Chapter 2

Risk awareness and assessment

Photo: J. Jenkins/PAHO

2.1. Understanding the nature of risk

Disaster risk is part of every day. Awareness of risk is therefore a necessary condition to engage in disaster risk reduction. The focus on risk management, rather than on the disaster event, reflects a proactive attitude for dealing with potential threats to social and materials assets, before they are lost. The analysis and lessons learned from prior experiences of disasters help to define profiles of risk attached to people, activities and places that share attributes, in the face of particular potential sources of damage. Understanding risk relates to the ability to define what could happen in the future, given a range of possible alternatives to choose from. Assessing risks, based on vulnerability and hazard analysis, is a required step for the adoption of adequate and successful disaster reduction policies and measures

This chapter will discuss briefly:

- The nature of risk, with emphasis on the linkages between hazards and vulnerability.
- The emerging trends in disaster impact, hazard and vulnerability patterns.
- Risk analysis and assessments with examples of application of these methodologies.

Levels of risk awareness depend largely upon the quantity and quality of available information and on the difference in people's perceptions of risk. People are more vulnerable when they are not aware of the hazards that pose a threat to their lives and assets. Risk awareness varies among people, communities, agencies and governments, according to their particular perceptions. These can be influenced by the knowledge of hazards and vulnerabilities, as well as by the availability of accurate and timely information about them.

Risk

The probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable/capable conditions.

Two elements are essential in the formulation of risk: the probability of occurrence for a given threat – **hazard;** and the degree of susceptibility of the element exposed to that source – **vulnerability.** The negative impact, or the disaster, will depend on the characteristics, probability and intensity of the hazard, as well as the susceptibility of the exposed elements based on physical, social, economic and environmental conditions.

The recognition of vulnerability as a key element in the risk equation has also been accompanied by a growing interest in linking the positive capacities of people to cope, withstand and recover from the impact of hazards. It conveys a sense of the potential for managerial and operational capabilities to reduce the extent of hazards and the degree of vulnerability. This awareness is reflected by the incorporation of capacity in the risk equation:

$$\text{Risk} = \text{Hazard (H)} \times \text{Vulnerability (V)} / \text{Capacity (C)}$$

or

$$\text{Risk} = \text{function of (H and V / C)}$$

Social dimensions are intimately linked to the decision-making process to deal with disaster risk, as they embrace a range of risk perceptions and their underlying causes.

A closer look at the nature of hazards and the notions of vulnerability and capacities in the context of disaster risk, allows for a better and more comprehensive understanding of the challenges posed by disaster risk reduction.

