CHALLENGES OF THE DECADE: NATURAL DISASTERS AND GLOBAL CHANGE

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by JAMES P. BRUCE
Chair, U.N. Scientific and Technical Committee for International Decade for Natural Disaster Reduction
Chair, Canadian Climate Program Board

INCREASING DISASTER LOSSES AND GLOBAL CHANGE

The rising toll of losses from natural disasters is an important, but often neglected manifestation of global change. The Munich Re-insurance Company estimates that natural disaster losses increased 3 times from the 1960's to the 1980's and insured losses nearly 5 times, adjusted for inflation.[1] Total global losses for 1990 were estimated to be of the order of $47 billion.[2] As many of you know very well, there are tricky problems involved in estimating the costs of disasters. While initial damage estimates pose serious difficulties, secondary effects, and the longer term impacts on economic development are even more elusive. Thus, while total damages may well be in considerable error, and probably understate the case, the trends, using consistent methodology, are probably more reliable, although the counting may be better now than in previous decades.

Accepting that there has been something like a 3 fold increase since the 1960's, what are the global changes that have brought this about? Are the natural hazards, that turn into disasters, more severe and frequent than in earlier decades? Or has the growing human population and its activities become increasingly exposed to the hazards, turning nazard into disaster?

The casual observer would suspect that the hazards themselves are increasing in severity and frequency. Since the beginning of the IDNDR in 1990 we have seen a sequence of major disasters. These include the tropical cyclones and floods of 1990 and 1991 in Bangladesh and the S. W. Pacific affecting 15-20 million people and resulting in hundreds of thousands of lost lives; earthquakes in Iran, California, and elsewhere; the disastrous floods of 1991 in China with losses estimated at $12 billion; the Mt. Pinatubo eruption in the Philippines, affecting 80,000 people; and renewed drought and famine in eastern Africa.[2]

In 1978, Burton et al[3] estimated that 90% of the world's major natural disasters are due to 4 types of hazards - floods, tropical cyclones, earthquakes and droughts. More recent estimates for 1964-89 based on data from the Office of U.S. Foreign Disaster Assistance (OFDA), indicate that some 93% of people affected in disasters including civil strife, are affected by those due to hydrometeorological (including drought and famine) and geophysical causes.[4] Heavily populated Asia and the Pacific Islands is by far the most disaster prone region, by any measure.

But there are difficulties even in trying to compare the relative magnitude of disasters caused by various environmental hazards. For example, in the U.S.-OFDA compilation of statistics on disaster history since 1900, "declared" disasters are only the more serious events but there are differing criteria for different hazards. For example, earthquakes and volcanos qualify if 25 or more people are injured or killed. Weather and flood disasters (excluding droughts) are "declared" only if 50 or more people are injured or die, and drought disasters are included only if "the number affected is substantial".[5] Given these difficulties and the fact that hazard occurrences are only well reported when they produce disasters, i.e. when they affect human settlements, it is quite impossible at this stage to say whether natural environmental hazards have been increasing in intensity or frequency over the period from the 60's to the 80's. There are, however, some factors that lend credence to the idea that hazards may be increasing.

HUMAN INFLUENCES ON NATURAL HAZARDS

We used to think of natural hazards as the forces of Nature or "acts of God". We now recognize that there are a number of ways in which global change due to human actions have been increasing the incidence and severity of such hazards. The removal of forests from the slopes of river basins, the erosion of agriculture soils leading to sedimentation of river mouths, and obstructions placed in channels, all contribute to increased flood levels and more damage. Droughts are often made more prolonged and severe by human actions which remove woody vegetation, and unwise agricultural and water management practices, changing the albedo, and the roughness characteristics of the land surface. There are some hints that a warming climate may also be at work in some types of disasters, but this must be considered mainly as a problem for the future rather than a process that has been documented.

There is the other side of this coin as well, as has been pointed out by Rattien.[4] That is, some kinds of natural disasters, for example, volcanic eruptions, have significantly changed atmospheric composition on a geological time scale. Even now, eruptions such as that at Mount Pinatubo in the Philippines inject large quantities of SO_2 and particles into the atmosphere, affecting significantly the atmosphere's radiation balance, at least for a year or so.

