2.3 Risk assessment

Risk assessments include detailed quantitative and qualitative understanding of risk, its physical, social, economic and environmental factors and consequences. It is a necessary first step for any serious consideration of disaster reduction strategies.

Its relevance for planning and development of disaster risk reduction strategies was explicitly addressed during the IDNDR. "In the year 2000, all countries, as part of their plans to achieve sustainable development, should have in place comprehensive national assessments of risks from natural hazards, with these assessments taken into account in development plans."

This was also outlined in Principle 1 of the 1994 Yokohama Strategy and Plan of Action for a Safer World. "Risk assessment is a required step for the adoption of adequate and successful disaster reduction policies and measures."

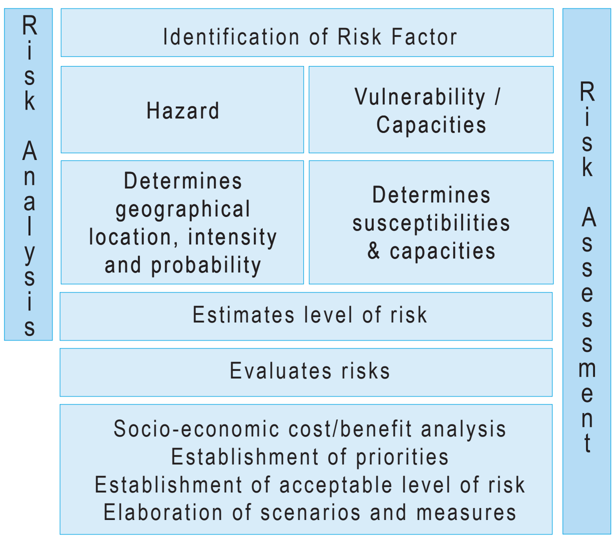
Risk assessment encompasses the systematic use of available information to determine the likelihood of certain events occurring and the magnitude of their possible consequences. As a process, it is generally agreed that it includes:

- *identifying the nature, location, intensity and probability of a threat;*
- *determining the existence and degree of vulnerabilities and exposure to those threats;*
- *identifying the capacities and resources available to address or manage threats; and*
- *determining acceptable levels of risk.*

Figure 2.10 shows the basic stages undertaken in a risk assessment process. The identification of hazards is usually the starting point for a systematic assessment of risk.

Risk assessment
A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.

Figure 2.10
Risk assessment process



Both hazard and vulnerability/capacity assessments utilize formal procedures that include collection of primary data, monitoring of hazard and vulnerability factors, data processing, mapping and social survey techniques.

The distinction between risk assessment and risk perception has important implications for disaster risk reduction. In some cases, as in vulnerability/ capacity assessment exercises, risk perception may be formally included in the assessment process, by incorporating people's own ideas and perceptions on the risks they are exposed to.

The increasing use of computer-assisted techniques, such as geographic information systems (GIS), may widen the breach between the information produced by technical risk assessments and the understanding of risk by people. Therefore, acceptable levels of risk may vary according to the relative views on objective risk versus perceived risk.

In the case of hazard assessment, where technical means are often employed for monitoring and storing data of geological and atmospheric conditions, the assessment activities typically involve scientific specialists. By contrast, vulnerability/capacity assessments make use of more conventional methods such as community-based mapping techniques, in which the community at risk should also play an active role.

Beyond these particularities, hazard and vulnerability/capacity assessments follow a set of procedures that are generally conveyed by the concept of risk analysis. Risk analysis constitutes a core element of the whole risk assessment process of providing relatively objective and technical information from which levels of risk can be projected.

The information produced by technical risk analysis allows for the determination of impartial government policy, resources needed for disaster preparedness and insurance schemes. In proceeding from the estimated levels of risk to the establishment of acceptable levels of risk, a different range of value judgments is usually taken into account.

Socio-economic cost/benefit analyses can highlight priorities that help calculate acceptable levels of risk. These will depend largely on combined government and community priorities, interests and capacities, ideally advanced through dialogue.

Hazard assessment

The objective of a hazard assessment is to identify the probability of occurrence of a specific hazard, in a specific future time period, as well as its intensity and area of impact.