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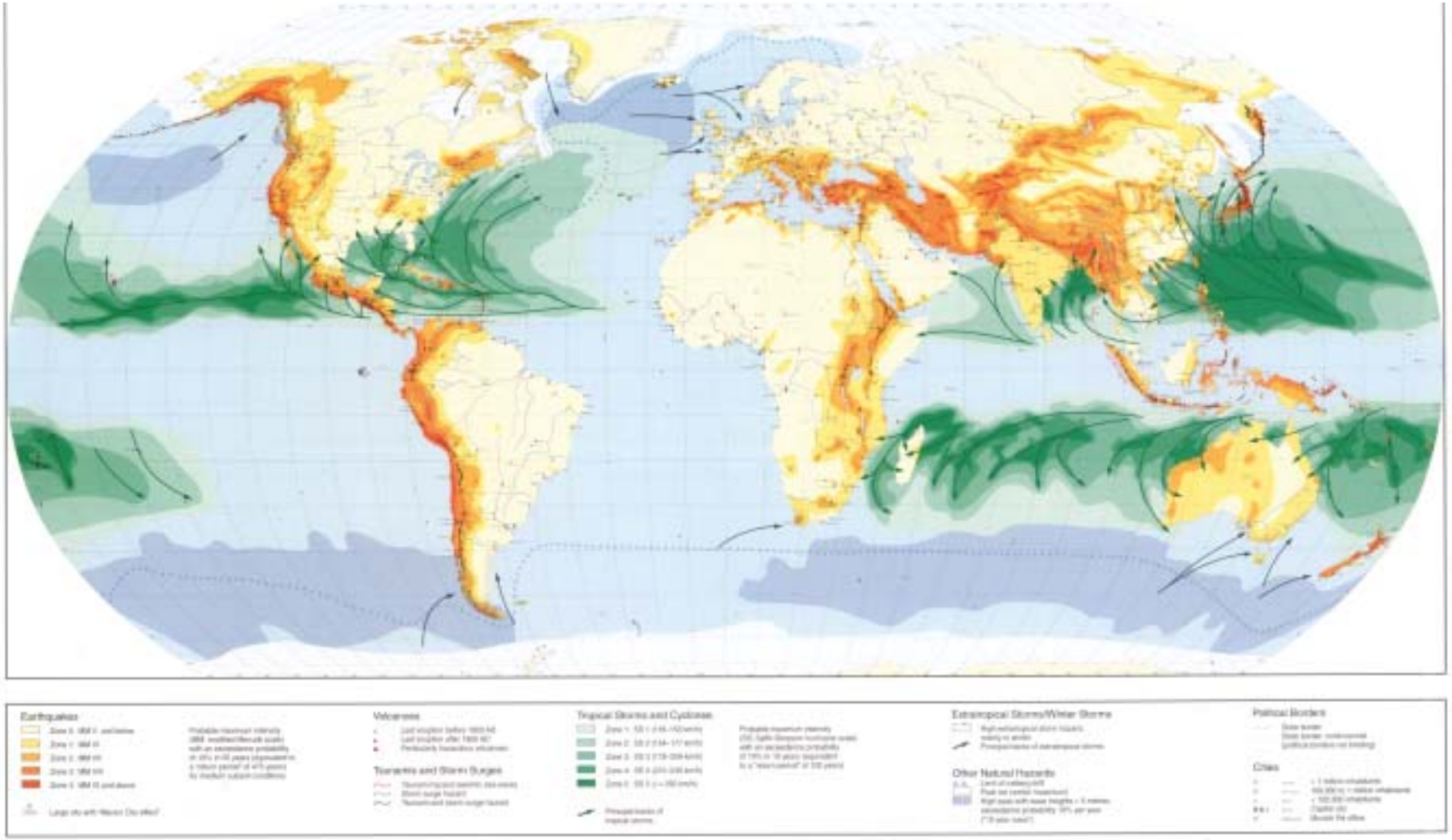
World Map of Natural Hazards



The main and auxiliary maps of the 3rd edition of the World Map of Natural Hazards include fully revised exposure zones for earthquake, storm (tropical storm, extratropical and monsoon storm, tornado, high sea), heavy rain, hailstorm and lightning. Furthermore, the maps indicate a number of other exposures (e.g. volcanic eruption, storm surge, tsunami, iceberg drift) and the effects of natural and man-made climatic changes. Together with the comprehensive worldwide catalogue of major catastrophes, the detailed descriptions of the various natural hazards and their detrimental effects in the special publication facilitate a sound and realistic assessment of the risk of loss.

This map is also available as a large wall map in various languages and as an attractive globe in English (see back for order numbers).

Source: MünichRe,

Understanding the nature of hazards

Understanding the nature of natural hazards involves a consideration of almost every physical phenomenon on the planet. The slow movements in the earth's mantle – the convection cells that drive the movement of continents and the manufacture of ocean floors – are the starting point and also the sticking point. They lift mountains and shape landscapes. They also build volcanoes and trigger potentially catastrophic earthquakes. Like those other invisible movements that take place on a vast scale through the atmospheric medium – the carbon cycle and the water cycle and the nitrogen cycle – volcanoes and earthquakes, along with technological advancements, provide the bedrock of strong nations, rich industries and great cities. They do, of course, have the potential to destroy them. This is also what happens with technological hazards and environmental degradation.

While most natural hazards may be inevitable, disasters are not. By seeking to understand and to anticipate future hazards by study of the past and monitoring of present situations, a community or public authority is poised to minimize the risk of a disaster. It is a measure of people's wisdom and a society's values if a community is able to learn from the experiences of others, rather than to suffer its own. There is a wealth of knowledge about the nature and consequences of different hazards, expected frequency, magnitude and potential geographical impacts, but many fewer examples of lessons learned from them.

