2.2 Emerging trends in hazards, vulnerability patterns and the impact of disasters

More than 90 per cent of the deaths related to natural disasters occur in developing countries. Disaster impact statistics show a global trend that there are now more disasters but fewer people dying, even though greater numbers of people are affected and economic losses are increasing.

Physical exposure of human beings and the fragility of economic assets to disasters have been partly shaped by patterns of settlement. Beneficial climatic and soil conditions that have spurred economic activities are associated with hazard-prone landscapes. Both volcanic slopes and flood plains historically have attracted human activities.

Where settlement patterns have contributed to configure risk scenarios, new forces such as population growth and increased rural/urban migration act as dynamic pressures which contribute to increasing people's exposure to hazards.

Poverty levels and the impact of development processes, especially those associated with an increasingly global society reflect current trends in socio-economic vulnerability related to the impacts of disasters. The pace of modern life has also introduced new forms of vulnerabilities related to technological developments and biological threats.

Localized and systemic environmental degradation is becoming highly influential as well, lowering the natural resilience to disasters. This is demonstrated by delayed recovery time and a weakened resource base on which human activity relies.

Phenomena like El Niño/La Niña, climate change and the potential for rising sea levels, are affecting the patterns and intensity of hydrometeorological hazards. Environmental degradation influences the effects of natural hazards by exacerbating their impacts and limiting the natural coping capacity and resilience of the areas affected.

Biological hazards in the form of plant or animal contagion, extensive infestations, human disease epidemics and pandemics continue to influence society in new and unpredictable ways. They exert particular impact on critical social aspects such as mortality, family relationships, health and economic productivity, among other things.

Disasters triggered by technological hazards often result in major accidents associated with industrialization and technological innovation. These can have a significant socio-economic and environmental impact. Although technological hazards have been part of society for hundreds of years, trends show increasing impact.

Specifically, in the energy, transportation and industrial sectors, technology can carry associated risks that are not always understood. The adverse effects of some technological disasters, both on society and on the environment, can considerably outlast the impacts associated with natural disasters.

Trends in impact of disasters

While no country in the world is entirely safe, the lack of capacity to limit the impact of hazards remains a major burden for developing countries, where over 90 per cent of natural disasters fatalities occur. Twenty-four of the 49 least developed countries still face high levels of disaster risk. At least six of them experienced between two and eight major disasters during each of the last 15 years, with long-term consequences for human development. These figures do not include the consequences of the many smaller and unrecorded disasters that cause significant loss at the local level.

In its annual publication *Topics* for 2000, the re-insurance giant Munich Re – a member of the Inter-Agency Task Force on Disaster Reduction – looked at the trend of economic losses and insurance costs over a 50-year period.

It based its analysis on what it calls "great natural catastrophes." There were 20 of them that accounted for US$ 38 billion in economic losses (at 1998 values) between 1950 and 1959. However, between 1990 and 1999, there were 82 such major disasters and the economic losses had risen to a total of US$ 535 billion. That is, the number of disasters had multiplied fourfold but economic losses were 14 times higher.

Economic losses in these cases are absolute figures, mostly losses incurred in industrialized countries. When seen as losses by percentage of GDP, it is developing countries that lose most, as shown in the table based on figures provided by Munich Re. For example, the economic losses of the United States from the 1997-1998 El Niño event were US$ 1.96 billion or 0.03 per cent of GDP. The economic losses in Ecuador were US$ 2.9 billion, but this represented 14.6 per cent of its GDP.

The International Federation of Red Cross and Red Crescent Societies, another ISDR Inter-Agency Task Force member, confirms the worsening trend of human suffering and economic loss during the last decade.

The total number of people affected each year by natural disaster – that is, who at least for a time either lost their homes, their crops, their animals, their livelihoods or their health, because of the disaster – almost doubled between 1990 and 1999.

In this period an average of 188 million people per year were affected by disasters. This is six times more than the average of 31 million people affected annually by conflict.

Even though the number of disasters has more than tripled since the 1970s, the reported death toll has decreased to less than half. It is important also to remember that smaller disasters are generally under-reported and therefore are not ordinarily reflected in global data. Their accumulated consequences likely reflect significant socio-economic tolls.

Box 2.1
The ecological footprint

Every human requires an area of land and shallow sea for food, water, shelter, transport, energy, commerce and waste.

In rich nations such as the United States, this ecological footprint is almost 10 hectares per person. But even in the poorest places in the United States this footprint is at least 1 hectare.

Every day, another 200,000 newborns will require up to 200,000 hectares of what might have been a benign and necessary wilderness. More people also means more fossil fuel consumption, which means more carbon dioxide emission, which means climate change.

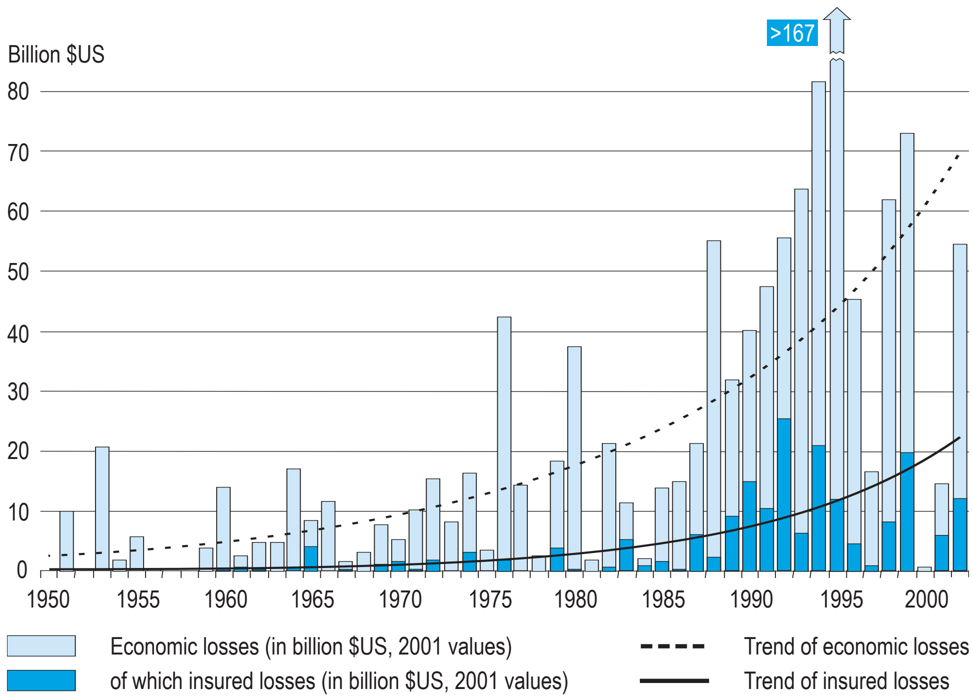
Such a world, climate scientists have warned repeatedly, is a world with a greater frequency of extreme events. Demographic pressures result in more forest loss and more land degradation. This means increased flooding, drought or both. The combination of climate change and population growth will exact a price.

The latest UN calculation is that three decades from now, around 70 per cent of the world's land will be affected in some way by human activity and half the people in the world will be short of water. Many of the other half will be at risk from increased flooding. By that time, there could be 8 billion people on the planet.

Adapted from: E.O. Wilson, Scientific American, February 2002.

Figure 2.5

Economic losses, major* natural disasters, 1950-2002



Source: MunichRe, 2002

*Note: Exceeding 100 deaths and/or $US 100 million in claims

There is considerable geographic variation in the occurrence and impact of natural hazards. Asia was affected by approximately 43 per cent of all natural disasters in the last decade. During the same period, Asia accounted for almost 70 per cent of all lives lost due to natural hazards.

