Setting Priorities: Global Patterns of Disaster Risk

Maxx Dilley[1]
United Nations Development Programme
Bureau for Crisis Prevention and Recovery

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Abstract

Natural disasters are caused not only by hazard events but also by the degree of exposure and vulnerability of society. Analysis of these causal factors has permitted identification of countries and areas within them where disaster-related mortality and economic losses are likely in the future. These high-risk areas are candidates for increased attention to, and investment in, disaster risk identification, reduction and transfer. Plans are underway to further identify disaster risk levels and factors on national and sub-national scales in high-risk countries to create evidence for improved risk management decision-making. Disaster risk management based on identification of disaster risks offers a preferable alternative to the current over-reliance on emergency management as a means of dealing with disasters.

Introduction

One of the key challenges in promoting a shift from disaster management to risk management is to make the risk factors that cause disasters more visible. Prior to disasters these causal factors may be hidden. Only after a disaster occurs does it become crystal clear the extent to which latent risk factors were present. Unfortunately by then it is too late to prevent losses.

Identifying where and when conditions of hazardousness and vulnerability are present creates the potential for acting before disasters occur, to reduce the risks. Risks can also be transferred away from exposed populations and assets, through insurance, contingency funds, catastrophe bonds and other financial mechanisms.

In the past several years a concerted effort has been mounted by international agencies seeking to promote a shift from emergency to risk management to create an evidence base on global disaster risk. Examples include *Reducing Disaster Risk: A Challenge for Development* (UNDP 2004)[2], *Natural Disaster Hotspots: A Global Risk Analysis* (Dilley et al 2005)[3] and *System of Indicators for Disaster Risk Management: Program for Latin America and the Caribbean* (Cardona, 2005; IDEA, 2005)[4].

For the first time there is complete global coverage of information on risk levels and specific factors that cause disasters associated with most major natural hazards. These global and regional reports complement risk analyses undertaken at national and local scales. This type of evidence allows the factors that cause disasters to be addressed through the development process. Since many of the most meaningful risk management decisions are made at the national-to-local levels, it is particularly important to strengthen the evidence base for disaster risk management at these scales.

This paper provides a brief overview of how risk and loss information are used in disaster and risk management, and provides a structure for organizing work towards improving how loss and risk information are generated, managed and applied at different spatial scales. The intent is to suggest a common framework for cooperation among scientists, practitioners and decision-makers, with a special focus on building capacity at the national level in high risk areas.

Disaster risk identification: A review of recent global and regional results

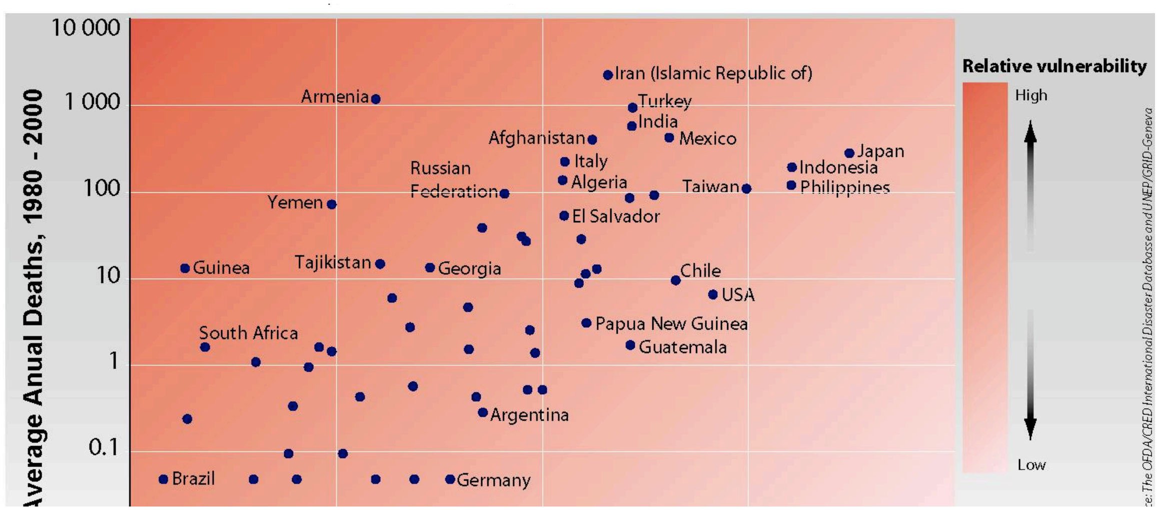
critical areas for improving the evidence base on disaster risks to support risk management decisions within high risk areas.

Reducing Disaster Risk: A Challenge for Development

This report by UNDP, released in 2004, assesses disaster-related mortality risks associated with cyclones, floods and earthquakes. Countries are the unit of analysis. The report identifies the relative contributions of hazard exposure and vulnerability factors to mortality risk and analyzes how these can be reduced or exacerbated through the development process.