Hazards are increasingly dynamic and with highly varying potential impacts. Due to changing environments, many countries and regional organisations call for a greater knowledge of hazard characteristics. Such knowledge requires additional, more focussed research on hazards and a greater understanding of their nature, effects and history.

A wide range of geophysical, meteorological, hydrological, environmental, technological, biological and even socio-political hazards, alone or in complex interaction, can threaten living and sustainable development. Hazards have often been divided into natural, human-induced technological and increasingly negative effects of environmental degradation is being added to this list.

While natural hazards can be divided into three broad categories -hydrometeorological, geological and biological- the variety, geographical coverage and types of impacts are huge. Forest fires, for example, are recognised as a natural hazard but are often referred to as environmental, along with pest infestation and desertification. In order to distinguish between different hazard types, many institutions have developed hazard catalogues. A table has been prepared by ISDR to summarise the current thinking *(see next page)*.

The strong compound relation between different types of natural hazards may give the impression that attempts to catalogue them are fatuous. At what stage does a landslide, recognised as a geological hazard, becomes a mudflow, which is often classified as a hydrological hazard? In the same vein, primary hazards often give rise to a myriad of related potential collateral or secondary hazards. In many cases, these cause greater threat to a community than do the primary hazards. Tropical cyclones can trigger other hazards, in particular storm surges, flash foods and landslides. Often the most serious impact of a tropical cyclone comes from the associated coastal and river floods. Similarly, damages related to earthquakes are often caused by landslides, fires, tsunamis, and floods.

All communities – urban or rural – are vulnerable to most hazards. However, different regions will be more prone to certain types of hazards than others. Floods and windstorms are the hazards that most frequently lead to disasters in Asia, the Pacific, Europe and North America, while it is droughts and epidemics that are reported in African countries. In contrast, Pacific and Caribbean islands are most vulnerable to the effects of tropical cyclones. El Niño events, floods, volcanic eruptions and earthquakes affect in greater degree the Andean and Meso-American countries. Even within a specific region, such as the Pacific, the frequency and intensity of specific hazards varies from one country to another. Hydrometeorological hazards are most common and floods alone account for two-thirds of people affected by natural hazards.

In the same way, different levels of income groups are more or less vulnerable to certain types of haz-

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Hazard classification

HAZARD
potentially damaging physical event, phenomenon and/or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

NATURAL HAZARDS
Natural processes or phenomena occurring in the biosphere that may constitute a damaging event.
Natural hazards can be classified by origin in: geological, hydrometeorological or biological.