During the two El Niño periods of 1991-1992 and 1997-1998, floods in China alone affected over 200 million people in each period. Nevertheless, in relative terms and considered per capita, Africa is the most heavily affected region, in particular when drought, epidemics and famine are considered.

The most terrible year in human losses during the last decade was 1991, when a cyclone devastated Bangladesh killing 139,000 people, bringing the global deaths for that year to 200,000.

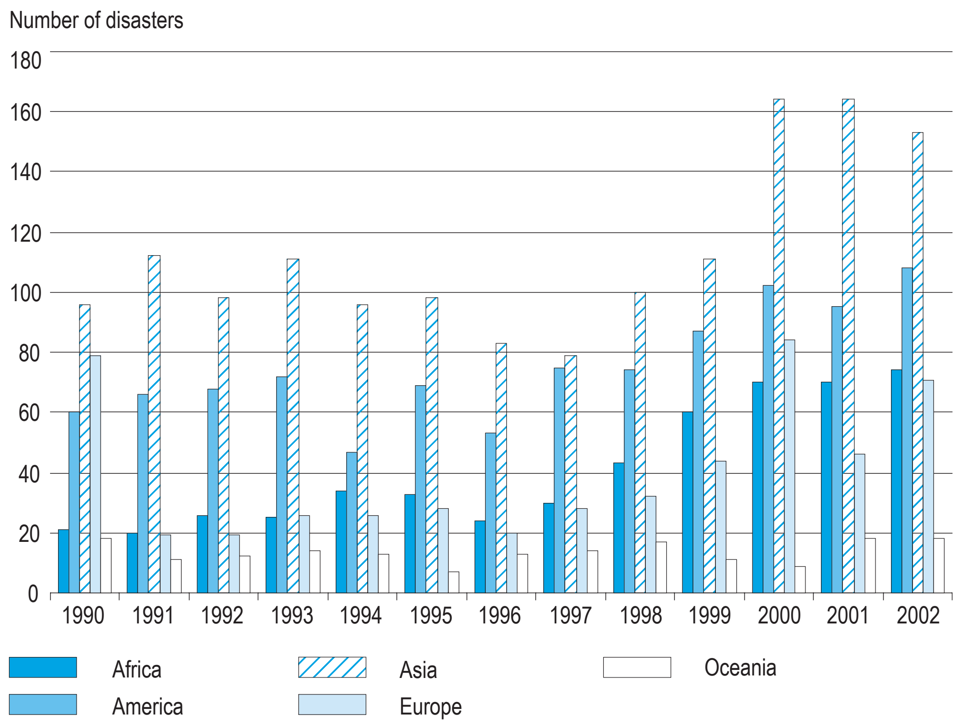
Cyclones continue to hit the Bangladesh coasts but such a catastrophe has not happened since. This is in part because the machinery of warning and preparedness – watchful officials, an aware public and a stronger sense of community responsibility – has improved in the last decade.

The worst disaster-related global economic loss of the 1990s was the 1995 Great Hanshin-Awaji earthquake in Kobe, Japan. A highly developed and well-prepared nation faced serious setbacks economically by losing important facilities of a primary port. Even eight years after that disaster, the amount of trade passing through Kobe remains 15 per cent less than pre-earthquake totals.

A particular concern emerging from long-term disaster trends is that the number and impact of weather-related disasters have rapidly increased over the last few decades. A comprehensive study undertaken by the World Meteorological Organization (WMO) looked at weather impacts for 2002 and examined their complexities and impact on different countries.

Notable points from this study were the catastrophic floods in Europe in August, causing losses of about $20 billion (the bulk of the year's global losses), the severe winter for Mongolia resulting in estimated losses equal to 15 per cent of gross national income, and the tropical storms in the Federated States of Micronesia, where the fatalities reached the exceptionally high national rate of 40 per 100,000 people.

Figure 2.6
Total number of reported natural disasters, 1991-2002



Source: EM-DAT: The OFDA/CRED International Disaster Database - www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium, 2004

Trends in hazards

Until recently, intensity and frequency patterns of natural hazards followed natural variations in global temperatures and tectonic activity. Today, while the scale of seismic and volcanic activity reflects these long time-scale variations, it appears that frequency and intensity of hydrometeorological hazards is being affected by a changing climate.

Although it is very difficult to show scientific evidence of these changes, projections for the future invite concern, as shown by the findings of the Intergovernmental Panel on Climate Change (IPCC). In some ways, societies are not only responsible for their own socio-economic vulnerability, but also are increasingly responsible for shaping new trends in hazard occurrence.

Hydrometeorological hazards

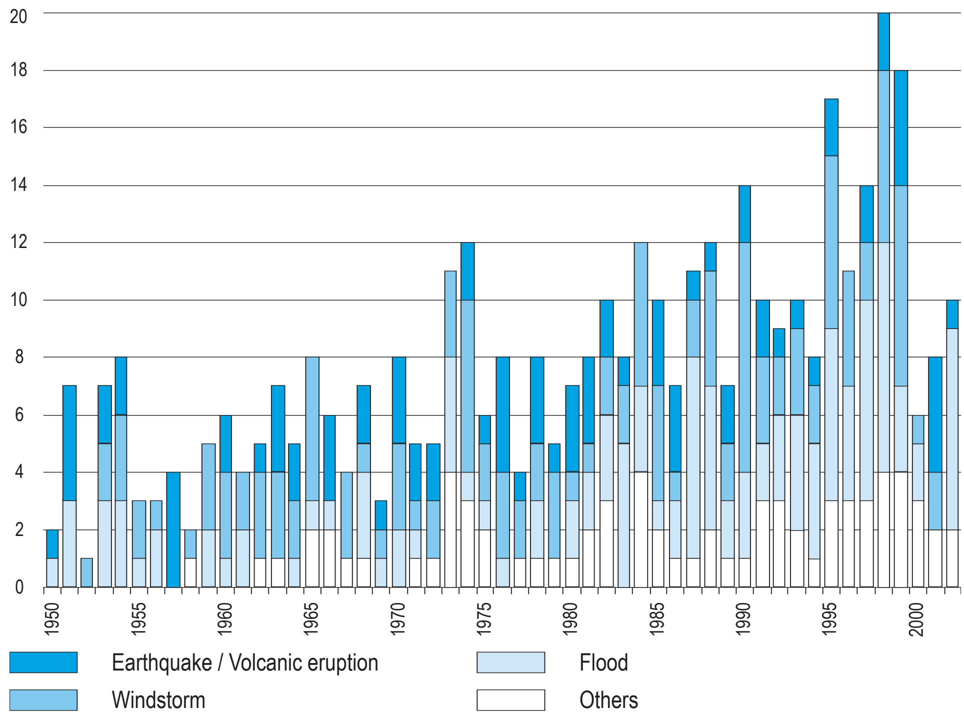
Societies are increasingly affected by inter-annual variations in climate such as those associated with El Niño/La Niña, which affect precipitation and temperature on inter-annual timescales that are only predictable to some degree. These regional climatic shifts can produce hydro-climatic hazard events associated with climate variability. The prevalence of droughts and floods that trigger disasters shows that many countries are vulnerable to natural climate variability and extremes.

Projected climate changes in coming decades expected to accompany global warming, are likely to change the frequency and intensity of climate hazards in ways that may adversely affect some regions. When dealing with the complex subject of climate change, some issues are now accepted by most scientists: temperatures are increasing globally, although these increases are not evenly distributed around the planet. As the atmosphere becomes warmer it can absorb more water vapour, leading to an increase in humidity. As a result, more water moving through the hydrological cycle will lead to more precipitation per event, more variability and more frequent climate extremes in relation to current climate ranges.