HAZARDS BECOME DISASTERS

But there is little doubt that the main factor causing the increased natural disaster losses is not the changes in natural hazards, but the increasing vulnerability of human communities to these environmental hazards. The major global change affecting the damage statistics is the rapidly increasing population and human activity in coastal zones and in earthquake, drought and flood-prone areas of the world. The limited efforts in disaster prevention, mitigation, warning and preparedness have simply not kept pace with the increasing exposure of populations to natural hazards.

Even advanced industrialized countries have much work to do in order to reduce potential losses. The Japanese National Land Agency Economist[15] estimates that an earthquake similar to that of 1923 would kill or injure 350,000 people in Tokyo if it occurred tomorrow.[7] The greatest tragedy is that in the less developed countries which are the most vulnerable to natural hazards, are least able to mount effective disaster reduction programs without substantial technical assistance. For example, of those developing countries with a high risk of c\floods, 55 have no adequate warning system.[8] Yet experience shows that reliable flood forecasts and warnings can reduce damages by between 6 and 40%. These are among the major challenges of the International Decade for Natural Disaster Reduction in the 1990's.

THE IDNDR - PROGRAM FRAMEWORK

The 25-member Scientific and Technical Committee for the IDNDR has established 3 main targets to be achieved by all countries by the year 2000.[2]

As part of their plans to achieve sustainable development, each country should have in place:

1. Comprehensive national assessments of risks from natural hazards, with these risks taken into account in development plans,

2. Mitigation plans at national and/or local levels involving long term prevention and preparedness and community awareness, and

3. Ready access to global, regional, national and local warning systems and broad dissemination of warnings.

To achieve these three targets, the Scientific and Technical Committee (STC) identified a program framework consisting of 7 main activities:

1. Identifying hazard zones and hazard assessment
2. Assessing vulnerability and risks
3. Raising awareness of decision and policy makers
4. Monitoring, predicting and warning of natural hazards
5. Undertaking long-term preventive measures, both non structural (e.g. land use planning), and structural (e.g. civil works and building codes)
6. Undertaking short-term protective measures and preparedness
7. Planning and executing early intervention measures (at the time of or immediately after hazards strike)

It is recognized that to achieve the targets within the program framework, a number of supporting activities are required. These activities cut across all program elements and include:

- education and training,
- public information programs,
- transfer of appropriate technologies both between and to, developing countries, and
- application of existing knowledge and techniques.

In addition, there are a number of important research needs, to devise better and more accessible techniques and to provide socio-economic input to policy development.

These targets and the program framework elements have been endorsed by the Special High Level Council for the Decade. This Council, which consists of 10 prominent members chaired by Hon. Miguel de la Madrid, past president of Mexico, will promote and advance the work of the IDNDR at the highest political and industrial levels.

The STC could not possibly review and approve all projects that fit into this program framework, since IDNDR projects are required at local, national, regional and global levels and in many fields. However, as an initial step the Committee did consider it important to identify from a number of proposals before it, some international demonstration projects which could make valuable contributions, and would demonstrate the types of activities needed.

These projects include:

1. Tropical Cyclone projects: Research and improved warning systems by the International Council of Scientific Unions and World Meteorological Organization to improve tropical cyclone risk assessments and preparedness.
2. Volcano Hazard reductions, including better risk mapping, instrumentation and mobile early-warning systems through ICSU and the U.N. Educational Scientific and Cultural Organization (UNESCO).

3. Minimizing Earthquake vulnerability for improved global hazard assessment, warnings and disaster management involving ICSU and U.N. Disaster Relief Organization (UNDRO).

4. An improved disaster data base and information system - coordinated by UNDRO.

5. Education, research and training activities, including disaster management training by UNDRO and the U.N. Development Program (UNDP), preparation of better training materials (UNESCO), and Roving Seminars (World Federation of Engineering Organizations (WFEO) and the Union of International Technical Associations (UITA).