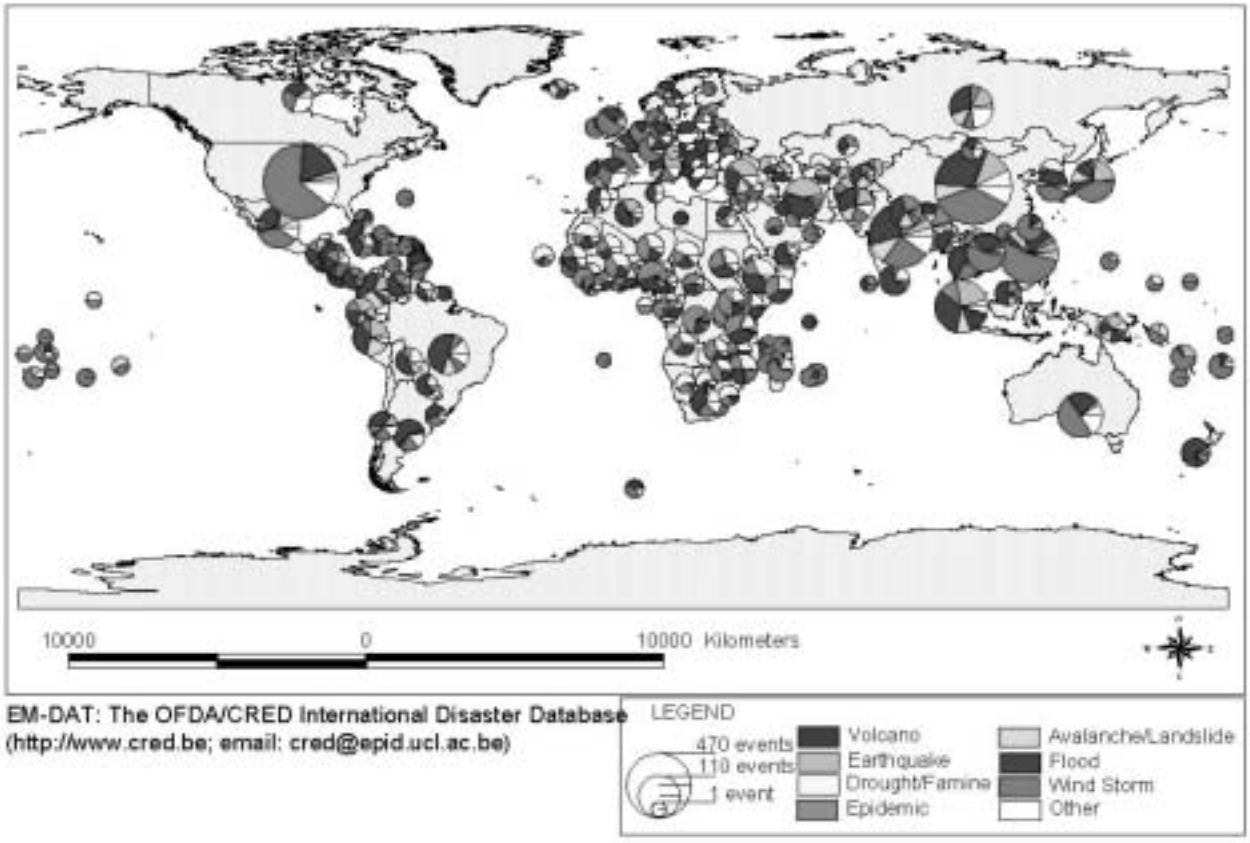
ORIGIN	PHENOMENA / EXAMPLES
Geological hazards Natural earth processes or phenomena in the biosphere, which include geological, neotectonic, geophysical, geomorphological, geotechnical and hydrogeological nature.	• Earthquakes, tsunamis; • Volcanic activity and emissions; • Mass movements i.e.: landslides, rockslides, rockfall, liquefaction, submarine slides; • Subsidence, surface collapse, geological fault activity.
Hydrometeorological hazards Natural processes or phenomena of atmospheric, hydrological or oceanographic nature.	• Floods, debris and mud flows; • Tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; • Drought, desertification, wildland fires, heat waves, sand or dust storms; • Permafrost, snow avalanches.
Biological hazards Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances	Outbreaks of epidemic diseases, plant or animal contagion, and extensive infestations.

TECHNOLOGICAL HAZARDS
Danger originating from technological or industrial accidents, dangerous procedures, infrastructure failures or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Sometimes referred to as anthropogenic hazards. Some examples: industrial pollution, nuclear activities and radioactivity, toxic wastes, dam failures; transport, industrial or technological accidents (explosions, fires, spills)

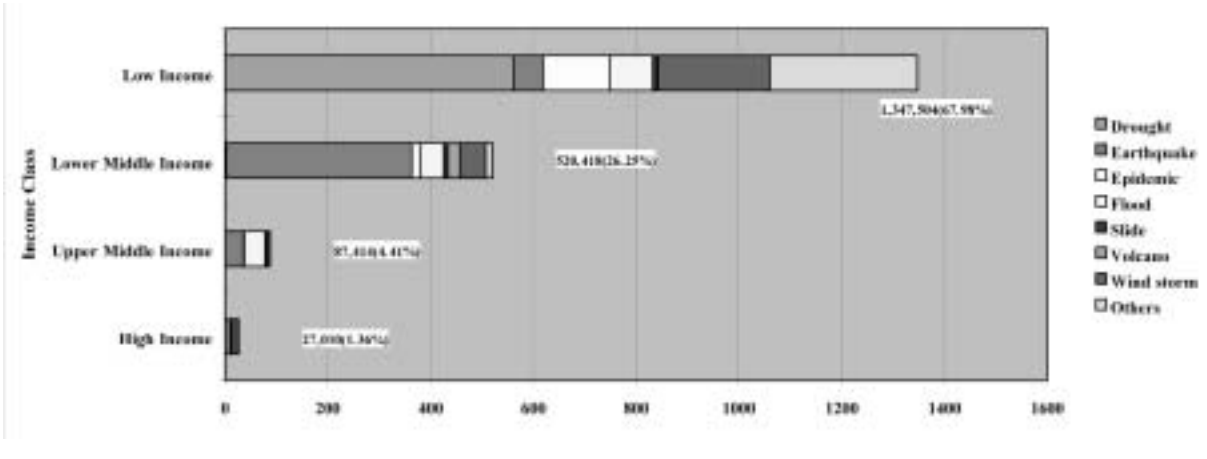
ENVIRONMENTAL DEGRADATION
Processes induced by human behaviour and activities (sometimes combined with natural hazards), that damage the natural resource base or adversely alter natural processes or ecosystems. Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards.
Some examples: land degradation, deforestation, desertification, wildland fires, loss of biodiversity, land, water and air pollution, climate change, sea level rise, ozone depletion.