These factors are expected to influence the occurrence and impact of disasters by affecting the intensity and frequency of extreme

Figure 2.7

Great natural catastrophes, 1950-2002



Source: CRED International Disaster Database, 2003Source: EM-DAT: The OFDA/CRED International Disaster Database - www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium, 2004
Note: Natural disasters of at least 1 000 deaths or 1 billion 2002 $US of economic losses

Box 2.2

El Niño outlooks

Climatic factors that affect the occurrence of natural disasters are influenced by irregularly recurrent phenomena such as the El Niño and La Niña. Atmosphere and ocean circulation models project that as the earth's climate warms over the next 100 years, it is likely that a more El Niño like condition may persist, leading to an increase in the incidence of floods and droughts in many parts of the world.

Both the 1982-1983 and 1997-1998 El Niño events, the strongest ever recorded, had disastrous impacts on Pacific Rim countries and the effects were felt worldwide. According to a 1999 scientific study led by WMO, the socio-economic impacts associated with the 1997-1998 El Niño events included:

- more than 24,000 lives lost because of high winds, floods or storm tides, that occurred during intense storms;
- more than 110 million people affected and more than six million people displaced as community infrastructures, including housing, food storage, transport and communications, were lost during storms; and
- direct value of losses exceeding US $34 billion.

This highlights the need for better monitoring of the phenomena, better forecasts of the related extreme events, and more importantly, stronger institutions to deal with such information and to increase community preparedness and resilience.

WMO, in collaboration with the US National Oceanic and Atmospheric Administration and the International Research Institute for Climate Prediction, has undertaken to coordinate the preparation of El Niño outlooks whenever the threat of an event manifests itself, as a contribution to the Inter-Agency Task Force on Disaster Reduction.

These outlooks draw on additional contributions from the Australian Bureau of Meteorology, China Meteorological Administration, the European Centre for Medium Range Weather Forecasts, Japan Meteorological Agency, National Institute of Water and Atmospheric Research in New Zealand, Met Office United Kingdom, and the Climate Variability and Predictability Project of the World Climate Research Programme.

hydrometeorological events. As is known, changes in precipitation patterns, soil moisture and vegetation cover are linked to the occurrence of floods and droughts as well as contributing to landslides and other types of debris flow. Another likely result of global warming is rising sea levels which would contribute to higher storm surges during hurricane and typhoon landfall in coastal areas.

The Inter-Agency Task Force on Disaster Reduction (IATF/DR) has a working group dealing with climate and disasters. In the area of drought preparedness and mitigation, there are a number of coordinated and collaborative initiatives that are foreseen to be undertaken within the framework of the IATF/DR involving all its working groups.

Box 2.3

2002 floods in Europe

Flood damage
Unusually heavy rain provoked record floods in Europe and Asia in 2002. According to WMO, "Floods in more than 80 countries have killed almost 3,000 people and caused hardship for more than 17 million worldwide since the beginning of 2002. Property damage amounted to over US$ 13 billion with more than 8 million square kilometres of land affected by floods – an area almost as large as the United States".

In Europe, the rains starting in August provoked flooding of the major rivers, including the Elbe, Danube, and Vltava. Prague and Dresden were at the centre of the storm, with the Czech Republic, Slovakia, Germany and Austria hit hard. Also affected were Italy, Spain, Russia, Romania and Hungary. Over 100 people died, hundreds of thousands were evacuated, and there was extensive damage to basic infrastructure and the commercial and private sectors. According to MunichRe, the losses in economic terms amounted to more than 15 billion Euros.

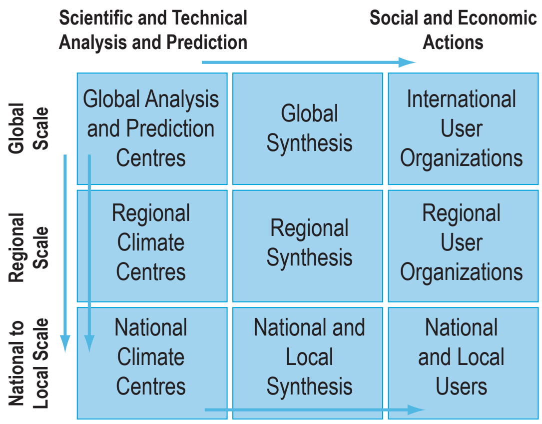
Tea and sympathy
Responding to the floods, some Mozambican artists organized a concert called "Bridge over troubled water" in sympathy for the affected people, although their country is still recovering from the 2000 and 2001 floods. The Government of Sri Lanka, for its part, airlifted no less than 2000 kilograms of Ceylon tea to German, Austrian and Czech flood victims.

Source: <http://www.reliefweb.int/w/rwb.nsf/s> and <http://www.iutcolmar.uha.fr/internet/Recherche/JCERDACC.nsf>.

Box 2.4

ISDR working group on climate and disasters

WMO leads a working group of the IATF/DR. It consists of members representing UN agencies, regional and scientific organizations and the private sector. It examines how scientific climate information is best conveyed to different user groups.



It is important that global, regional and national centres work together to ensure that users, who obtain information from various sources, receive a consistent message and applicable information.

The working group defined a matrix for more coordinated and systematic information transfer between those involved in the interpretation of scientific assessments and the many different user communities. The working group is also preparing El Niño outlooks.

In view of the increased frequency and intensity of meteorological and hydrometeorological hazards, this working group, together with another working group on risk, vulnerability and impact assessment, has expressed a need to improve disaster impact databases and to link them to climate databases.

Drought

Drought is usually characterized in terms of its spatial extension, intensity and duration. Its creeping characteristics and various impacts make the adoption of a precise and universally accepted definition of drought difficult, adding a degree of confusion. Drought is often forgotten once it ends, and seems to catch everybody unawares again once it reappears.

Droughts are usually classified as being meteorological, hydrological, agricultural, economic or social in nature, revealing the multiple and cross-cutting causes and impacts on societies and ecosystems.

Box 2.5
ISDR discussion group on drought

The ISDR ad hoc discussion group on drought, composed of sixteen experts, has produced a report, titled An Integrated Approach to Reducing Societal Vulnerability to Drought. The document identifies many critical issues associated with drought risk reduction, including:

- supporting and strengthening programmes for the systematic collection and processing of meteorological and hydrological observations;
- building and strengthening scientific networks for the enhancement of scientific and technical capacities in meteorology, hydrology and other related fields;
- developing an inventory of climate and water resources indicators and indices;
- improving understanding of drought climatology (frequency, intensity and spatial extent) and patterns;
- understanding the principal causes of drought at local, regional and global levels;
- developing decision support models for the dissemination of drought-related information to end users and appropriate methods for encouraging feedback on climate and water supply assessment products, and on other forms of early warning information;
- developing and disseminating vulnerability and risk assessment tools that are appropriate for different social and environmental conditions;
- disseminating drought planning methodologies that can be adopted by drought-prone countries in the preparation of plans;
- developing national and regional drought management policies that emphasize monitoring and early warning, risk assessment, mitigation and response as an essential part of drought preparedness;
- supporting development of regional networks for drought preparedness that build greater institutional capacity by sharing lessons learned in drought monitoring, prediction, vulnerability assessment, preparedness and policy development;
- educating policy makers and the public regarding the importance of improved drought preparedness as a part of integrated water resources management; and
- enhancing collaboration among regional and international organizations, within regions as well as between regions to address overlapping responsibilities and jurisdictional issues.

The complete report is available on ISDR’s web site <http://www.unisdr.org>.

Meteorological drought is defined by the deficiency of precipitation from expected or normal levels over an extended period of time. Hydrological drought is best defined by deficiencies in surface and subsurface water supplies leading to a lack of water for meeting normal and specific water demands.

Usually triggered by meteorological and hydrological droughts, agricultural drought may be characterized by deficiency in the water availability for specific agricultural operations such as deficiency of soil moisture, which is one of the most critical factors in defining crop production potential. Economic droughts have been referred to as low rainfalls outside the normal expected parameters with which an economy is equipped to cope. Social droughts are linked to the direct, as well as indirect, impacts on human activities.