For example, the assessment of flood hazards is extremely important in the design of engineering facilities and in zoning for land use. Construction of buildings and residences is often restricted in high flood hazard areas. Flood assessments should be developed for the design of sewerage treatment facilities, as well as for sites having industrial materials of a toxic or dangerous nature.

Certain hazards have well-established techniques available for their assessment. This is the case for

Table 2.5
Differences between risk assessment and risk perception

Phase of analysis	Risk assessment processes	Risk perception processes
Risk identification	Event monitoring Statistical inference	Individual intuition Personal awareness
Risk estimation	Magnitude/frequency Economic costs	Personal experience Intangible losses
Risk evaluation	Cost/benefit analysis Community policy	Personality factors Individual action

Adapted from: K. Smith. *Environmental hazards*, 1997

Box 2.15
The World Meteorological Organization (WMO) and hazard assessment

WMO and the IDNDR Scientific and Technical Committee promoted a project to further develop the concept of comprehensive, multi-hazard or joint assessment of natural hazards. It was recognized that society is usually at risk from several different hazards, many of which are not water-related or natural in origin.

More importantly, it was also noted that joint assessment of risk from these various hazards was in its infancy. Therefore the project focused on the most destructive and most widespread natural disasters, namely those of meteorological, hydrological, seismic, and volcanic origin.

An example of the development and application of such an approach to land-use planning was provided by Switzerland where the composite exposure to risks from floods, landslides and avalanches was considered. The project noted that an increased understanding of the hazard assessment methodologies of each discipline is required, as they varied from one discipline to another.

Source: *Comprehensive Risk Assessment for Natural Hazards*, WMO, 1999.

floods, earthquakes and volcanic hazards. Many of the analytical techniques useful for hazard assessments can be accomplished by using standard computers and widely available software packages.

For seismic hazards, ground shaking and ground movement are the two most important effects considered in the analysis. Dynamic ground shaking is a critical consideration for buildings and construction.

The objective of a statistical earthquake hazard assessment is to assess the probability that a particular level of ground motion at a site is reached or exceeded during a specified time interval. An alternative approach is to evaluate the ground motion produced by the maximum conceivable earthquake in the most unfavourable distance to a specific site.

Earthquake hazard assessment in areas of low seismic activity is more prone to errors than in areas with more frequent earthquake activity. This is especially the case if the time span of the available data is considerably smaller than the mean return interval of large events, for which the hazard has to be calculated.

In most cases, the overall activity of a volcano and its potential danger can be gleaned from field observations by mapping the various historical and prehistoric volcanic deposits. These deposits can, in turn, be interpreted in terms of eruptive phenomena, usually by analogy with visually observed eruptions.

Other hazards have less well-defined parameters. In the future, efforts must continue to increase our understanding and develop methodologies for the assessment of hazards such as heat waves and dust storms, in particular, with regard to the factors that influence their development, movement and decay.

Multi-hazard assessments are difficult to accomplish due to the different approaches in assessing individual hazards. But multi-hazard assessments are essential, for example, in the case of the multiple potential effects of tropical storms.

Box 2.16
Multi-hazard assessment in Turrialba, Costa Rica

In the framework of a UNESCO sponsored project in capacity building for natural disaster reduction, a case study was carried out on multi-hazard risk assessment of the city of Turrialba, located in the central part of Costa Rica. This city of 33,000 people is located in an area regularly affected by flooding, landslides and earthquakes. In order to assist the local emergency commission and the municipality, a pilot study was conducted to develop a GIS application for risk assessment and management.

The cadastral database of the city was used in combination with various hazard maps for different return periods to generate vulnerability maps for the city. In order to determine the cost of elements at risk, a distinction was made between the costs of construction and the value of building contents. These cost maps were then combined with the vulnerability maps and individual hazard maps for the different return periods, to obtain graphs of probability and resulting loss values.

The resulting database is an example of a tool for local authorities to assess the effects of different mitigation measures, and for which cost-benefit analysis can be conducted.

Source: International Institute for Geoinformation Science and Earth Observation (ITC), Enschede, The Netherlands, <http://www.itc.nl>.

These events cannot be considered in isolation and assessments should take account of the different components that actually represent the risks occurring either separately or in combination.

The use of GIS techniques has broadened the possibilities to undertake multi-hazard assessments. The following case study exemplifies the potential for multi-hazard assessment using GIS in urban areas.