6. Improved risk assessment, including input from the Tropical cyclone project[1] and the development of comprehensive risk assessment techniques from all types of hazards; coordinated by WMO.

7. Preventive Projects: Low cost structural designs for developing countries to minimize casualties and damages (World Health Organization (WHO) and WFEO and UITA, with CERESIS - Regional Centre of Seismology for South America).

8. Technology Transfer: Extension of a simple successful PC-based technology transfer scheme for floods and droughts developed by WMO to other types of hazards in a project called System for Technology Exchange for Natural Disasters (STEND).

9. Public Health projects to improve disaster preparedness and management plans and responses (WHO) and disaster mitigation for hospital facilities (Pan American Health Organization (PAHO) part of WHO).

10. International Centres for research and training in disaster reduction: the furthest along in planning is Morocco. Should these be a part of the IGBP-START initiative for global change research centres in developing countries?

11. The Instability of Mega-cities: led by the International Agency of Engineering Geology (IAEG) and International Union of Geological Science (IUGS).

It should be clear from this group of important projects that the international scientific community and agencies are coming together effectively to advance the objectives of the IDNDR.

National and regional organizations are also urged to participate in these international projects and to initiate projects of their own. The IDNDR Secretariat in Geneva acknowledges and keeps a registry of all projects world-wide which fit within the program framework and wish to use the IDNDR designation. At last count some 100 countries have designated national committees or focal points for the IDNDR and many are working vigorously to improve disaster management in their own countries and regions. Taken together, after a rather slow start, there are now heartening signs of progress under the IDNDR banner.

CLIMATE CHANGE - POTENTIAL EFFECTS ON NATURAL HAZARDS

One worry in the minds of many, is the potential impact of climate change on natural hazard frequency and severity. Since hydrometeorological hazards are the most important causes of disasters in much of the world, this is not an unreasonable concern. To assess the potential effects requires a projection or scenario of future climate. The projections which depict the most likely future, are those of the Intergovernmental Panel on Climate Change (IPCC), established by WMO and UNEP in 1988.* While intergovernmental in initial structure, many leading scientists from academic and private institutions participated actively in the scientific assessment and reviews of socio-economic impacts and policy options. More

than 1000 specialists from 70 or so countries participated. The IPCC report of 1990 was reviewed at the Second World Climate Conference of Oct-Nov 1990. The science assessment was accepted as the best scientific consensus that could be achieved at this time. The IPCC is currently up-dating its science assessment. In private discussions, Sir John Houghton of U.K. the chair of the Scientific Assessment Working Group, has said that the research and modelling results of the past year and a half have not significantly changed the main conclusions of their 1990 report.

I am sure that many of you are familiar with that report, but let me remind you of some of the key conclusions and projections as they might affect disasters world-wide. The IPCC reviewed the rapid increase in atmospheric greenhouse gas concentrations, especially in the last few decades and stated that:

"We are <u>certain</u> that these increases will enhance the greenhouse effect, resulting on average in an additional warming of the earth's surface." They go on to predict, under a **"business as usual"** scenario for greenhouse gas emissions, and on the basis of model outputs from a number of countries, **"a rate of increase of global mean temperatures during the next century of 0.3°C per decade with an uncertainty range of 0.2°C to 0.5°C per decade; this is greater than that seen over the past 10,000 years".** Their projection for related sea level rise is for the observed rise of the past few decades of 1 to 2cm/decade to increase to about 6cm/decade, with an uncertainty range of 3 to 10cm, giving by the end of the next century an increase of 2/3 + or - 1/3 metre.

The IPCC noted the uncertainties associated with these global predictions, and that even more surround the regional projections. However, they had sufficient confidence to advance projections for 3 of the 5 regions they studied. For Central North America, and the European portion of the Mediterranean basin they predict summer conditions 2 to 3°C warmer than pre-industrial times by 2030, with 15% - 20% reductions in soil moisture, i.e. more frequent and severe droughts. In the Southern Asia region (mainly India and Bangladesh) a 1 - 2°C. temperature increase is projected by 2030, but with a strengthening of summer monsoon circulations, an increase of 5 - 10% in soil moisture, suggesting more severe river flooding, but fewer droughts. A further robust outcome of the models is more winter snowfall in the Arctic and Sub-Arctic with earlier and more rapid spring melt, suggesting larger and earlier spring floods in Arctic basin rivers.