During coming years, it is expected that vulnerability to drought will increase, mainly due to population increases, environmental degradation and development pressures. Several efforts have therefore been made at international, regional and national levels to address drought challenges.
In that context, and unlike sudden-onset disasters, drought presents unique characteristics that require different approaches to reduce their impacts.

- Drought does not directly destroy shelter, infrastructure or food stores.
- Drought effects are cumulative.
- It is often very difficult to detect the onset of droughts until major impacts become discernible, such as lack of water or food.
- Impacts can be spread over a larger geographical area than the damages that result from most other natural disasters.
- Quantification of impacts and provision of disaster relief is far more difficult.

Further, there are several social and economic parameters that affect the severity of drought. Food prices, conflicts, human activity, vegetation, water supplies and demand, all make it extremely difficult to quantify or define indicators of its severity.

Southern Africa
Drought has been a recurrent feature in most parts of Southern Africa, with five recent major

periods of drought, in 1980-1983, 1987-1988, 1991-1992, 1994-1995 and 1997-1998. Three of these events were regional in scale, with the 1991-1992 drought considered the worst in living memory, placing more than 20 million people at risk.

Central and South-West Asia

The persistent multi-year drought occurring in Central and South-West Asia since November 2001 is an example of climatic variability that has affected up to 60 million people in parts of Iran, Afghanistan, Tajikistan, Uzbekistan and Turkmenistan.

Chronic political instability in many parts of the region and military action in Afghanistan have further complicated the situation. A recent study by IRI concludes that over the last three years Central and South-West Asia represent the largest region of persistent drought in the world.

In Iran alone, 37 million people have been affected. Water reserves in the country were reduced by 45 per cent in 2001, 800,000 head of livestock were lost in 2000, and 2.6 million hectares of irrigated land and 4 million hectares of rain-fed agriculture were affected. Damage to agriculture and livestock has been estimated by the UN at US$ 2.5 billion in 2001 and US$ 1.7 billion in 2000. Afghanistan and Pakistan are affected on a similar scale.

Sea level rise and coastal systems

An estimated 46 million people living in coastal areas are at risk of flooding from storm surges every year, and sea-level rise poses a longer-term threat. Climate change may likely exacerbate these trends with significant impacts upon the ecosystems and populations. A growing number of people will inhabit coastal areas.

Many traditional communities and subsistence populations also rely on the wealth of resources in coastal areas and continue to be drawn to these high-risk regions. For example, indigenous coastal and island communities in the Torres Strait of Australia and in New Zealand's Pacific Island Territories are especially vulnerable.

Although adaptation options exist, such measures are not easily implemented on low-lying land. Also, climate change and sea level rise issues are not yet well incorporated in current models for coastal zone management.

Box 2.6

Reducing drought impacts

The need to improve drought preparedness through the development of policies and plans has become well accepted: South Africa (early 1990's), sub-Saharan Africa (UNDP/UNSO, 2000), West Asian and North African countries, Mediterranean region (CIHEAM, 2001), Morocco. Some of these programmes were developed with the UN Convention to Combat Desertification (UNCCD). The total number of countries who ratified the Convention is 190 (as at December 2003).

In Australia, the 1992 National Drought Policy is widely recognized as a successful policy and often replicated. It has three main objectives:

- encourage primary producers and other sections of rural Australia to adopt self-reliant approaches to managing for climatic variability;
- maintain and protect Australia's agriculture and environment resource base during periods of extreme climate stress; and
- ensure early recovery of agriculture and rural industries, consistent with long-term sustainable goals.

Table 2.2
Examples of impacts resulting from projected changes in extreme climate events

Projected changes during the 21st century in extreme climate phenomena and their likelihood[a]	Representative examples of projected impacts[b], all high confidence of occurrence in some areas[c]
Simple extremes	
Higher maximum temperatures: more hot days and heat waves over nearly all land areas (very likely[a])	• Increased incidence of death and serious illness in older age groups and urban poor • Increased heat stress in livestock and wildlife • Shift in tourist destinations • Increased electric cooling demand and reduced energy supply reliability
Higher (increasing) minimum temperatures: fewer cold days, frost days, and cold waves over nearly all land areas (very likely[a])	• Decreased cold-related human morbidity and mortality • Decreased risk of damage to a number of crops and increased risk to others· • Extended range and activity of some pest and disease vectors • Reduced heating energy demand
More intense precipitation events (very likely[a] over many areas)	• Increased flood, landslide, avalanche, mudslide and debris flow damage • Increased soil erosion • Increased flood runoff could increase recharge of some floodplain aquifers • Increased pressure on government and private flood insurance systems and disaster relief
Complex extremes	
Increased summer drying over most mid-latitude continental interiors and associated risk of drought (likely[a])	• Decreased crop yields • Increased damage to building foundations caused by ground shrinkage • Decreased water resource quantity and quality • Increased risk of forest fire
Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities (likely[a] over some areas[d])	• Increased risks to human life, risk of infectious disease and epidemics • Increased coastal erosion and damage to coastal buildings and infrastructure • Increased damage to coastal ecosystems such as coral reefs and mangroves
Intensified droughts and floods associated with El Niño events in many different regions (likely[a])	• Decreased agricultural and rangeland productivity in drought and flood-prone regions • Decreased hydro-power potential in drought-prone regions
Increased Asian monsoon precipitation variability (likely[a])	• Increased flood and drought magnitude and damages in temperate and tropical Asia
Increased intensity of mid-latitude storms (little agreement between current models[b])	• Increased risks to human life and health · Increased property and infrastructure losses

a Likelihood refers to judgmental estimates of confidence used by TAR EGI: very likely (90-99% chance); likely (66-90% chance). Unless otherwise stated, information on climate phenomena is taken from the Summary for Policymakers, TAR WGI.
b These impacts can be lessened by appropriate response measures.
c High confidence refers to probabilities between 67% and 95% as described in Footnote 6.
d Information from TAR EGI, Technical Summary, Section F.5.

Source: Report of working group II: Impacts, adaptation and vulnerability of the Intergovernmental Panel on Climate Change, 2001

Box 2.7
Disaster risk and climate change

Although climate change from rising greenhouse gas concentrations is not implicated as the primary cause of the growth of disasters over recent decades, it remains highly relevant to disasters and to disaster reduction for several key reasons:

1. The existing trends evident in weather parameters, though small, will be having some effect on hazard events already – for example rising global temperatures on heat waves.
2. The Intergovernmental Panel on Climate Change (IPCC) has consistently projected the likelihood of increased frequency and intensity of hazards in the future – when and where these changes will become manifest is very uncertain, so precautionary preparations are essential.
3. The experience of countries in managing multiyear climatic changes can provide valuable lessons for dealing with the projected longer-term changes.
4. Disaster reduction provides a solid, meaningful, no-regrets set of activities in support of climate change adaptation plans.
5. Responses to the climate change issue, in respect to both emission mitigation and adaptation, will inevitably alter the climate-related risks of countries, possibly negatively.

Source: Report of working group II: Impacts, adaptation and vulnerability of the Intergovernmental Panel on Climate Change, 2001

Geological hazards

Geological hazards include internal earth processes of tectonic origin, such as earthquakes, tsunamis and volcanic emissions, as well as external processes such as mass movements – landslides, rockslides, rock falls or avalanches, surface collapses, and debris and mud flows.

Earthquakes and volcanic eruptions represent the classic rapid-onset, sudden-impact hazards. The regional distribution of earthquakes and volcanoes is closely related to the geophysical activity associated with the tectonic plates. Most of the world's earthquakes and volcanoes occur along the tectonically active margins of these major plates – but also at weak points within them.