Various hazards can be measured according to different scales, which can make comparisons difficult. An earthquake can be quantified based on the amount of energy released (Richter scale) or the amount of damage potentially caused (Modified Mercalli scale). A heat wave is measured using maximum temperatures and a windstorm is graded by using wind velocity.

Even without sophisticated assessment tools, it is possible for local communities to collect hazard information. Such steps are suggested in UNEP's *Hazard Identification and Evaluation in a Local Community*, consisting of basic checklists to identify and map major hazards.

Hazard mapping, awareness and public policy

Key dimensions of hazard assessments are the presentation of the results and assuring the understanding of the added value of hazard mapping and awareness by policy makers. Maps can be prepared manually using standard cartographic techniques or electronically with GIS.

Box 2.17
Hazard mapping and risk awareness

Several initiatives on hazard mapping were developed during the 1990s as part of the International Decade for Natural Disaster Reduction. One example was the Eastern Asia Natural Hazards Mapping Project, which started in Japan in 1994. The objectives of the project were to enhance awareness of natural hazards, in particular geological hazards, among planners and policy makers of national and regional development, as well as the general public in a given region. Also, the project aimed to promote scientific studies on geological hazards and to transfer technology on hazard mapping to developing countries through collaborative activities. The Eastern Asia Geological Hazards Map is one of the products available.

Source: Geological Survey of Japan, 2002.

Box 2.18
General flood risk maps in Sweden

Since 1998, two Swedish agencies have been conducting a general mapping of Sweden's waterways, aiming to cover 10,000 kilometres, or about 10 per cent of the total. Waterway maps highlight flood-prone areas for two probable levels according to statistical calculations based on a series of existing measures. The probability of flood occurrence is calculated for a century return-period. The calculation is made on a systematic combination of all the critical factors that contribute to a flood (e.g. precipitation, snowmelt, upper ground moisture, dimensions of dams and the filling of basins in governed waterways). The work is done with the use of GIS techniques and a digital elevation model database for the water level. The two probable flood models are mapped at a scale of 1:100,000 with useful background information including waterways, lakes, roads, railways, buildings and built-up areas. Further refinements are planned, like the production of 1:50,000 maps that will assess potential socio-economic damages from different flood scenarios.

Different types of hazards will require different mapping techniques. The importance lies in the easy understanding and clear intended purpose of the information generated.

For example, maps are the standard format for presenting flood hazards. Flood-hazard areas are usually divided according to severity (deep or shallow), type (quiet water or high velocity) or frequency. In Sweden, for instance, flood risk maps are used to highlight the areas under threat from floods during periods with high water levels and discharge.

In the case of volcanic hazards, the zoning of each direct and indirect hazard can be drawn according to the intensity, the extent of the hazard, the frequency of occurrence or in combination.

Composite hazard maps are important tools for joint hazard assessments. These combined hazard assessments need to be presented using simple classification, such as indicating high, medium and low risk, or no danger. One example of hazard mapping conducted for joint hazard assessment is provided by the Sri Lanka Urban Multi-Hazard Disaster Mitigation Project.

Hazard mapping is challenged by several constraining factors. First and foremost the lack of technological infrastructure can be a basic

Box 2.19

Mapping risk in Switzerland

Since 1998, the canton of Bern, in Switzerland, has been using a planning tool which indicates potential risk areas. Maps are designed using computer modelling and GIS. The maps are not expensive and allow a complete overview of the canton based on a uniform set of criteria. The risk areas cover approximately 44 per cent of the territory, mostly in non-residential areas. However, about 8 per cent of inhabitants are in potential risk zones.

The maps indicate:

- exposed areas, which could potentially be affected by mudflows, avalanches, rock falls and landslides;
- vulnerable assets, include habitats, railroads, and all roads serving residential areas;
- potential impact zones, which overlap exposed areas and the vulnerable assets;
- protection forest, which provide an important protective role for residential areas and communication networks.

One particular hazard not modelled is flood risk, despite it causing severe social and economic impacts. The types of impact related to floods depend heavily on flows that are too low to be currently modelled satisfactorily.