The greatest concern for disasters must centre on the potential effects on small island countries and low lying coastal areas of the projected sea level rise, especially in regions where tropical cyclones and accompanying storm surges occur. The IPCC's Response Strategy working group's report concentrated considerable attention on the urgent need for improved coastal zone management to reduce exposure to hazards, as an important adaptation strategy.

One issue of considerable uncertainty is the possible effect of global warming on the frequency and severity of tropical cyclones. Currently an average of 80 of these killer storms form in tropical regions each year. Conditions required for formation of tropical cyclones are:[10]

1. ocean surface temperatures greater than 26.5°C, coupled with a relatively deep oceanic mixed layer,
2. significant values of absolute vorticity in the lower atmosphere,
3. weak vertical wind shear directly overhead, and
4. mean upward motion and high mid-level humidities.

These are the conditions that favour deep convection and tropical cyclogenesis. The future climate scenarios from the climate system models indicate higher sea surface temperatures which would imply potentially more severe and widespread tropical cyclones. However, the model outputs also suggest greater atmospheric stability with more warming in the upper troposphere than near the ground and thus an inhibiting change in the third and fourth factors listed above. This suggests that the potential for increased cyclone activity as a result of higher sea surface temperatures may not be fully realized.

In examining this complex situation for the Australian region, Holland and his colleagues[11] also note the close relationships between regions of tropical cyclone formation in the S.W. Pacific and the state of the El Nino - Southern Oscillation (ENSO) phenomenon. The interaction between greenhouse gas induced warming and ENSO has not been well explored and this makes projections of future tropical cyclone activity of this region very difficult. Early conclusions of Holland et al are that there could be an increase in cyclone activity in the central South Pacific, which could seriously affect the Cook, Society, and Somoan Islands and Kirabati.

In general, however, the signals are too conflicting to draw conclusions about changes in frequency and severity of tropical cyclones, although it seems likely that their normal range will expand as sea surface temperatures rise.

Whether or not tropical cyclones increase, the frequency of severe storm surges in the islands nations of the Pacific and Indian Oceans, the Caribbean Sea, the Bay of Bengal, the Philippines, Florida and other regions will be exacerbated by sea level rise. This makes imperative the improvement of coastal zone or island management plans to reduce loss of life, property and human suffering in tropical storms and storm surge flooding.

This has been just a short overview of some of the implications for natural hazards and disasters of a global warming induced by anthropogenic increases in greenhouse gases. Other speakers will undoubtedly address this theme further.

THE POLICY ISSUES

From the point of view of public policy are the inter-relationships between responses to the issues of climate change, and disaster reduction being recognized? The U.N. Conference on Environment and Development the "Earth Summit" in Rio de Janeiro in June of this year offers a marvelous opportunity to make the connection. It is evident that natural disasters frequently set back the hard won economic development of developing countries with periodic drops in national economic output highly correlated with occurrence of major natural disasters[12]. It is also evident from experience, especially in developed countries, that human losses and economic impacts due to natural hazards can be significantly reduced. As Mary Anderson[13] has pointed out, "economic losses as a percentage of national wealth are 20% higher in developing countries", and as Burton et al[3] note "about 95% of disaster related deaths occur among the two thirds of the world's population that occupy developing countries". There have been several calls for all countries to build into their plans for sustainable development, the preventive and preparatory measures needed to reduce the human and economic losses from natural disasters. These have come from the High Level Council and the Scientific and Technical Committee for the Decade[2], from the Latin American countries in their Guatemala Declaration of September 1991[14], from the Commonwealth Expert Group on Environment and Sustainable Development[15] and from ICUN's prescription for "Caring for the Earth"[16]. The IDNDR provides an excellent opportunity to improve international cooperation to reduce losses in the developing world through use of techniques both proven and new.