While many tectonic hazards occur less frequently in a particular place than other hazards, explosive demographic growth and rapid urbanization processes increase the exposure of human beings and their economic assets.

Earthquakes and volcanic activity also act as triggering events for secondary or tertiary hazards. Ground-shaking effects produced by earthquakes can promote tsunamis and seiches, and are associated with mass movements such as landslides, avalanches and rockfalls. In the same fashion, ground deformation that accompanies magma's rise in eruptive phases of volcanoes can generate massive landslides, debris flows and lahars.

Mass movement and landslides contribute to major disasters every year on a global scale, and their frequency is on an upward trend. The number of deaths caused by landslides is likely underestimated, since they are usually masked by the broad disaster statistics of earthquakes and floods. Recent examples are the debris flows in Venezuela in December 1999 with around 20,000 deaths, and the El Salvador earthquakes of 2001, which caused 600 deaths in just one landslide.

Box 2.8
Towards landslide risk management

The Joint Technical Committee on Landslides (JTC-1) comprises representatives from the International Society for Soil Mechanics and Geotechnical Engineering, the International Society for Rock Mechanics and the International Association for Engineering Geology. The JTC-1 promotes the development of educational programmes, including research, information dissemination and new techniques in landslide risk reduction. It also organizes events related to landslide risk management, such as the international symposium on landslides held every four years.
<http://www.em.pucrs.br/islrio>

Another initiative on this subject is the International Consortium on Landslides (ICL), a scientific NGO based at Kyoto University, created under the auspices of UNESCO, WMO, FAO and the ISDR Secretariat. The ICL aims to promote landslide research, as well as landslide risk assessment and mitigation studies. To this purpose, it is facilitating the development of specific projects in conjunction with the protection of cultural and natural heritage.
<http://icl.dpri.kyoto-u.ac.jp/>

Volcanic hazards

About 50 to 60 volcanoes erupt every year. Large eruptions endanger the lives, settlements and livelihoods of almost 500 million people estimated to live near active volcanoes. That number will increase in the future as more than 60 large and growing cities are located near potentially active volcanoes.

Volcanoes with high levels of activity are located predominantly in developing countries, particularly in Latin America, the Caribbean, and parts of Asia and in the South-West Pacific. Despite improvements in many national civil defence agencies, eruptions are becoming increasingly risky because of rising population densities and expanding infrastructure in the areas surrounding volcanoes.

As the physical characteristics and chemical properties of a specific volcano become better known, it can be monitored more easily. However, the prediction of an impending eruption is still a major challenge for volcanologists. Therefore, predicting future volcanic eruptions and related hazards must also be matched with a series of other forms of risk management, including:

- analysis of volcanic risks;
- early warning and short-term forecasting of eruptions;
- timely evacuation of people from hazardous areas;
- development of land-use and contingency plans to minimize future volcanic disasters; and
- sustained information programmes for the population.

Major volcanic eruptions do not occur spontaneously. They are preceded by a variety of physical, geological and chemical changes which accompany the rise of magma towards the Earth's surface. The monitoring of these changes with well-established scientific techniques provides the best opportunity to develop a warning system. Recent volcanic events show that the cost of monitoring volcanic activity and pre-disaster planning is very small when compared to the potential losses.

For early warning to be effective, sustained public education and information are necessary. This

Box 2.9

Nyiragongo Volcano, Democratic Republic of the Congo

Goma is overshadowed by two large and active volcanoes, Nyiragongo and Nyamalagira. Both are linked by a common subterranean geological structure, and the crater of the former contains what is said to be the largest lava lake in the world. According to a French-British scientific report in 2002, any weaknesses in the sides could result in catastrophic consequences for the surrounding population. Nyiragongo and neighbouring Nyamuragira are responsible for nearly two-fifths of Africa's eruptions.

Nyiragongo is considered by the scientific community as one of the most dangerous volcanoes in Africa. In 1977 extremely fluid, fast moving lava flows drained the lava lake killing about 50-100 people, although other estimates run as high as 2,000 fatalities. Additional activity occurred in 1982 and 1994. Significantly, following a crater eruption of Nyamuragira in January 2000, the only local volcanologist signalled the possibility of a later eruption of Nyiragongo, which indeed occurred in February 2001.

In May 2001, the small Goma observatory requested assistance to acquire seismographs, thermometers and funds to conduct field surveys. Nyiragongo again showed signs of activity later in the year, and an earthquake was felt in Goma while black smoke was sighted above the volcano. Similar phenomena were noted in January 2002, that suggested an imminent eruption.

The local volcanologist again sent messages to the international community four days later, raising the alarm and requesting assistance. Nyiragongo began erupting on 17 January and continued for six days. One lava flow headed for the town of Goma where it split the town in half. Another lava flow headed towards the town of Gisenyi in Rwanda.

According to an expert report, "the eruption forced the rapid exodus of 300,000 to 400,000 people, mostly into neighbouring Rwanda, with dramatic humanitarian consequences… Forty-seven victims were reported killed directly due to the eruption, to which one must add another 60 people killed during the explosion of the petrol station in Goma centre on January 21."

At least 16,000 homes were destroyed, leaving 100,000 people homeless, and 24,000 children without schools. Goma and Gisenyi also suffered from strong seismic activity associated with the eruption.

Adapted from: Final report of the French-British scientific team, 2002.

includes understanding results of volcanic studies and analysis, the possible dangers and the local plans to address them prior to emergency conditions. This can be done through education, although the best prepared communities also conduct regular disaster warning and prevention exercises.

In 1990, the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) launched a programme to support the UN International Decade for Natural Disaster Reduction (IDNDR) and to promote the reduction of risks related to volcanoes.

The initiative selected 16 volcanoes for monitoring and research with the aim of directing attention to a small number of active volcanoes. It encouraged a range of research and public-awareness activities aimed at understanding the volcanoes and the hazards they pose.

Biological hazards

A wide range of diseases, originated or transmitted by organisms that affect people, their crops or animals, are considered biological hazards.

Exposure to biological hazards is in many cases linked to the occurrence of other natural hazards, such as floods, drought, and storms. The increasing prevalence of hydrometeorological hazards may influence the occurrence of water- and vector-borne diseases such as cholera, malaria, leptospirosis and typhus.

In the same vein, vulnerability to insect infestations can constitute an additional source of concern for many countries, in association with the impacts of climate change. That could be the case for the Russian Federation, according to a recent national assessment of global climate change and associated risks.

The outbreak of severe acute respiratory syndrome (SARS) infected 6,000 people and caused more than 400 deaths in 30 countries. WHO has declared SARS as the most significant outbreak of disease spread through air travel in history. The various impacts of SARS,

Box 2.10

A society falling apart: Southern Africa's silent disaster

When more than 14 million people in Southern Africa faced famine in 2002, an intervention with food aid began that by February 2003 had averted mass starvation. But hunger was not the crisis. It was a symptom of a pernicious new process.

HIV/AIDS, together with food shortages, poverty, common disease and mismanagement is bringing a region to its knees. Millions are dying and all the food aid mustered will not save them. What is needed is an integrated approach that reverses the slow but inexorable destruction of Southern Africa's social fabric.

World attention is focused elsewhere because the television images that define disaster in Africa are missing in this case. There are not skeletal figures studded across the landscape, no agonizing evidence of malnutrition, no hunger camps, and no endless lines of wasting children with flies buzzing in their eyes.

Today's disaster is a silent one and most of those dying are dying at home. The disaster is the erosion of Southern Africa's communities. AIDS, a killer on its own, is uniting with other factors to weaken and undermine the ways in which people recover from adversity using age-old coping mechanisms.