Potential hazards

Sector exposed to mud flows and other flash floods

Sector exposed to avalanches

Sector exposed to stone falls

Sector exposed to deep landslides

Sector exposed to average to deep landslides

Vulnerable assets

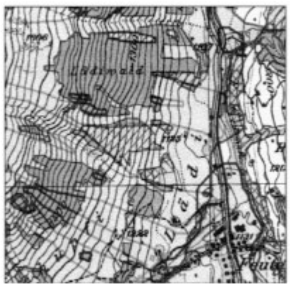
Residential area

Main roads

Access roads

Railroads

Forest



Forest with an important protection function

Forest with a protection function

Other forests

Exposed zones represented in a simplified manner

Source: Office des forêts du Canton de Berne, Switzerland, 1999.

limitation. Further, the importance of hazard mapping is not always as appreciated among decision makers and practitioners as it could be. It is not usually so visible and not a priority on many institutional agendas.

Additionally, inadequate training and insufficient communication or collaboration among relevant bodies also can adversely affect the hazard mapping process. For example, in Bangladesh, while many different entities are carrying out projects in risk and hazard mapping and land-use planning, there exists no common focal point for the coordination of these related initiatives.

Box 2.20
Hazard mapping in South Africa

In South Africa, various institutions are engaged in hazard mapping. While projects are sometimes conducted in isolation and the data is not widely used, there are other examples where the resulting information is beneficial to additional institutions beyond the one that collected it.

Most hazard maps are becoming available online and they often function as scaled image maps containing additional information about particular areas. The Agriculture Research Council, the National Disaster Management Centre, the Department of Water Affairs and Forestry, and the Department of Health are all using satellite data to compile hazard maps, which then become part of their much larger geographical information systems.

Use of the US National Oceanic and Atmospheric Administration (NOAA) satellite data further enables the generation of locally relevant geo-referenced maps. The National Botanical Institute of South Africa also embarked on the mapping of degradation patterns for the whole of the south of the country. These maps provide valuable information on the state of South Africa's ground cover.

Source: National Disaster Management Centre.

Vulnerability and capacity assessment

Vulnerability/capacity assessments are an indispensable complement to hazard assessment exercises. Despite the considerable efforts and achievements reflected in the improved quality and coverage of scientific data on different hazards, the mapping and assessment of social, economic and environmental vulnerabilities of populations are not equally developed.

Some aspects of the social nature of vulnerability/capacity pose different challenges to risk assessment. Gender-specific data and gender-balanced assessments are needed but often lacking. Women and men assessing disaster effects on livelihood resources, for example, may see very different problems and solutions simply because the gender division of labour situates them differently in the production process. The same is true with respect to women's and men's different social networks and personal coping skills.

Often, there is a huge gap in the understanding and application of vulnerability/capacity assessments between the technical or academic institutions undertaking these tasks and the local authorities and communities involved in the exercise.

A great deal of work has been focused on the assessment of the physical aspects of vulnerability. This has been done mainly in relation to more conventional hazardous phenomenon, such as windstorms, earthquakes and floods. The spatial overlapping of hazard zones with infrastructure such as airports, main highways, health facilities, and power lines is commonly used in the examination of the physical aspects of vulnerability.

The Organization of American States (OAS) has been one of the pioneers in Latin America and the Caribbean in using GIS tools for physical vulnerability assessment, focused on infrastructure and critical facilities.

A pilot project launched early in the 1980s has implemented more than 200 activities in 20 countries by integrating hazards, natural resources, population and infrastructure data.

Box 2.21
Community risk in Australia

One of the advantages of GIS techniques is the possibility to carry out multi-hazard analysis. Community Risk in Cairns is the first of a series of multi-hazard case studies by the Australian Geological Survey Organization (AGSO). It considers earthquakes, landslides, floods and cyclones.

The AGSO Cities Project undertakes research for the mitigation of the risks posed by a range of geo-hazards to Australian urban communities. GIS has been used extensively to drive the analysis and assessment. Risk-GIS, as it has been christened in the Cities Project, is a fusion of the decision support capabilities of GIS and the philosophy of risk management. An interactive mapping system of the Community Risk in Cairns project and an advanced mapping system for experienced GIS users are available on the Internet.
<http://www.ga.gov.au/map/cairns>.

Source: Australian Geological Survey Organization.

As examples of the benefits, it was discovered that all of the main airports in Guatemala were located in high intensity seismic areas, and 670 kilometres of paved roads in Ecuador were located in a 30-kilometre radius of active volcanoes.