The analysis is based on a Disaster Risk Index, developed by the United Nations Environment Programme, that measures relative vulnerability to the above hazards. Relative vulnerability is measured as the number of people killed in a country due to a particular natural hazard compared to the number of people exposed. Countries that suffer a higher loss of life than others who are equally exposed have a higher relative vulnerability to the hazard in question.

Countries with relatively high vulnerability to earthquakes, for example, include the Islamic Republic of Iran, Turkey, India, Italy, Algeria, and Mexico (figure 1). Countries with relatively low vulnerability include Japan, Costa Rica and the United States of America.



Countries relatively highly vulnerable to cyclones include Honduras, Nicaragua and Bangladesh (figure 3). Low-vulnerability countries include Australia, Japan and Cuba.

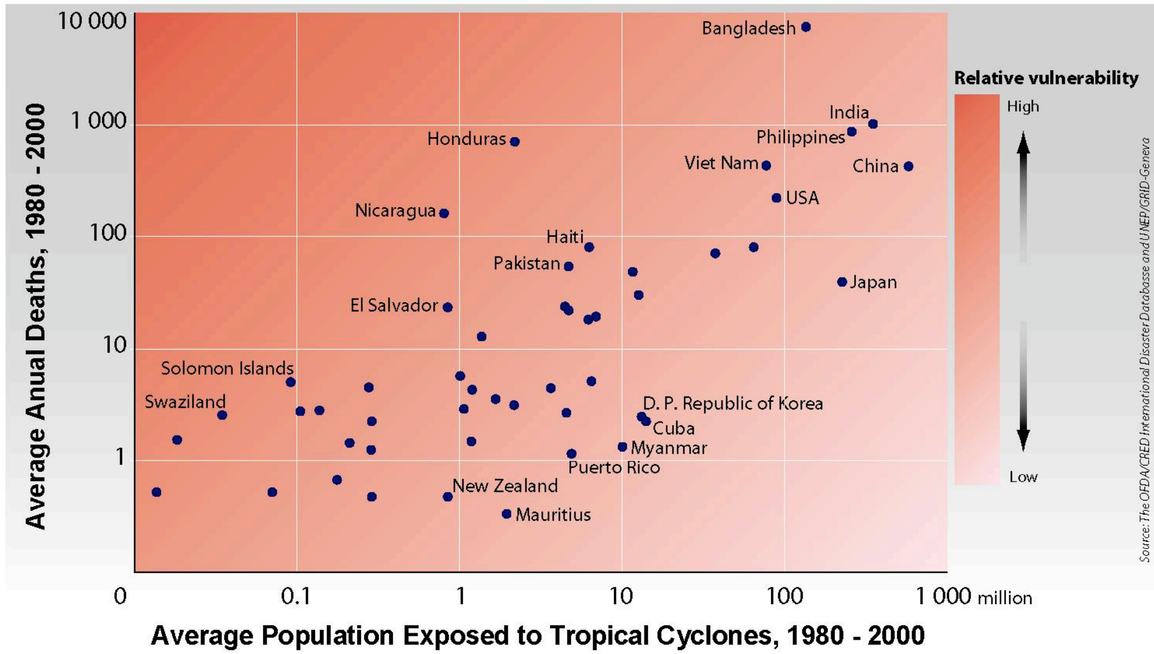


Figure 2 Relative vulnerability to cyclones (UNDP 2004)

Small island states are special cases when it comes to cyclone vulnerability, due to the potential for covariate losses across wide swaths of the population and economy during cyclone landfalls. There are clear differences among small island states, however, in terms of mortality in relation to hazard exposure (figure 3). Cuba and Mauritius have relatively low vulnerability, for example, compared with that of Haiti, Cape Verde and the Solomon Islands.