Poor access to health care, the acculturated spread of tuberculosis, malaria and other diseases, an appalling absence of safe water and sanitation, uncontrolled urbanization and ineffective agriculture are among the aggravating factors. Added to this is AIDS. So many problems are emerging and they are quietly feeding and exploiting one another.

Life is becoming unsustainable. Farmers fall ill with AIDS, wives leave the fields to nurse them. Fewer hands in the field means less food, and coupled with drought, that may spell famine. But rain or no rain, there is poverty. The farmers die, leaving wives infected and penniless, wondering how to feed their children and pay for their education. They cannot afford seed or fertilizer, cannot work the land as they used to. And they agonize over their children's future. Who will care for them when they are orphaned?

Southern Africa already counts 3.2 million children orphaned by AIDS, many of them in households headed by the eldest child, where neither tomorrow's meal nor education is certain. Schools exclude them when they cannot pay the fees, buy exercise books and uniforms. While one generation is dying of AIDS, the next generation is being denied the right to succeed.

Adapted from: Juan Manuel Suarez del Toro, President of the International Federation of Red Cross and Red Crescent Societies, 2003.

ranging from the restricted access to goods, services and information as well as severe financial repercussions illustrate the increasing vulnerability to biological hazards in the context of a shrinking world.

Among the biological hazards that pose a threat to contemporary societies, the human pandemic HIV/AIDS occupies a special place. Due to its enormous social and economic impacts on communities, it also constitutes a major vulnerability factor for other natural hazards. In particular, HIV/AIDS exacerbates vulnerability to drought conditions.

The situation is very critical in Southern Africa, facing catastrophic consequences of HIV/AIDS infection. With many countries recording adult HIV infection rates of 25-30 per cent, the 1990s have seen the deaths of thousands of skilled people occupying middle-management positions in the private and public sectors.

Precious opportunities to develop sustainable local and technical capacities in disaster reduction have been undermined by continuing HIV-related deaths. With its far-reaching effects that span all professions, social sectors and communities in Southern Africa, HIV/AIDS will continue to constitute a major aspect of both household and national vulnerability for the foreseeable future.

Environmental degradation

As human activity continues to alter the biosphere, changes result in localized environments as well as in larger ecosystems. Environmental degradation compounds the actual impacts of hazards, limits an area's ability to absorb those impacts, and lowers the overall natural resilience to hazard impacts and disaster recovery.

In addition, environmental degradation that occurs and is significant enough to alter the natural patterns in an ecosystem, affects the regular temporal and spatial occurrence of natural phenomenon. Climate variability and climate change are currently the most obvious examples.

Environmental degradation, natural disasters and vulnerability are all linked. The connection between environmental degradation and the progressive impact of natural disasters can be illustrated by the case of the Yangtze River basin in China, where concerns related to environmental vulnerability have been incorporated in watershed management.

Viet Nam offers another example of the complex links between deforestation, floods and landslides. Viet Nam's forest cover dropped from 43 per cent to 28 per cent in 50 years. This is due to a combination of many years of war, with the use of deforestation as a tool of war; legal and illegal trade in timber as Viet Nam's economy became more open to international investment and trade; and also quite likely by climate change. Reduced forest cover makes the people of Viet Nam more vulnerable to floods and landslides.

Box 2.11
Flooding in China

The catastrophic floods in the Yangtze River basin, China, in 1998, brought to national attention the fact that changes in the use of land and the environmental degradation of watersheds had greatly exacerbated flooding. Extremely high levels of rainfall in the Yangtze Basin and rapid snowmelt from Tibet and the Himalayas only magnified the risks posed by degraded landscapes.

Prior to this event, the pressure for rapid development tended to overshadow environmental concerns. Since environmental degradation has now been firmly accepted as one of the root causes of increased impacts from natural hazards, it is essential to understand and act on both the conceptual and operational links between environmental management and disaster risk reduction.

Having concluded that flooding was worsened by environmental degradation, in 1999 the government formulated a new policy framework to promote ecological watershed management. As a result, a massive plan was initiated to redirect land-use management in river basins, targeted at the Yangtze and the Yellow River basins.

Figure 2.8
Link between environmental degradation, natural disasters and vulnerability

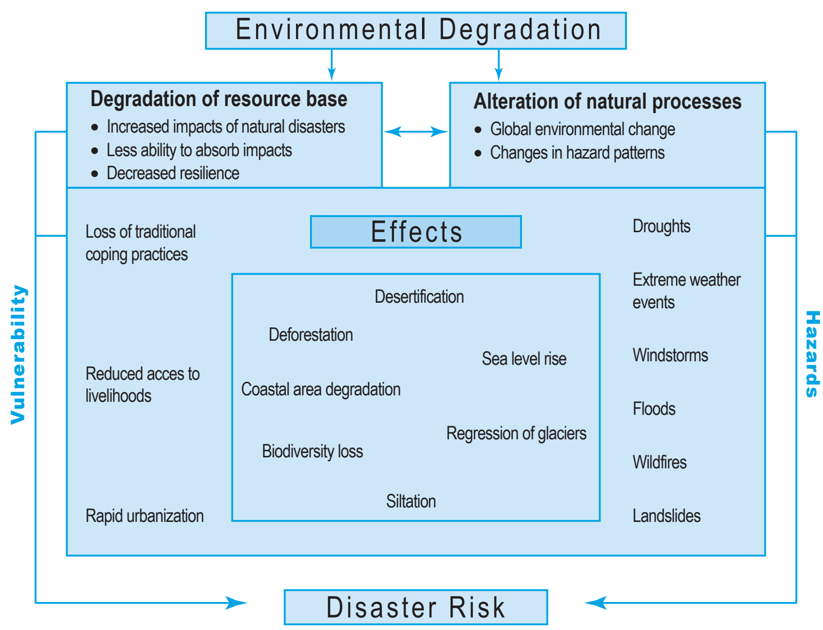


Figure 2.9 shows how primary and secondary effects of environmental degradation result in increased impacts of natural disasters – in this case in relation to watershed management and floods.

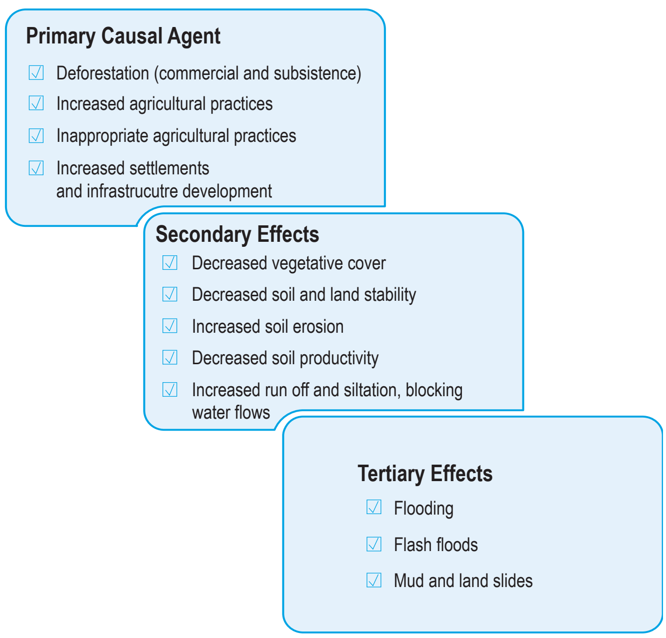
Land degradation and flash floods

According to UNEP data, two thirds of Africa is dry land, of which over 70 per cent is classified as degraded. About 90 per cent of pasture land and 85 per cent of croplands in the countries closest to the Sahara desert have been affected and there is some evidence that the desert is advancing on the south and east.

Deforestation is an important catalyst of land exhaustion and soil erosion. In Africa, more than 90 per cent of all wood is used for cooking and other energy needs and the demand for fuelwood has grown considerably. Since kerosene is expensive to buy, there is a shadow of land cleared of woodland around most settlements.