The Provincial Emergency Program (PEP) of British Columbia, Canada, has developed a complete step-by-step hazard, risk and vulnerability analysis tool kit. The purpose of the tool kit is to help the community make risk-based choices to address the potential impact of hazards. It is also a requirement mandated by the Local Authority Emergency Management Regulation of the British Columbia Emergency Program. The tool kit can be downloaded from the PEP web site <http://www.pep.bc.ca>.

The US National Oceanic and Atmospheric Administration (NOAA), in collaboration with the Federal Emergency Management Agency (FEMA), has produced a community vulnerability assessment tool, presented as a CD-ROM. It is called *Helping communities determine and prioritize their vulnerabilities to hazards*. This CD-ROM provides another step-by-step guide for conducting community-wide risk and vulnerability assessments.

It also provides a case study demonstrating the process for analyzing physical, social, economic and environmental vulnerability to hazards at the local level. The intended audience includes emergency managers, planners, building officials, and others who are responsible or interested in reducing the impacts of hazards.

Also included on this CD-ROM is a comprehensive case study on the application of the vulnerability assessment methodology. New Hanover County, North Carolina, was a pilot community for this methodology. As one of the original seven pilot communities for the FEMA Project Impact Initiative, this community embarked on a long-range hazard mitigation planning effort that included the development of a community vulnerability assessment.

Several initiatives leading towards comprehensive risk assessments are currently underway in the Pacific islands states. In the Cook Islands, risk assessments related to tropical cyclones and associated flooding have been conducted. These include hazard mapping, vulnerability assessments of infrastructure and critical facilities, and recording the social aspects of economic losses on communities.

Box 2.22

Risk assessment in Fiji

Examples of Fijian risk assessments include:

- the Suva Earthquake Risk Management Scenario Pilot Project, undertaken for the capital city of Suva (1995-1998) and involving an earthquake and tsunami exercise, SUVEQ 97 (based on the devastating 1953 Suva earthquake and associated tsunami)
- a comprehensive study of a potential eruption of the Taveuni Volcano which involved international scientists, senior government officials and infrastructure agencies
- a comprehensive flood mitigation study of known flood-prone areas on the island of Viti Levu.

The risk assessment information provided input for community early warning systems for tropical cyclones, as well as primary information for reports, plans and technical support materials.

In Fiji, in recent years, several comprehensive risk assessment projects also have been undertaken. These have always involved the relevant government departments and infrastructure agencies and include representatives from NGOs and the private sector. International agencies and consultants have participated to ensure that up to date methodologies were employed.

Risk assessments undertaken in Fiji have been based on detailed hazard and vulnerability assessments, integrating scientific geological and meteorological information with details about the built environment (building stock, infrastructure, critical facilities and lifelines) and the natural environment.

Modern methods have been employed, including ground surveys, remote sensing and GIS mapping. The results have had major implications for disaster management, such as in helping to formulate building codes and training emergency service personnel. These initiatives are being used as the basis of similar studies in other Pacific island states.

Methodological challenges

While hazard mapping has been improved by the wider use of GIS techniques, the inclusion of social, economic and environmental variables into GIS models remains a major challenge.

The need to assign quantifiable values to the variables analyzed in the spatial models used by GIS is not always possible for social and economic dimensions of vulnerability. Moreover, the diverse scales at which different dimensions of socio-economic vulnerability operate make the spatial representation through these techniques very difficult. In addition, the quality and detail of the data required by GIS analysis are in many cases non-existent, especially in LDCs.

On the other hand, well-conceived low-tech approaches can be a very good option to GIS-based techniques. The approach adopted for hazard mapping and risk assessment by the Kathmandu Valley Earthquake Risk Management Project is an excellent example of what can be achieved with simple and affordable but methodical techniques.

The use of GIS for vulnerability/capacity analysis is still at an embryonic stage in comparison with its wider use in hazard mapping. Several research initiatives are aiming to solve these current methodological constraints, especially those dealing with quantifying social aspects of vulnerability.

Assessing socio-economic vulnerability

Socio-economic vulnerability assessments rely on more conventional methods, which provide other opportunities and advantages, such as the active involvement of the communities at risk in mapping and assessment exercises.