NOTES:
1. *Hazards can be single, sequential or combined in their origins and effects.*
2. *Some hazards may have natural or human-induced origin, i.e. wildland fires and desertification, in such a case they may be classified as hydrometerological hazard or refered to environmental degradation.*

Map- Distribution of natural disasters, by country and type of phenomena (1975-2001)



Number of People Killed (Income Class/Disaster Type)
(1975-2000) World Summary



Graphic elaborated by ADRC from OFDA/CRED international disaster database

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ards. While droughts affect primarily the lower social classes, the impact of earthquakes and floods are more evenly spread out between society.

Understanding the nature of vulnerability and capacity

Risk is rooted in conditions of physical, social, economic and environmental vulnerability that need to be assessed and managed on a continuing basis. The primary objective is to minimize exposure to hazards through the development and reliance on individual and societal capabilities and institutional capacities that can withstand potential loss or damage

Over the past thirty years there has been a significant and important development in the understanding about what makes people, social, economic and environmental assets susceptible to hazards. The concept of vulnerability may have been referred to first by engineers, in considering construction values and building designs related to levels of resistance to physical forces exerted by earthquakes, wind and water.

During the 1980s and 1990s, there was a growing interest in the linkages between disasters and development. Originally focussed on considering primarily the impact of disaster on development, it was then expanded also to address the impact of development on the toll of disaster related damage. This expressed a new range of socio-economic and environmental concerns built around the notion of vulnerability.

In parallel with this expanded interest on the relationship between disasters and development during the last decades, the role of community participation as well as people's general coping capacities was also recognized as key elements in explaining disaster risk. The creative link between the negative conditions with which people live, and the often overlooked positive attributes which they also possess, underline the importance of socio-economic dimensions of risk. However, it remains a challenge to encourage the identification of locally available strengths and capacities to reduce risk to hazards. The importance of exposing capacities hidden in non-disaster times becomes a critical task for disaster risk reduction. Capacity apply to all levels of society and social organizations, and a broad range of physical, social, economic and ecological considerations.

Vulnerability is a reflection of the state of the individual and collective physical, social, economic and environmental conditions at hand that are shaped continually by attitudinal, behavioural, cultural, socio-economic and political influences at the individuals, families, communities, and countries.

Governed by human activity, vulnerability cannot be isolated from ongoing development efforts, and it therefore plays a critical role in the social, economic and ecological spheres of sustainable development.

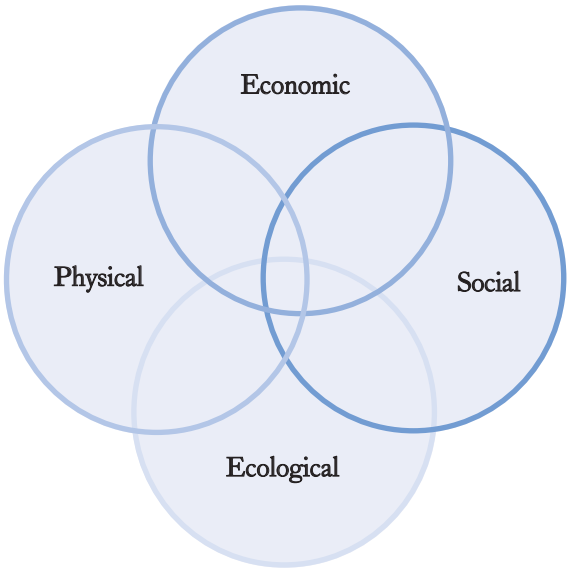
Vulnerability

A set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of a community to the impact of hazards.