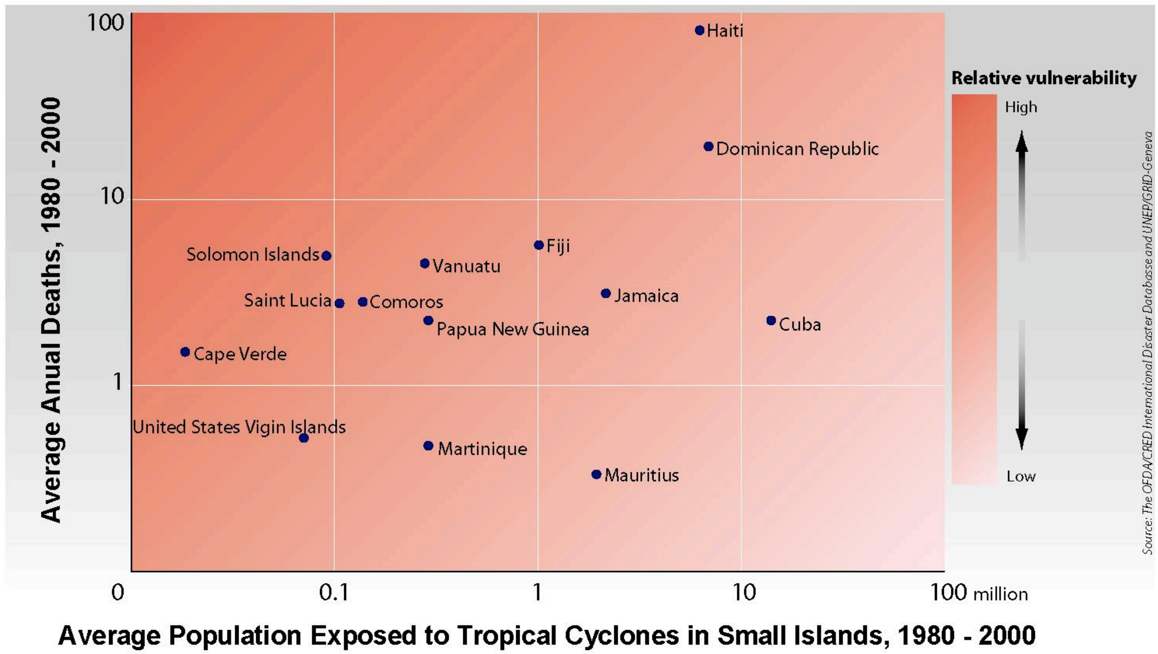


Figure 3 Relative vulnerability to cyclones among small island states (UNDP 2004)

Countries relatively highly vulnerable to flooding include Venezuela, Morocco, Somalia and Botswana (figure 4). Argentina and Germany on the other hand have historically experienced relatively low mortality during flood events.

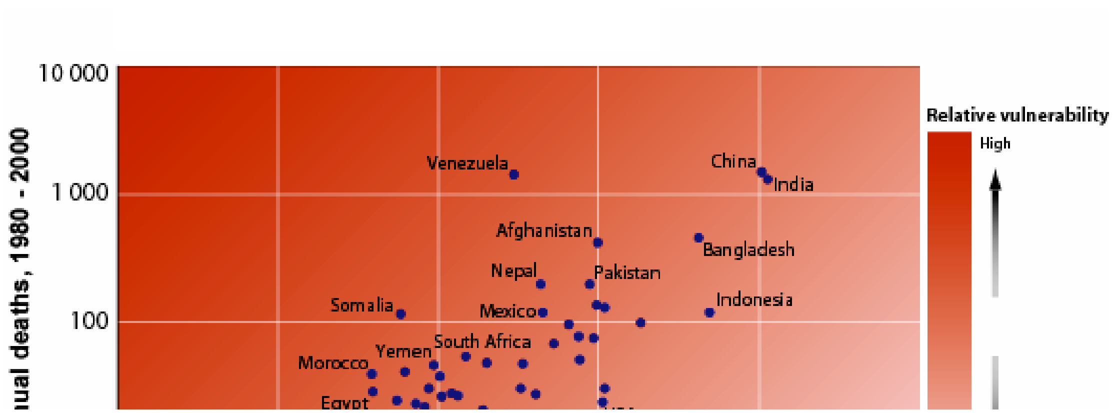


Figure 4 Relative vulnerability to flooding (UNDP 2004)

Disaster Risk Hotspots

The Disaster Risk Hotspots project, a collaboration between Columbia University, the World Bank and a host of partner organizations, assessed global risks of disaster-related mortality and economic losses associated with cyclones, drought, earthquakes, floods, landslides and volcanoes (Dilley et al 2005). Mortality and economic loss risks for each hazard were assessed for each 5x5 km cell on the earth's surface, excluding those with small populations and/or low agricultural production. The project identified relative risk levels for each hazard and all hazards together. Risks were calculated based on the hazard exposure of people and GDP in each grid cell, weighted by historical loss rates for each hazard -- stratified by region and country wealth status -- as a means of representing vulnerability. The report emphasizes the theory, data, methods, results and applications of the analysis.

Disaster-related mortality risks associated with hydro-meteorological hazards are highest across the sub-tropical zones, with drought related mortality risks being highest in semi-arid regions of Africa (figure 5). Mortality risks associated with geo-physical hazards are highest along plate boundaries, around the Pacific rim and across southern Asia. Some countries such as the Philippines and Indonesia are at high risk from all three types of hazards. In general mortality risks tend to be highest in developing or middle income countries.

