CENTER FOR HAZARDS & RISK RESEARCH AT COLUMBIA UNIVERSITY

The World Bank Group

ASSESSMENT OF HIGH-RISK DISASTER HOTSPOTS

BRAINSTORMING MEETING

SYNTHESIS AND RECOMMENDATIONS

A Joint World Bank/Columbia University Workshop
Lamont-Doherty Earth Observatory, Palisades, New York
6-7 September 2001

On September 6-7, the Center for Hazards and Risk Research at Columbia University and the Disaster Management Facility conducted a meeting to solicit expert input for a global project to identify areas of highest natural disaster risk (meeting announcement with project description attached). The project is funded by a grant to the World Bank and ProVention Consortium from the United Kingdom's Department for International Development Conflict and Humanitarian Assistance Department.

Approximately 30 people attended the brainstorming meeting (participant list attached). Day one consisted of approximately 20 short presentations followed by questions (final agenda attached). Presentations were wrapped up on day two, followed by several hours of moderated plenary discussion on the major themes identified.

On the basis of input provided by the brainstorming meeting, the World Bank will prepare terms of reference for the project. The range of technical challenges identified at the meeting, as well as the challenges of incorporating the potential contributions of other major stakeholders working in this area, suggest that the project should be implemented in two phases. The first phase will provide an initial "rough-cut" global risk assessment results for key hazards and affected populations and elements. Additional research directions and partnerships identified during the first phase will be the basis for a second phase and final products. It is hoped that the data, methods and partnerships developed in the course of the project will provide an on-going framework for continuing tangible progress in the area of global natural disaster risk management.

The following summary is based on presentations and discussion at the brainstorming meeting. The summary does not comprehensively cover all themes and issues presented and discussed. Additional material can be found in individual presentations posted on the website report of the meeting:

Rationale for project

Background materials and opening remarks by the meeting organizers describe the disaster risk hotspots project as a means of providing a rigorous analytical basis for narrowing down a global problem -- natural disasters -- to smaller, highest risk, geographic areas where natural disaster risk management is most crucial. Through spatial analysis of recent and forthcoming global data sets, the project will seek to characterize and quantify natural disaster risks and their causes to

obtain a data-based, first-order identification of areas where additional risk identification, reduction and transfer measures are especially warranted.

Discussion of the hotspots project rationale at the brainstorming meeting raised issues such as:

- participation and stakeholder involvement
- the economic merits of disaster prevention and the relative merits of alternative preventive measures
- appropriate formulations of disaster-loss outcomes against which to assess risks (e.g. mortality or economic impacts)
- the role of science for informing policy
- the complementary roles of global- and national/local-scale analyses
- the utility of a data-based global risk identification project when it can be argued that disaster-prone areas are already identifiable based on personal experience, existing national-level disaster event databases and case studies, and
- the significance natural disasters when compared with other global problems such as HIV/AIDS.

In the context of the issues raised, the following points were made or are worth noting:

- The hotspots project will provide input for allocating disaster and risk management resources geographically, sectorally and pre- versus post-disaster but its results will not have a deterministic effect on decision-making in any of these areas.

- As the initial stage of the project is global in scope, the initial stakeholders are primarily international organizations. At national to local scales, however, it is understood that regional, national and local-level stakeholders will not only be involved but also expected to provide essential input for determining research priorities.

- While the project is expected to identify high disaster-risk areas, it is not expected to identify risk reduction priorities within those areas. The project focus is on risk identification rather than reduction and, in any case, risk reduction and transfer measures clearly must be based on the priorities and capacities of national governments and at-risk communities rather than on results of a global geographic analysis.

- National-level disaster-event databases catalogue instances of "realized risk" but provide a limited basis for comparing risks between geographic areas, identifying risks at sub-national scales and specifying the portion of the risk contributed by hazards versus vulnerability-related causal factors. The hotspots project will identify the actual geographic distribution of risk based on the spatial distributions of risk factors and elements at risk, albeit initially at a global scale, rather than using countries as the unit of analysis. The specific contributions to overall risk of: 1) geophysically-derived hazard event probabilities and, 2) the characteristics of vulnerable or potentially vulnerable elements, will be evaluated. It is hoped that further research will be assisted by the data and risk assessment methods tested and validated during the course of the project.