Action must be taken to place this issue firmly on the UNCED agenda, since the "Earth Summit" provides a great opportunity to draw to the attention of the world's leaders, the need for incorporating disaster planning into every national development plan. "The basic argument for integrating disaster awareness into development planning is that it is wasteful not to do so"[12], and I would add, it is tragic that it has not been done in many vulnerable countries.

The issue of climate change also has a profound North-South dimension, and is already a major focus of the UNCED'92 Earth Summit Agenda. There is widespread realization that the burning of fossil fuels, and other human activities since the beginning of the industrial era, have profoundly changed the chemical composition of the global atmosphere. The changes are continuing at ever-increasing rates, altering the radiation balance at the earth's surface. We have already considered some of the potential consequences. The "Precautionary Principle" in the face of remaining uncertainties, and our obligations to vulnerable countries, especially the island states, makes it abundantly evident that we in the north, especially in North America, must reduce our dependency on fossil fuels. Many of the energy efficiency and fuel switching measures required to reduce greenhouse gas emissions could also save us money, help make us competitive in the world, while reducing our burden on the global atmosphere.

To address the issue thoroughly requires a global bargain such as that being formulated by the International Negotiating Committee (INC) for a Climate Convention. We cannot expect the developing countries to withhold the benefits of economic progress from their people. We can and must find ways to assist this progress in a manner that minimizes the additional impact on the global environment. This will involve some profound changes - reversing the flow of financial resources which currently goes from South to North, assisting with appropriate energy technologies and protecting tropical forests. The developing countries must be helped to follow efficient energy pathways in their economic development, "leapfrogging" over the dirty era of our northern industrial development. These issues are central to the climate negotiations now underway which, it is hoped, will be well-advanced by the time of the Rio "Earth Summit".

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13. Anderson, Mary B. (1990). Which costs more: prevention or recovery? in "Managing natural disasters and the environment". Eds. A. Kreimer and M. Munasinghe, The World Bank, Washington, pg 17-27.

14. Guatemala Declaration (1991). Report of the Scientific and Technical Committee for IDNDR, Second Session, Guatemala City, 16-20 Sept., 1991, Annex III.

15. Commonwealth Group of Experts (1991). "Sustainable development: an imperative for environmental protection". Commonwealth Secretariat, Marlborough House, Pall Mall, London, SW1YSHX, 130 pp.

16. The World Conservation Union (IUCN), UNEP, and WWF, (1991). "Caring for the Earth: a strategy for sustainable living". Gland, Switzerland, 228 pp.

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7. The Economist, 7 Dec., 1991. "Waiting for the big one". pg 101-103.

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10. Frank, W.M. (1985). Tropical cyclone formation: Chapter 3 in "A Global View of Tropical Cyclones". Eds. R.L. Elsberry et al, U.S. Office of Naval Research, 185 pp.

11. Holland, G.L., McBride, J.L. and Nicholls, N. (1988). Australian region tropical cyclones and the greenhouse effect", in G.I. Pearman, (ed) Greenhouse: Planning for Climate Change: CSIRO, and Brill, Leiden and Melbourne, pg 438-55.

However, even with the greatest imaginable commitments to reductions of greenhouse gas emissions and to reforestation, a major increase in greenhouse gas concentrations has already taken place, and will continue for a number of decades. Thus adaptation strategies including disaster mitigation, are not an alternative to greenhouse gas limitation strategies, but are an absolutely essential feature of a considered response to climate change.

SUSTAINABLE DEVELOPMENT

The major goal of the UNCED process is to take cooperative steps, world-wide, towards development which is much more sustainable, environmentally and economically. Sustainable development cannot be achieved without addressing these two major issues, two related challenges of the Decade, climate change and disaster reduction. The international framework to address these issues is now in place in the form of the International Decade for Natural Disaster Reduction and the International Negotiating Committee for a climate change convention. These should come together at the Earth Summit this June. Let us work to ensure that these issues are effectively addressed in Rio de Janeiro, and that the vital connections are recognized in national and international policies and decisions.