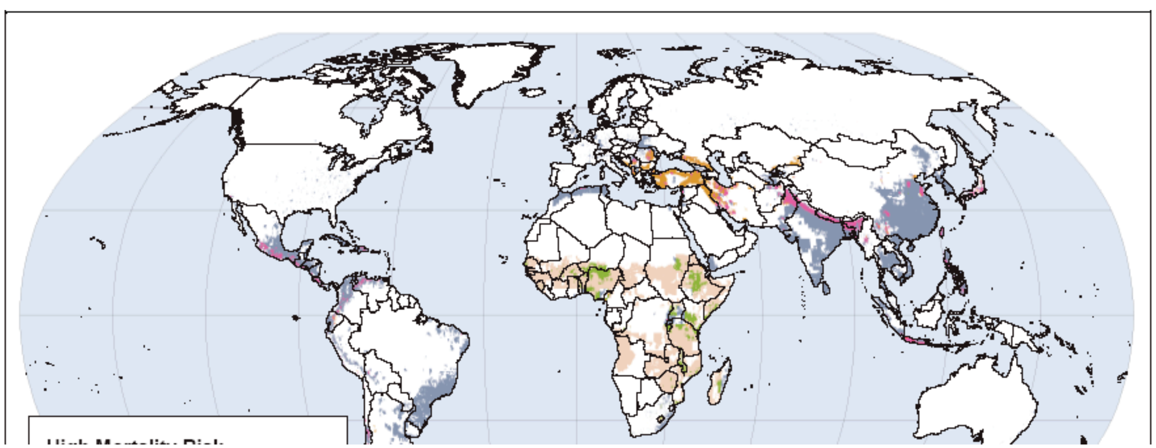


Figure 5 Mortality risks: Global distribution of highest risk disaster hotspots by hazard type: Mortality risks (Dilley et al 2005)

The project also evaluated total economic loss risks, which, compared to mortality risks are more concentrated in wealthier countries (figure 5). Large areas of Europe, North America and Southern and Eastern Asia are hotspots with respect to total economic loss risks. Large areas of the caucuses region are at relative high risk from all three types of hazards.

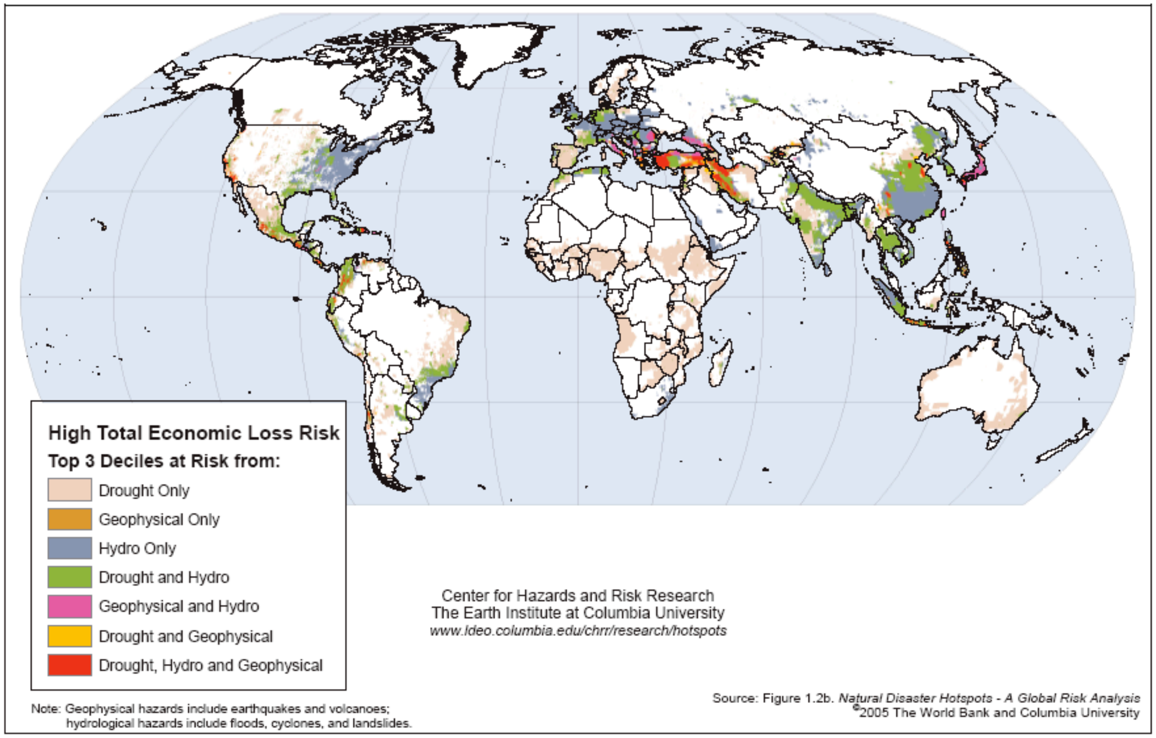


Figure 6 Total economic loss risks: Global distribution of highest risk disaster hotspots by hazard type (Dilley et al 2005)

When risks are evaluated for economic losses in proportion to GDP per unit area, the largest risk burden shifts back to the developing world (figure 7). Coastal zones and large areas of Africa and Central Asia are at relatively highest risk by this measure.