- Immediate applications for the project results that are within the manageable interests of the sponsoring organizations, who have disaster and risk management mandates, render questions regarding the utility of the project for decision-making moot. To meet such needs, however, the formulation of disaster-loss outcomes against which to measure risks must reflect both the humanitarian and economic dimensions of the disaster problem. It will also be important to clearly characterize and communicate uncertainties arising from the probabilistic nature of hazard events as well as data limitations. Finally, the results must be interpretable as a basis for concrete risk management action both globally and in larger-scale, more detailed, follow-up work.

Risk and assessment methods

In order to measure risk an outcome must be specified. Risks of this outcome can then be stated, for example as the probability of exceeding a specified threshold (e.g. 10 deaths/per 1000 inhabitants) or in terms of total expected losses.

There was discussion of a number of potential disaster-loss outcomes against which to assess risks. In the health sector, and from a humanitarian perspective, morbidity and particularly mortality are the central. From economic perspectives, potential outcomes include total direct and indirect economic losses, impoverishment or deepening of poverty, and proportional economic losses in relation to GDP (the latter of which could be interpreted as incorporating economic resilience).

Selection of outcomes will have to balance what would be optimal for user organizations with what is possible methodologically and given data constraints. For example, for World Bank applications it would be highly desirable to be able to measure disaster risks in terms of their effect on poverty. The only global wealth data set identified at the brainstorming meeting, however, was a national income map weighted by sub-national population distribution. Currently poverty maps are available for only a handful of pilot countries. While the EMDAT database maintained by the Center for Research on the Epidemiology of Disaster contains mortality figures for historical disasters, which would be useful for calibrating a mortality-based risk model, the economic data in EMDAT is insufficiently comprehensive to serve the same purpose with respect to economic outcomes. Such data constraints could limit the ability to compare predicted versus realized risk.

When considering the risks of particular outcomes, risk factors must be considered both individually and collectively. Hazards must be considered individually in order to identify elements at risk and vulnerability factors, and to set the stage for identification of mitigation measures. At the same time, the total risk of any outcome experienced a population or set of exposed elements may be a function of multiple hazards and vulnerability factors.

Another issue raised throughout the meeting is the fact that risks may be considered as static (e.g. the maximum flood level expected over a 100 year period) or dynamic, that is, constantly changing based seasonality, inter-annual climate variations, changes in population and the built environment, etc. Even in the case of static risk, the selection of time interval can drastically affect the risk assessment. For example, the risks of a major earthquake may be small over the next 20 years but significant over the next 200. Population, economic and environmental trends

can significantly affect risk within a decade. With the prospect of global climate change, some hydro-meteorological hazards may be dynamic at decadal time scales.

The hotspots project is not intended as an early warning system; thus the emphasis would seem to be on static risks. Nonetheless the dynamic character of particularly the elements at risk and their vulnerability will have to be considered when assessing risks even over relatively short time periods. Decisions will have to be made on how to handle time-dependent and time-independent assessment of risk.

A similar phenomenon to time-dependence arises with respect to spatial scale. A coarse grid size will result in different levels of assessed risk over set of selected points within a given cell than would occur if the cell were subdivided. It was also noted that many policy decisions as well as much data are based on the country as the unit of analysis. While a delineation of risk derived from spatial relationships between distributions of hazards and affected socio-economic elements would not be expected to conform to national boundaries, it may be useful or necessary to integrate national and non-national data for interpreting the implications of the geography of risk for countries as a whole. As many socio-economic indicators are country-based, allowing for this approach could also increase the kinds of data available integration and analysis substantially. Clearly a global risk analysis provides only a starting point for further attention to risk factors in high risk areas.

Incomplete data, the probabilistic nature of hazard events and the dynamic nature of risk overall dictate that results from the hotspots project will contain a high degree of uncertainty. Communicating uncertainty is a perennial conundrum for scientists and effectively acting on uncertain information is a perennial challenge for policy-makers. As the hotspots analysis is intended to inform both specialized and non-specialized audiences, special efforts will be needed to achieve clarity and transparency with respect to uncertainty in the results. At the same time, given that there will always be uncertainty, the benefits in incremental reductions in uncertainty will have to be carefully weighed and the pursuit of uncertainty reduction not distract from the project's overall goal of broadly identifying the geographic areas where effective risk management is most crucial.