The physical aspects of vulnerability assessment answer the questions: What is vulnerable? Where is it vulnerable? Socio-economic aspects of vulnerability answer the questions: Who is vulnerable? How have they become vulnerable?

Attributes of groups and individuals, such as socio-economic class, ethnicity, caste membership, gender, age, physical disability and religion are among the characteristics that differentiate vulnerability to hazards.

Conceptual frameworks and models provide a basis for vulnerability analysis in relation to specific hazards. The “pressure and release” and “access” models, developed in the 1990s, provided a good basis for the analysis and further identification of specific vulnerable conditions. These models have linked dynamic processes at different scales and access to resources with vulnerability conditions.

In most cases, the occurrence of a disaster has served to validate models of vulnerability analysis.

Box 2.23

Simplicity pays! The experience in the Kathmandu Valley, Nepal

In the approach adopted for hazard mapping and risk assessment in the Kathmandu Valley Earthquake Risk Management Project an emphasis was placed on utilizing the geological and seismological data already available rather than spending resources to generate new data or information by conducting special research.

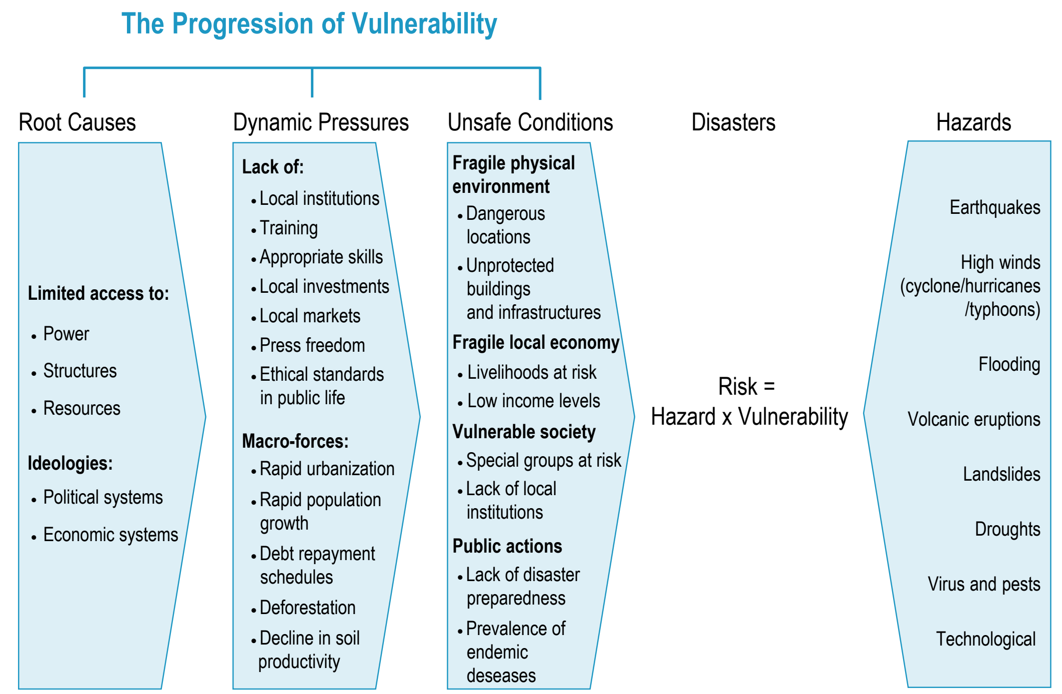
The only prior suitable example of an earthquake scenario developed in a developing country was that of Quito, Ecuador. The project built upon that methodology and adapted it to suit the conditions prevailing in Nepal.

The project consistently adopted simple technical approaches, which made the project cost-effective and understandable for the lay people involved. For example, simple plastic-laminated maps that showed the location of potential damage to infrastructure with names of localities and rivers were found most suited to convince managers of the potential losses of critical facilities.

During the whole process of evaluating the earthquake hazard or assessing the earthquake risk, the research team interacted closely with the management of the critical municipal facilities and the emergency response services. Thus different institutions accepted the earthquake scenario and the loss estimation easily without encountering much apathy. About 30 institutions participated in this process, and the earthquake damage scenario proved to be a great awareness-raising tool.