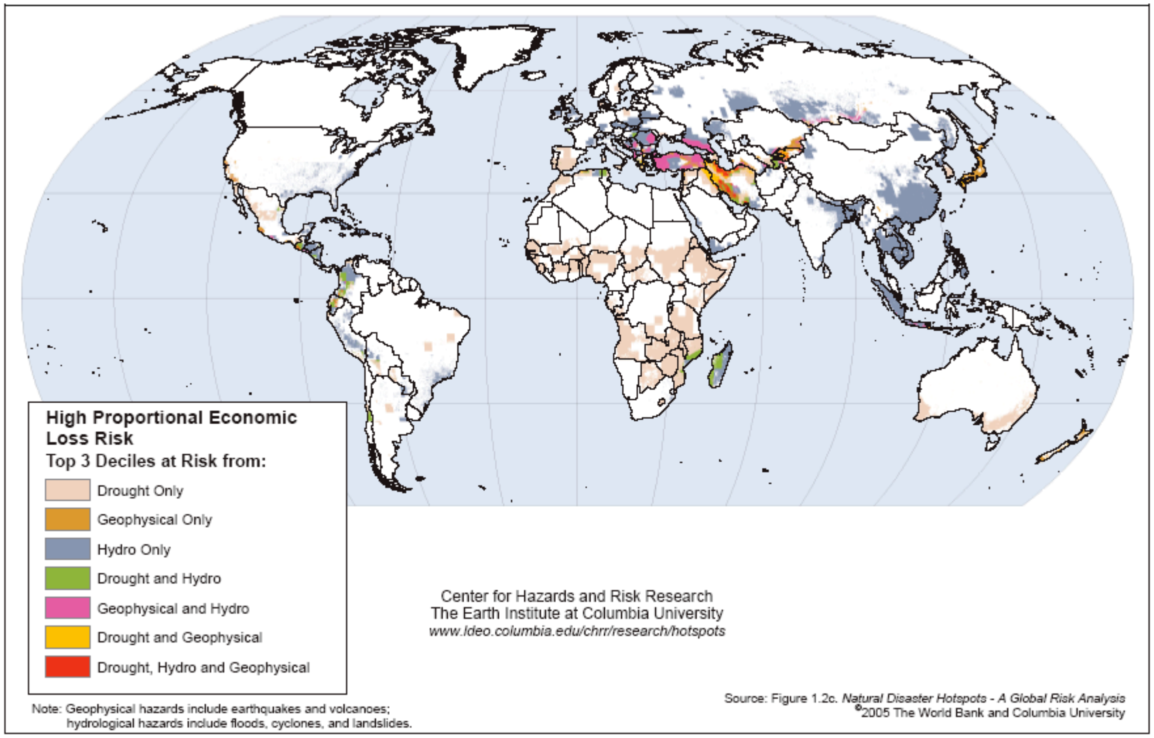


Figure 7 Economic loss risks in proportion to GDP per unit area: Global distribution of highest risk disaster hotspots by hazard type (Dilley et al 2005)

Risk Indicators for the Americas

Additional information about risk patterns is available for a set of countries in Latin America and the Caribbean, thanks to an analysis by the Inter-American Development Bank and the National University of Colombia in Manizales (Cardona 2005, IDEA 2005). This project assessed different aspects of risk and risk management capacity with composite indicators incorporating a variety of variables selected by experts. Countries are the unit of analysis. The report discusses methods, results and interpretation of the composite indexes.

One index, the Disaster Deficit Index, concerns the financial capacity of countries to absorb the economic losses and recovery costs of a major disaster (figure 8). Values greater than one indicate that the country would not be able to meet the financial demands of a hypothetical major loss event.