Data requirements and availability

Presentations by experts on the full range of natural hazards and a selection of sectors provided an introduction to the data that could be available for the project. Some gaps or potential gaps were also identified. A summary of data coverage based on the information presented includes:

A. Hazards

- floods, earthquakes cyclones and volcanoes -- global data availability relatively good
- drought -- global data not immediately accessible but may exist somewhere in useable form; otherwise a dataset will have to be constructed from existing global climatic data sources
- landslides -- no global data set known to exist but one could be derived from global slope, soil and rainfall data

- tsunamis -- no global data set available and construction of one would be a major undertaking.

B. Elements at risk

- population -- several global datasets exist, and these can be used to weight national-level statistics such as income, male/female ratios, age profile, household size, etc.
- buildings -- a new global urban building stock dataset with considerable potential was presented
- urban -- geographic data on urban centers was not presented but such data is likely to be available
- infrastructure -- a difficult problem, as infrastructure is composed of different sub-systems (water, electric, telecommunications, transport, etc.) and sub-sub-systems, each with different and varied characteristics in terms of their response to hazards; some aggregate infrastructure characterizations could possibly be developed for selected areas, albeit with a considerable degree of subjectivity
- agriculture -- no existing global data set was identified
- water resources -- not covered at the meeting.

C. Vulnerability

- vulnerability was presented in terms of definitions and potential vulnerability factors to consider, both generally and in relation to specific hazards.
- generic vulnerability factors presented include institutional strength and performance, social networks, land rights, race/ethnicity, age, unemployment, access to credit, health care, governance, along with hazard-specific vulnerability factors
- at the global scale, a general understanding of vulnerability could be used to interpret the results of a global hotspots analysis derived initially from relationships between hazards and elements at risk
- it would also be possible to concretely identify and measure vulnerability factors at larger, more local scales for highest risk areas through case studies.

Integration of case studies

Case studies adhering to a consistent conceptual framework and using common or similar methodologies could:

- provide spot checks to "ground truth" the global analysis
- compare risks and risk factors between particular locations in more detail
- provide opportunities to involve national and local level stakeholders to expand project ownership beyond the circle of a few international experts
- permit vulnerability risk factors to be more rigorously included in the assessment of risk for particular places, and
- provide input for assessing the potential of specific risk management solutions in high risk areas.

Although their input data requirements might exceed what is available globally, a number of models were identified that could be used to incorporate vulnerability factors into an overall risk model for localized areas (Deodatis, Wyss, Kunreuther, Macleod). It was underscored that any case work, modeling or otherwise, would need to be based on local knowledge, priorities and involvement of key stakeholders at the national-local level if it is to have much value for national-local level follow-up risk management action.

Inclusion of case studies also provides an open-ended project structure in which the contributions of any investigator can potentially be incorporated into the overall analysis. Thus, even though the project would not necessarily fund any or all case studies that could potentially be undertaken, if the project develops criteria and provides a framework for such studies it will help to improve methods, leverage value from, and provide an organizing structure for individual studies that could otherwise simply be simply ad hoc, one-off , stand-alone efforts .

Stakeholders and partners

The need to involve stakeholders in any case studies also extends the case of the global analysis and partners and stakeholders working on vulnerability and risk assessment efforts globally. Several such initiatives were presented, including a geographic risk analysis for the UN Development Program's planned *World Vulnerability Report* conducted by the UN Environment Program. In addition to partners at the technical level with data and expertise needed to implement the hotspots analysis, there would be considerable value in terms of the project's overall goals in consulting regularly with sponsoring or "user" agencies whose operational needs the project is trying to address.

Thus, while a project management focal point is needed, the project clearly will involve collaboration across institutional boundaries in order to pull together even the core required expertise and participation. This core group can be augmented by a broader set of collaborating investigators who wish to participate in the project through work on specific themes or case studies.