Source: Mani Dixit et al, “Hazard Mapping and Risk Assessment: Experiences from the Kathmandu Valley Earthquake Risk Management Project” in Regional Workshop on Best Practices in Disaster Mitigation: Lessons Learned from the Asian Urban Disaster Mitigation Program and other Initiatives, Bali, Indonesia, 2002.

Figure 2.11
Vulnerability analysis



Adapted from: Blaikie et al., 1994

The analysis of the damages experienced in disasters constitutes a major source of information for vulnerability/capacity identification.

As opposed to the inductive analysis used in GIS techniques – where level of risk is inducted by integrating layers of information – an historical analysis of disaster data provides the information to deduce levels of risk based on past experiences. In addition, historical disaster databases are essential to identify the dynamic aspects involved in vulnerability, providing the criteria to assign relative weights to different dimensions of vulnerability in risk assessment exercises. In this context, the refinement, maintenance and systematic feeding of disaster data sets are vital for risk assessment as a whole.

The insurance industry's approach to disaster risk is based on this kind of data. Some of these issues are being addressed by the Task Force through its working group on risk, vulnerability and impact assessment.

Droughts have proven to be a particularly difficult task for risk assessment. Risk assessment tools developed for food security provide conceptual inputs as well as primary data related to vulnerability to droughts.

The World Food Programme (WFP) and the Food and Agriculture Organization (FAO) work with other UN agencies, national governments, and NGOs to integrate vulnerability analysis and mapping techniques. The Disaster Risk Index (DRI), produced as part of UNDP's report *Reducing Disaster Risk: A challenge for development*, is studying ways to integrate drought data into a comprehensive risk index.

The Risk Assessment Tools for Diagnosis of Urban Areas against Seismic Disasters (RADIUS) provides a good example of hazard-specific tools that contribute to defining urban risk scenarios. The IDNDR Secretariat launched the RADIUS initiative in 1996 to promote worldwide activities for reduction of urban seismic risk.

In the Americas, vulnerability assessment and techniques workshops are being held under the auspices of OAS. They provide an opportunity to explore methodological challenges and applicability of risk assessments. The technical information and comments generated by this and similar activities support the policy work carried out by the working group on Vulnerability Assessments and Indexing of the Inter-American Committee for Natural Disaster Reduction, also a member of the Inter-Agency Task Force on Disaster Reduction.

The assessment of the economic impact of disasters on a society or local community is a very important input to the overall disaster risk assessment process. The Economic Commission for Latin America and the Caribbean (ECLAC) has a well-established methodology to assess the macroeconomic, social and environmental impact of natural disasters in the region.

A recent report from ECLAC looks at the disaster impacts on infrastructure and various productive sectors, and focuses on the methodological and conceptual aspects of disaster impact assessment. Policy implications of the ECLAC methodology of disaster impact are also explored. <http://www.eclac.cl>

Box 2.24
ISDR working group on risk, vulnerability and impact assessment

The WG3 on risk, vulnerability and impact assessment is chaired by UNDP. Its main goal is to contribute to sustainable reduction in disaster risk by incorporating approaches, methods and tools for risk, vulnerability and impact assessment in risk reduction processes. The working group is subdivided into three sub-groups:

- **Sub-group 1: improving the quality, coverage and accuracy of disaster databases, chaired by IRI, Columbia University**
  This sub-group initiated a series of studies to compare existing disaster databases, in particular EM-DAT (maintained by CRED) and DesInventar LA RED. An other main area of focus is the potential for linking disaster and related data from different sources through a common unique identifying number (GLIDE) that would be assigned to each event.
- **Sub-group 2: review of indexes relevant for risk and vulnerability indexing, chaired by UNDP**
  This newly established sub-group covers the following topics: review of relevant indexes, examples of disaster risk indexes, disaster risk reduction framework and its potential indexing.
- **Sub-group 3: tools and best practices for risk and vulnerability analysis at the local and urban Levels, chaired by UN-HABITAT**
  This Sub-group is working in collection and organisation of an inventory of risk analysis and vulnerability mitigation tools, which can be easily, accessed both by UN/ISDR partners and the general public through the internet. The sub-group is presently in the implementation phase of the project, which is supported by UNDP and the ISDR Secretariat.