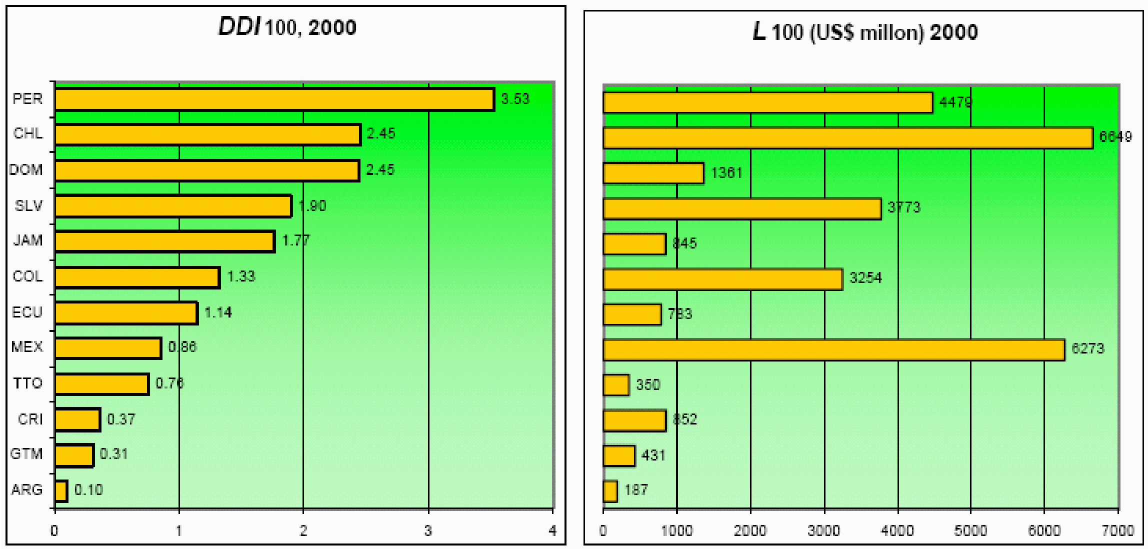
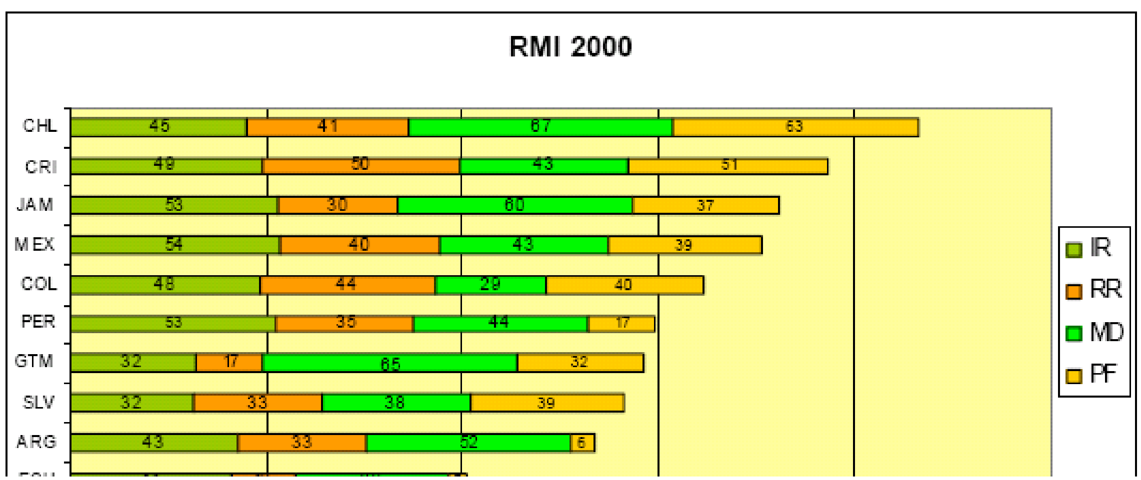


Figure 8 Disaster financing deficit index for maximum probable loss in 100 years for 12 countries in the Americas (Cardona 2005)

Another index, the Risk Management Index, evaluates risk management performance in the areas of risk identification, risk reduction, disaster management and governance and financial protection (figure 9). Countries with higher values are judged to be more able to manage disaster risks.



Thus, in the past two years, new information has become available that suggests which countries and regions are most at risk, from which hazards and, to some degree, from which vulnerability factors. These analyses set the stage for focused work in high risk areas to identify the causal factors of disasters in support of risk management decision-making. This project has the potential to assist in making disaster risks more visible, enabling them to be reduced before disasters happen, leading to reduced losses.

Loss and risk identification priorities: Opportunities for cooperation

The following section outlines three areas of work where there is potential to advance the state of the art with respect to the assessment of losses and risk and the application of loss and risk information to disaster and risk management. The first focuses on loss assessment and loss information, the second on improving the evidence on disaster risks, and the third on systematically enhancing the knowledge, experience and tools for loss and risk identification.

Information on disaster losses: Data and applications

Information on disaster losses plays a crucial role in disaster and risk management. Considerable value-added can be obtained by organizing the collection and use of this information to serve multiple purposes (figure 1). The first area of use (box "I" in figure 1) is disaster management. Secondly, over time, data on accumulated losses can be captured in loss databases containing essential information on each disaster (box "II" in figure 1). This information on accumulated losses and the costs of relief, recovery and reconstruction document the impact of disasters on development. The third area in which loss data is a crucial input is the assessment of risks of future disasters (box "III" in figure 1). Risk information is vital for contingency planning and disaster preparedness as well as for prioritizing measures to reduce losses over time. The following section briefly sketches priorities for continued attention within each area.

