure 30. Ranking of the localities according to the RMI



NEXT STEPS:
A REGIONAL ASSESSMENT PROGRAM, BASED ON INDICATORS, FOR THE AMERICAS

The availability of indicators for disaster risk and the performance of risk management is a powerful tool to orient action and scarce resources to reduce disaster risk as well as to improve the effectiveness of national and regional efforts and the development assistance provided by the international community. With the development of the present set of robust indicators, a permanent program to ensure that this information is consistently available is now within reach.

We propose the setting up of a ***Disaster Risk Management Assessment Program (RiskMAP)***, which would provide a comprehensive framework through which to profile risk, identify the performance of national disaster risk management systems, and to develop, with the authorities of participating countries, appropriate risk management solutions at the national and regional levels. Such a Program would include a monitoring and evaluation process for tracking progress in the countries' risk profiles, as well as for the effectiveness of efforts to promote the soundness of country and regional risk management systems. The aim is to allow a consistent and independent application of the indicators, a replicable and manageable application process (in terms of time and cost), as well as the provision of direct feedback by the assessment teams and countries on the robustness of the methodologies and on the process for their updating. RiskMAP would have three primary components or areas of work:

Component 1: Country level assessments

The core of RiskMAP program would be the country-level assessments, which would apply a suite of indicators to profile disaster risk and the soundness of the risk management system, determine countries' adoption of risk management standards of good practice, and identify developmental and technical assistance needs for strengthening countries' risk management. A voluntary program, the countries would request to participate. The assessments, then, are triggered by the country request (facilitated by the Program itself), in order to ensure that the process of the assessment engages upfront key policy-makers and institutions to the discussion of disaster risk management. Countries would receive a national report detailing the results of the assessment and recommendations for strengthening. A sub-set of this report (the rest of which may remain proprietary) – the indicator results – would be registered in the RiskMAP program and included in the annual publication of the state-of-the-regions in disaster risk management. *Certified teams, drawn from regional centers of excellence and others would undertake the country assessments applying the suite of indicators. Manuals and supervision would be developed – during a program design and start-up phase for the Program.*

Component 2. Indicators, methodologies, and data improvements

This will be a process through which the indicators and their methodologies used in the country assessments are validated, updated as needed, and new indicators added to the core suite. This process would include periodic reviews by experts, as well as annual meeting of national policy and technical stakeholders. Special activities related to data improvement and the evaluation of additional indicators (such as subnational indicators) for inclusion in the core suite of indicators would be developed and validated under this component. *The advantages of such a formal and transparent process, based on peer review, for the adoption of methodological refinements and additions to the core suite of indicators are: (i) A direct and clear link of new developments in datasets into methodology refinements. (ii) A visible platform for vigorous technical and stakeholder reviews of the indicators as well as related methodological issues, and include the publication of technical papers.*

Component 3. Risk Management Solutions

This component would promote dialogue between countries and the development of national and regional risk management solutions. Such a forum would be built on the annual report on the state-of-the region in disaster risk management based on the assessment program and conference of stakeholders and participants. These would promote the exchange of technical information for public policy formation, the benchmarking of disaster risk and risk management of the countries in the region and, through the financial support to select sub-regional working groups, promote the work on risk management solutions. One would expect partners from the region – CEPREDENAC, CDERA, CAPRADE (Central America, the Caribbean, Andean region) to be leaders in facilitating this dialogue and action.

Setting up a RiskMAP Program

Putting in place a sustainable RiskMAP Program may take two to three years. The first step would be to evaluate options and develop the proposed institutional arrangements for such a Program, including its governance structure. Ideally, this proposal would be developed jointly with a select set of IFIs, bilateral and UN agencies, in consultation with countries of the region. During year one, the proposed institutional set up for the Program would be developed and initial agreements and partnerships necessary for its piloting would be secured. Years two and three would pilot the arrangements, with the aim of working towards a permanent structure that consistently orients action and scarce resources to reduce disaster risk and improves the effectiveness of national and regional efforts and international development assistance. An explicit objective for the Program is to have organization and governance structure that avoids the worst of bureaucratic rigidities and is able to effectively promote a dynamic interaction of the Program's stakeholders.

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