In effect, economic and social pressures – made worse by drought – have caused a breakdown of the traditional system of land-use management that was adapted to such fragile environments.

Figure 2.9
Primary and secondary effects of environmental degradation



Box 2.12
Land degradation in Southern Africa

Declining agricultural yields in countries of the Southern Africa Development Community (SADC) are also attributed to water erosion. In South Africa, as much as 6.1 million hectares of cultivated soil are affected by water erosion, with up to 300 million tons of soil lost annually due to physical degradation processes. Similarly, it is estimated that approximately 30 per cent of croplands in communal farming areas of Zimbabwe have been abandoned due to depleted soil fertility.

In Zambia, soil erosion by water is the most serious form of physical soil degradation, with approximately 100,000 hectares designated at various stages of degradation. Land degradation processes have been particularly prominent in Zambia as a result of deforestation, dense human population, overgrazing, poor crop cover and poor soil management techniques. This is reflected in marked deforestation, reaching 2,644 square kilometres annually from 1990-1995. While land degradation increases the severity of flood and drought impacts in the region, it is an unsurprising outcome, both of widespread rural poverty as well as macroeconomic forces.

Increasing land degradation also exacerbates flood risk, especially flash floods. In Southern Africa, escalating land degradation is strongly associated with overgrazing, which accounts for more than half the soil degradation in the region.

Wildland fire as an environmental hazard

Throughout the world, fire is part of agriculture and pastoral livelihoods. Natural wildfires are established elements in traditional land-use systems and have beneficial effects in natural ecosystem processes and in bio-geo-chemical cycles. However, the excessive use or incidence of fire due to rapid demographic and land-use changes leads to the destruction of property and reduction of natural productivity. Those consequences reduce the carrying capacities, biodiversity and vegetation cover of the landscape.

Climate variability such as the periodic occurrence of extreme droughts or the protracted effects associated with the El Niño/La Niña phenomenon add to the severity of fire impacts. Projected demographic and climate change scenarios suggest that these situations will become more critical during coming decades.

Box 2.13
ISDR working group on wildland fires

The objective of the ISDR working group on wildland fires has been to propose means and to facilitate the creation of mechanisms to share information and undertake tasks to reduce the negative impacts of fire on the environment and humanity. It brings together both technical members of the fire community and authorities concerned with policy and national practices in fire management to realize their common interests of fire risk management and disaster reduction at a global scale.

The working group was chaired and coordinated by the Global Fire Monitoring Center at the Max Planck Institute for Chemistry, in Freiburg, Germany. The working group attends to the existing programmes being implemented by its members to ensure complementary work plans. It has pursued several key priorities:

- Establish, and determine operational procedures for a global network of regional and national focal points for the early warning of wildland fire, fire monitoring and impact assessment, with the intention to enhance existing global fire monitoring capabilities and facilitate the functioning of a global fire management working programme or network.
- Propose internationally agreed criteria for the collection of fire data and related damage assessments in order to generate knowledge required by the various user communities at global, regional, national and local levels.
- Strengthen the existing regional, national and local capabilities in fire management and policy development through the dissemination of information and increased networking opportunities to meet multiple information needs. These include international initiatives such as the Convention on Biological Diversity, the Convention to Combat Desertification, the UN Framework Convention on Climate Change, the UN Forum on Forests, the FAO Global Forest Resources Assessment and the ongoing international criteria and indicators processes of the Collaborative Partnership on Forests. They also embody the overall scope of work of the UN agencies and programmes concerned.
- Transfer knowledge to local communities to advance their participation and utilization of appropriate tools that contribute to wildfire prevention, fire disaster preparedness and fire hazard mitigation.

In 2004 the working group developed into a global network and programme.

<http://www.fire.uni-freiburg.de>

Technological hazards

Technological hazards are related to quickly occurring, high-impact events such as hazardous chemical spills and nuclear accidents. They are therefore linked more with exposure rather than environmental degradation. In the case of hazardous materials – chemical and toxic waste or leakage – exposure is the critical factor.

That was the case in Bhopal, India, in 1984, where gas leaked to form a deadly cloud that killed and injured thousands of people. Most of these casualties came from poor families allowed to settle around the chemical plant. The fatal consequences of this chemical release were directly related to economic growth, as a complex and poorly managed industrial system threatened an unsuspecting and unprepared community.

Exposure to technological hazards is not exclusively an urban industrial issue. Virtually every modern product and process is disseminated to most countries and social settings. Of the 25 nations with operating nuclear power stations, at least 14 are in developing countries. Major oil spills and releases of nuclear radiation are associated predominantly with advanced energy and transportation technologies. Chernobyl, Exxon Valdez, Minimata and Bhopal are some unforgettable names of past technological disasters. These should underline the importance of reducing future risks.

Trends in physical vulnerability

Ninety per cent of the global population growth occurs in Least Developed Countries (LDCs). In these countries, exposure to hazards is already high through dense concentrations of population in often unsafe human settlements. Vulnerability levels are also exacerbated by socio-economic and environmental conditions.

In 1980, sub-Saharan Africa had a population of 385 million. This figure is expected to at least double by 2005. In some instances, food production represents 40 per cent of GDP, yet population growth is outstripping food production. What is more, food production could slow with less reliable rainfall patterns.

The long-term trends of demographic growth for LDCs are creating environmental, as well as political, refugees. As many as 10 million people have migrated during recent years but there may eventually be even greater redistribution of the African population in response to the deteriorating food situation. Some of this redistribution will likely concentrate even greater numbers in hazardous areas, or swell cities that are already poorly suited to address the needs of rapid growth.

Due to the urban concentration of population, the greatest potential for disaster exists in the 100 most populous cities. Over three-quarters of these are exposed to at least one natural hazard. No less than 70 of these cities can expect, on average, to experience a strong earthquake at least once every 50 years. The greatest concern is for the 50 fastest growing cities, all of which are located in developing countries.

Cities were often built on accessible locations with inherent risks such as coastlines, to facilitate transport, or floodplains because of their fertility with ample space for growth. Urbanization and increasing competition for land result in unregulated construction. This spills into adjacent high-risk areas such as hillsides, low-lying areas, industrial areas or floodplains.

Cities now hold disproportionate amounts of material wealth in terms of residential and commercial buildings and infrastructure. This infrastructure is critical to the economic activities of the city. The impact of disasters on cities can devastate national economies and limit access to industrial markets at an international level. This is especially important where one or two primary urban areas account for the major economic values and social vitality of a country.

Urbanization and rural displacement account for the rapid growth of informal, illegal settlements in the most risk-prone places near cities including Mexico City, Rio de Janeiro and Manila. Disaster risk concerns go hand in hand with other equally pressing urban issues, such as decaying infrastructure, poor housing and homelessness, hazardous industries, inadequate services, unaffordable and poor transportation links, and unemployment.

Table 2.3
15 largest cities in the world in 2000 and forecasts for 2010 (population in millions)

2000		2010	
26.4	Tokyo	26.4	Tokyo
18.1	Mexico City	23.6	Bombay
18.1	Bombay	20.2	Lagos
17.8	Sao Paulo	19.7	Sao Paulo
16.6	New York	18.7	Mexico City
13.4	Lagos	18.4	Dhaka
13.1	Los Angeles	17.2	New York
12.9	Calcutta	16.6	Karachi
12.9	Shanghai	15.6	Calcutta
12.6	Buenos Aires	15.3	Jakarta
12.3	Dhaka	15.1	Delhi
11.8	Karachi	13.9	Los Angeles
11.7	Delhi	13.79	Metro Manila
11.0	Jakarta	13.7	Buenos Aires
11.0	Osaka	13.7	Shanghai

Extract from *The State of the World's Cities*, UN-HABITAT, 2001.