Coping capacity

The manner in which people and organisations use existing resources to achieve various beneficial ends during unusual, abnormal, and adverse conditions of a disaster event or process.

Interaction of vulnerability factors



The figure below illustrates the four broad areas in which different aspects of vulnerability can be grouped. They are depicted by intersecting circles to show that all spheres interact with one another.

Physical factors: This concept is conventionally asset-oriented, and comes from the schools of land use planning, engineering and architecture. Physical aspects of vulnerability, although continually broadening in scope, still mainly refer to the location considerations and susceptibilities of the built environment. It may be described as exposure to hazards – "living in harms ways" or "being in the wrong place at the wrong time." Physical vulnerability may be determined by aspects such as density levels, remoteness of a settlement, its siting, design and materials used for critical infrastructure and for housing.

Social factors: Social vulnerability is linked to the level of well being of individuals, communities and society. It includes aspects related to levels of literacy and education, the existence of peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, knowledge structures, customs and ideological beliefs, and overall collective organizational systems.

Some groups are more vulnerable than others, mainly those less privileged in class and caste structures, ethnic minorities, the very young and very old, and other disadvantaged and marginalized segments of the population. Gender issues, particularly the role of women, are also important. In many societies, women have a primary responsibility for domestic life, essential shelter and basic needs. Therefore, women are more likely to become more burdened, or more vulnerable in times of crisis.

Public health, concerning physical, mental and psychological well being, is a critical aspect of social vulnerability. The disabled, of whom there are hundreds of millions world-wide, are particularly susceptible, as their evacuation and continued care is severely hampered during disasters. Predisposition to infection, exaggerated exposure to communicable diseases, lack of defensive mechanisms, insufficient basic infrastructure, especially water supply and sanitation, as well as inadequate health care facilities and supplies, are all expressions of increased vulnerability.

Levels of literacy and training, traditional knowledge systems, and access to information on disaster risk and measures, as well cultural aspects, such as indigenous beliefs, traditions and ways of coping also shape levels of susceptibility. Deeply rooted beliefs that are destiny oriented or pose a fatalistic vision of disasters, can reflect a religious or ideologically inherited sense of vulnerability, and these people may present a great challenge in moving towards the acceptance of a culture of prevention and protection.

Social vulnerability is also linked with other factors, like the state of domination and power relations in the concerned society. A great social cohesion and regulation improves the coping capacities, whereas social insecurity increases vulnerability. In this sense, the decline of traditional structures, civic groups or communities formerly engaged in the collective well being, or in the protection of the weakest people, can strengthen the disastrous consequences of a hazard.

Organizational and governance structures play an important role in the level of social vulnerability.

Economic factors: Levels of vulnerability are highly dependent upon the economic status of individuals, communities and nations. The poor are in general far more vulnerable than economically better off sectors of society. This relates both to the proportional possibility of higher losses when a disaster strikes, and to the capacity to recover from disasters. The links between the eradication of poverty, impact consequences on recovery conditions from natural disasters, and the state of the environmental resource base upon which both depend are crucial.

Economic vulnerability also includes levels of individual, community and national economic reserves, levels of debt and the degree of access to credit and loans as well as insurance. An economy lacking in diversity is generally more vulnerable. Similarly, inadequate access to critical and basic socio-economic infrastructure, including communication networks, utilities and supplies, transportation, water, sewage and health care facilities increase people's exposure to risk.

Ecological factors: The discussion of environmental aspects of vulnerability covers a very broad range of issues in the inter-acting social, economic and ecological aspects of sustainable development as it relates to disaster risk reduction. The key aspects of environmental vulnerability can be summarized by the following five distinctions: *(see page 60 diagram on "Environmental degradation")*

- The extent of natural resource depletion.
- The state of resource degradation.
- Loss of resilience of the ecological systems.
- Loss of biodiversity.
- Exposure to toxic and hazardous pollutants.