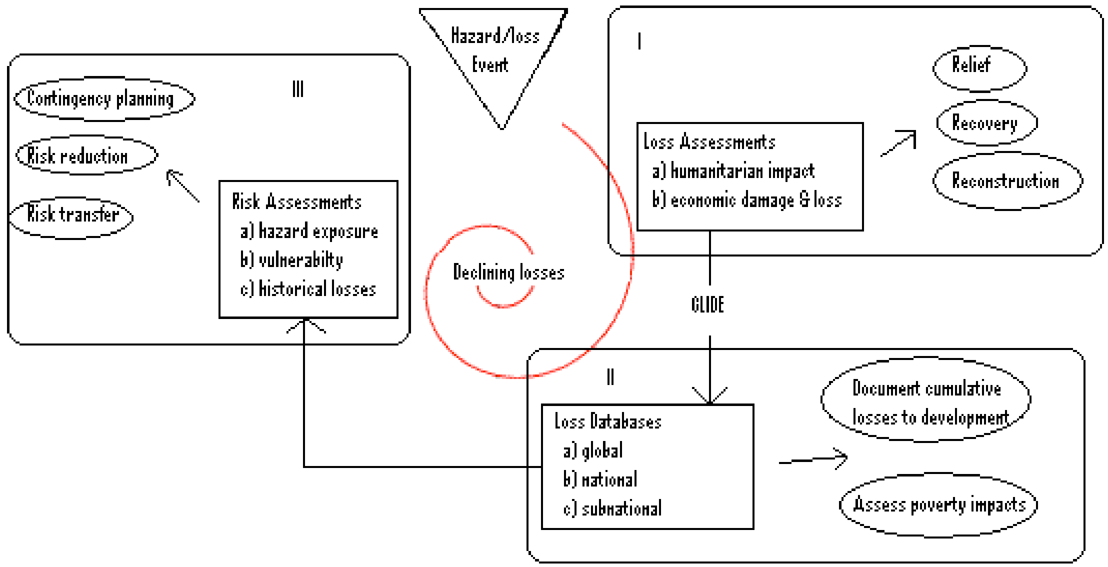


Figure 10 Multiple-uses and value-added of data on disaster losses used throughout the disaster and risk management cycle

When a disaster occurs, the response can be divided into three phases: relief, recovery and reconstruction. Each phase is supported by assessment information that supports key decisions in each domain. In the relief phase, assessment data includes how many people were killed, injured or displaced, and their degree of access to basic requirements -- water, food, shelter and medical care. This information is used to estimate needs for relief supplies. Recovery involves the initial restoration of the functioning of the economy, government and society. Damage and loss data, combined with an analysis of political, livelihood and social systems, supports recovery planning. Data on the economic value of damages and losses is used as the basis for estimating the financial requirements for reconstruction and for reconstruction planning. More work needs to be done to integrate data collection, compilation and analysis in support of decision-making in each of these phases.

trends in losses. They document the cost of disasters to development and the allocation of these costs across economic sectors and socio-economic classes. The disaster history of a country or region also provides information concerning the risks of future disasters. Loss trends provide important indicators for monitoring the successfulness of disaster reduction efforts. Although such databases exist, they are not well integrated and capacity is needed in disaster-prone countries to collect and maintain this type of data on a sustained basis.

One crucial convention for building and maintaining disaster databases is the GLobal disaster IDEntifier, or GLIDE. The GLIDE was conceived by the Asian Disaster Reduction Center, in Kobe Japan. It consists of a unique number for each disaster, incorporating a two-letter hazard code, a unique sequence number and geo-location codes based in ISO standards. The location codes are hierarchically formatted to allow data to be disaggregated or aggregated regionally, nationally or sub-nationally. Use of the GLIDE allows historical events to be unambiguously identified. This facilitates verifying data on a single event across multiple sources, linking hazard event data to disaster data, and referencing reports, evaluations and other material about the disaster. The GLIDE creates the potential for a global, multi-tiered, decentralized tracking system for disaster losses, in which data on losses, hazards and other information from multiple sources can be virtually linked. More information on the GLIDE can be seen at www.glidenumber.net and www.reliefweb.int . Incorporating the GLIDE into existing and emerging loss data bases, cross-linking entries in these databases, and linking disaster to hazard event data will constitute a major undertaking.

Accumulated information on historical losses is a crucial input for understanding disaster risk patterns. While historical losses may not completely reflect future losses, information on historical losses is vital for corroborating results of risk analyses based on hazard exposure and vulnerability. Risk information supports decisions related to setting risk reduction priorities and measures, the design of risk transfer schemes, and disaster preparedness. One particular preparedness activity is contingency planning. Identification of high risk areas creates the possibility of developing scenarios of likely future disasters. Such scenarios can be used to refine response roles and responsibilities, pre-allocate resources and work out logistics in advance of potential disasters. Contingency plans lead to more effective, quicker response. Risk information allows contingency planning and preparedness efforts to be more systematically prioritized. The potential for such prioritization based on new evidence of disaster risk patterns has not been fully explored, however.

Regularly updated risk information at multiple scales

The preceding section focused mainly on loss data. This one explores in more detail the creation and use of evidence on disaster risks.

Many crucial risk management decisions are made at the national and local levels. It is therefore crucial to begin to systematically develop more in-depth information on risk levels and risk factors at larger scales to inform risk management efforts. Much work has been done at larger spatial scales, but many high-risk areas remain inadequately served with evidence concerning the causal factors of disasters. Much could also be done to compile risk information at larger scales more systematically, to begin to evaluate methods and results and contribute to development of a global knowledge base on risk patterns and risk identification good practices. Information on global and regional risk patterns described above provides a basis for focusing efforts in areas where risks of disasters are highest.