Nearly 3 billion people, or almost half of the world population, live in coastal zones. Thirteen of the 15 largest cities in the world are also located by the sea. Not only is the exposure of people increased by their inhabiting hazard-prone areas, but a concentration of industrial infrastructure and critical facilities also worsen the situation. Communication and transportation networks, education and health infrastructure are increasingly vulnerable to the impact of natural hazards.

In some Andean countries, a trend is evident in the dynamic growth of the coastal areas. The Pan-American Highway links the main port cities of Lima, Guayaquil, Puerto Cabello and La Guaira. Rapid urbanization along this coastline contributes to increased levels of risk. Thirty-five per cent of the Peruvian population now lives between Lima and Callao.

The triangle formed by Quito, Guayaquil and Cuencas contains more than 70 per cent of the Ecuadorian population, inhabiting only 15 per cent of the national territory. The triangle formed by La Paz, Cochabamba and Santa Cruz accounts for 80 per cent of the total GDP of Bolivia, and about 70 per cent of the country's population.

In South Africa, it is expected that around 50 per cent of the population will live within 50 kilometres of the coast in the near future. While this affords economic and other opportunities, it also exposes millions of people to extreme weather events triggered by the Indian, Atlantic and Southern Oceans. Moreover, coastal development for tourism is being actively promoted in many countries, often located precisely in areas prone to tropical cyclones and tsunamis.

Another aspect of physical vulnerability is trade corridors. In Latin America there is the Central American Highway, the Quito-Guayaquil corridor, the Pan-American Highway in the Andean region, the Buenos Aires-Mendoza-Santiago-Valparaiso corridor, and Brazilian coastal corridors with maritime connections to Asian and European destinations. The development of trade corridors has political, economic, social and environmental implications. Their resilience to the impact of

Table 2.4
Urban population as a percentage of total population annual growth rate expressed as a percentage

	1970	1995	2015	1970-1995	1995-2015
Least developed	12.7	22.9	34.9	5.1	4.6
All developing	24.7	37.4	49.3	3.8	2.9
Industrialized	67.1	73.7	78.7	1.1	0.6
HDI: Human Development Indicator (UNDP)					
Low HDI	18.2	27.4	38.6	4.1	3.7
Medium HDI	23.0	37.7	52.7	3.9	2.8
High HDI	52.8	70.9	78.5	3.3	1.7

Extract from *The State of the World's Cities*, UN-HABITAT, 2001.

natural hazards is particularly important to maintain their economic value and to realize the intended sustainable development of cities and regions.

Vulnerability and trade corridors

An example of the high vulnerability to the recurrent impacts of natural hazards in the context of trade corridors is provided by the experience in Central America. During Hurricane Mitch in 1998, the Central American intra-regional market was interrupted for more than two weeks by damages to many parts of the Central American Highway. In Peru and Ecuador, the impact from El Niño in 1997-1998 disrupted the circulation of the Pan-American Highway in hundreds of sections.

Trends in socio-economic vulnerability

The relationship between disaster risk and development offers a good starting point to identify macro trends in socio-economic vulnerability. To some degree, socio-economic and environmental vulnerability is shaped by development processes and vice versa. Understanding how patterns of social change and development set the scene for future disasters becomes crucial to improving disaster risk assessment and analysis, and therefore is essential for disaster risk reduction as a whole.

Development and vulnerability

An analysis of disaster impacts shows that an estimated 97 per cent of natural disaster- related deaths each year occur in developing countries (World Bank 2001). Although losses are smaller in absolute figures, the percentage of economic losses in relation to the GDP in developing countries far exceeds those in industrialized countries.

Between 1985 and 1999, the world's wealthiest countries sustained 57.3 per cent of the measured economic losses to disasters, representing 2.5 per cent of their combined GDP. During the same years, the world's poorest countries endured 24.4 per cent of the economic toll of disasters, representing 13.4 per cent of their combined GDP.

Some vulnerability factors are closely associated with certain types of development models and initiatives. The links between disaster and development are elaborated in detail in the UNDP's 2004 report *Reducing Disaster Risk: A challenge for development.*

Poverty is a key issue in the analysis of vulnerability. In Southern Africa, poverty levels remain high, especially in rural areas. Thirty-seven per cent of Mozambicans, 64 per cent of Zambians and 36 per cent of Zimbabweans live on less than US$ 1 per day.

Per capita GDP for Zambia and Mozambique fall far short of per capita GDP in developing countries. In addition, high levels of foreign debt have discouraged investment and growth, with Zambia shouldering external debts that constitute 181 per cent of its GDP. Under these conditions, it is unrealistic to expect significant investments at household or national levels to mitigate the impact of natural or other threats.

Globalization

The impact of globalization on patterns of vulnerability is critical to identify new trends in disaster risk. The impacts of economic adjustment measures to encourage greater efficiencies and global competitiveness have commonly resulted in shrinking job markets.

Loss of income can render people more vulnerable to disaster risk. In South Africa, from 1996-2000 more than 500,000 formal sector jobs were lost. From 1997-2000, more than 140,000 miners lost their jobs and 50,000 primarily female workers lost their jobs in textile industries.

Traditional knowledge at risk

The pace of technological and cultural change poses a real threat to the wealth of local knowledge and related skills and resources preserved among indigenous people and in many rural communities. Economic vulnerability can increase as local livelihoods are transformed from relying on traditional forms of production to using more intensive or modern methods of agriculture and land-use systems.

In the past, people from Pacific islands used various techniques to cope with the impact of natural hazards. This included food preservation, harvesting wild foods, planting disaster-resistant crops, using hazard-resistant designs of traditional houses and construction, and relying on established social networks for extended community support.

Many of these traditions have become neglected as more people gravitate towards modern lifestyles, becoming increasingly disassociated from a sensitive consideration of natural conditions in the process. It has also been observed that crops, which formerly provided contingent food reserves in many countries at times of disaster, are now rarely planted.

Box 2.14

Traditional versus modern ways of coping – is it necessary to choose?

The traditional pattern of agricultural land use in the Sahel was well adapted to uncertain rainfall conditions. Generally speaking, the northern zone of Sahel having a mean annual rainfall of 100-350 millimetres was used for livestock. The southern Sahel, with a rainfall of 350-800 millimetres, was able to support rain-fed crops.

This system permitted a degree of flexible interdependence. Herders followed the rains by seasonal migration, while cultivators grew a variety of drought-resistant subsistence crops such as sorghum and millet to reduce the risk of failure. Fallow periods were used to rest the land for as much as five years in order to maintain the fertility of the soil. In the absence of a cash economy, a barter system operated between herders and sedentary farmers.

During recent decades, this system has collapsed for a variety of reasons. Population growth has exerted pressure on the land, resulting in soil erosion. In turn, the rangelands have been overgrazed with rapid degradation of the resource base. The need of national governments for export earnings and foreign exchange has produced a trend towards cash crops. These demands have competed for land with the subsistence requirements for basic grains and reduced the fallowing system.

Subsistence crops have been discouraged to the extent that produce prices have consistently declined in real value over 20 years. At the same time, the practice of maintaining food reserves has been seriously neglected under pressure of loan repayments to international banks. In addition, a lack of government investment to improve the productivity of rain-fed agriculture and a failure to organize credit facilities for poor farmers have tended also to undermine the stability of the rural base.

National governments have progressively campaigned against a nomadic lifestyle. In many instances, foreign aid has been earmarked for sedentary agriculture rather than to benefit herders. Increasingly, strict game preservation laws have been introduced which restrict the possibility of local inhabitants hunting for meat during drought. Traditional forms of livelihood, such as caravan trading, have declined as a result of the enforcement of international boundaries and customs duties, together with competition from lorries.

Adapted from: K. Smith, 1996.