National level

Areas experiencing frequent disasters and known to be at high risk are prime candidates for comprehensive risk management planning in order to reduce risks and losses. An adequate evidence base on which to make risk management decisions is crucial in order to get maximum benefit from available resources.   Coverage of these high risk areas with risk identification analyses is uneven. Greater focus on these areas, using rigorous methods and high-resolution data at national and sub-national scales, would yield improvement. Compiling and evaluating existing analyses would provide an invaluable foundation for this effort and constitutes an important next step.

For many reasons it is important that local institutions have the primary responsibility for generating and maintaining risk assessment products. These include the need to incorporate local knowledge, sustainability, ownership, maintenance and cost. Having the ability to generate, maintain and apply risk information at national and sub-national scales may require infusions of financial and technical resources, however. Therefore a system that can routinely provide this type of support is needed if high-quality risk information is to become widely available for risk management decision-support in high risk areas.

As one moves from smaller to larger spatial scales, from the global to the community level, scientific rigor must be increasingly complemented by stakeholder participation

In parallel with, and in support of, the promotion of science-based risk identification in high risk countries, there is a need to continue to advance work on risk identification globally. One area of work is to systematize technical support for risk assessment "downscaling" at the national level. This includes development and application of methods, collaboration with local experts on specific aspects of risk identification analysis, and development of a toolkit for risk identification. The toolkit would be initiated by compiling methods, lessons learned and best practices from existing risk assessment literature and practice. As new results are obtained, new methods, results, lessons learned and good practices would be compiled and added to the tool kit.

Improvements can also be made in existing global products, such as those described previously. Areas for improvement include better global data on hazards, exposure and vulnerability and better methods for integrating these data to assess risks. Given the importance of floods and droughts globally, improving the global data on these hazards is particularly important. The recent Indian Ocean tsunami underscores the need for a better characterization of risks associated with that hazard in coastal areas as well.

Cross-scale integration

One means of supporting the process of compiling and enhancing risk information at multiple scales is to create a global risk information platform in which data at multiple scales can be integrated. The higher the risks, the more important it is to have higher resolution. An integrated risk information system could support the regular release of a global report on the state of disaster risk. The report could regularly update the status of risk globally, with chapters submitted by countries focusing on particular high risk areas. Routinely generating such a report would be facilitated by having a GIS-based, web-accessible platform into which data and results at different scales could be incorporated. As risk patterns change, or new data and results become available, revised results could be generated and interpreted for priority setting and decision-making. In the interim the risk information platform would support development and integration of new data sets and on-going revision of results.

A later phase could begin to incorporate dynamic risk assessment and predictions -- on-going recalculation of risks based on such things as current storm tracks, cumulative and projected rainfall anomalies, volcanic activity etc. Hydro-meteorological hazard probabilities in particular vary seasonally and inter-annually in ways that are increasingly well understood.

The setting of standards is also important. The credibility of loss and risk information as a basis for decision-making and resource allocation depends on scientifically rigourous theory, data and methods. As the demand for these products grows it is critical that the ability to supply them keeps pace.

Risk management decision-support

The investment required to realize the above vision would only be justified to the extent that it has a material impact on the reduction of disaster losses. By this standard, the effective use of loss and risk information to reduce losses constitutes another evaluation factor in addition to the technical quality of loss and risk assessment work. A number of criteria affect the likelihood of loss and risk information contributing to the overall goal of loss and risk reduction.

In high risk areas, there should be a broad-based commitment to risk management, particularly within the government, but also including civil society, research institutions and the private sector. Involvement of these stakeholders in the process of identifying risks is key to developing analyses that support real-world decisions by real-world agents.

Since many disaster prone countries are also poor, it helps if there is a strong commitment to risk management by the international community as well. Agencies that have key roles to play in this regard include the United Nations system, bi-lateral donors, international finance institutions, and non-governmental organizations. Risk and loss information can help raise the visibility of disaster risks among these constituencies and encourage them to work together to develop and act upon a common set of evidence-based risk management priorities. Increasingly the private sector is participating in the development of innovative ways to transfer as well as reduce risks.

Requirements for achieving high quality loss and risk assessment results include national and/or local technical capacity, adequate and accessible data, and inter-institutional cooperation. Scientific work at national and local scales with insufficient engagement by local experts is unlikely to contribute to achieving reduced losses over the longer term.

Finally, the biggest payoffs will be in the highest risk areas, where disasters are virtually guaranteed to continue to occur until measures are taken to reduce and transfer the risks. Such areas warrant the time, effort and resources necessary to mobilize comprehensive, address the root causes of disasters, rather than the consequences. Reduction of recurrent losses in disaster-prone areas would increase the potential for secure, sustainable development.

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