<http://www.unisdr.org/eng/task%20force/tf-working-groups3-eng.htm>

In 2002, Emergency Management Australia (EMA) produced *Disaster Loss Assessment Guidelines*, as a follow-up of the *Economic Costs of Natural Disasters in Australia*, published in 2001 by the Bureau of Transport and Regional Economics. These guidelines provide a comprehensive review of methods to assess the economic impacts of a disaster in a regional context.

Box 2.25
Vulnerability assessment products and services

The Unit of Sustainable Development (USDE) of OAS and NOAA have created several vulnerability assessment products and services available to development planners, researchers, and coastal resource and emergency managers, designed to help reduce vulnerability to the adverse impacts of natural hazards. These products and services include the Vulnerability Assessment Techniques workshop series, the Vulnerability Assessment Techniques and Applications web site and a related list server.

Vulnerability Assessment Techniques (VAT) workshops
The VAT workshop series has been created to provide a forum for networking opportunities and dialogue to explore new ideas and potential partnerships in the development, analysis and application of vulnerability assessments. VAT workshops bring together researchers and practitioners from government agencies, academic institutions, and the private sector in the Western Hemisphere, that share an interest in vulnerability assessment methodologies. Professionals are exposed to a variety of risk and vulnerability assessment techniques and their applications at local, state, national and regional levels of activity.

Vulnerability Assessment Techniques and Applications (VATA) web site
The VATA web site provides a central source for vulnerability assessment research, policy initiatives, links and resources, in addition to over 40 case studies presented during the VAT workshop series. This site supplies resources to support community-based decision-making to protect lives and property to sustain economic stability and to preserve the environment. One key feature of the VATA web site is the case study locator tool, which allows users to search the workshop case studies easily by geographic location, hazard type and development area. The NOAA Coastal Services Center and the OAS/USDE created and maintain the VATA web site <http://www.csc.noaa.gov/vata/>.

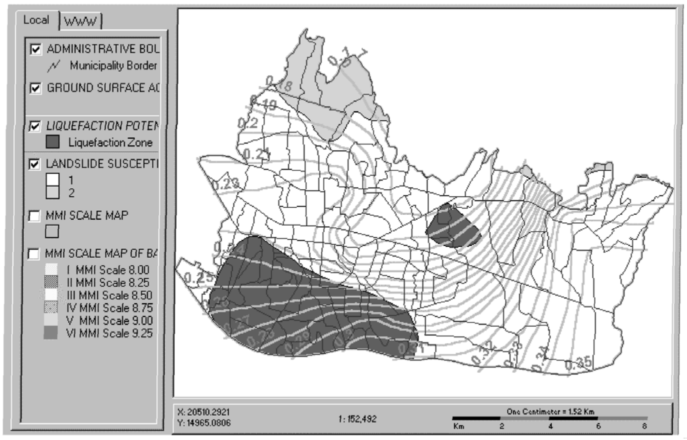
Vulnerability Assessment Techniques and Applications (VATA) list server
By special request, the NOAA Coastal Services Center has created the VATA list server so that people interested in the area of vulnerability assessments may easily communicate with each other. The stimulating discussions that occurred at the VAT workshops are continued through this list server <http://csc.noaa.gov/mailman/listinfo/vata>.

Box 2.26
The RADIUS initiative

The RADIUS initiative achieved four main objectives, since its launch in 1996:

- develop earthquake damage scenarios and actions plans for nine case study cities around the world;
- produce practical tools for estimation and management of urban seismic risk;
- raise public awareness of seismic risk;
- promote information exchange for seismic risk mitigation at city level.

The seismic damage scenarios developed describe human loss, damage to buildings and infrastructure, and their effect on urban activities for nine cities: Addis Ababa, Ethiopia; Antofagasta, Chile; Bandung, Indonesia; Guayaquil, Ecuador; Izmir, Turkey; Skopje, Macedonia; Tashkent, Uzbekistan; Tijuana, Mexico; and Zigong, China.



The action plans proposed new priorities for urban planning and for improvement of existing urban structures and emergency activities. The experiences of these nine cities were incorporated into a practical manual for damage estimation and guidelines for RADIUS-type projects, applicable to cities elsewhere.

With the tools, cities can conduct similar projects to estimate earthquake damage and prepare a risk management plan on their own. In addition, a comparative study was conducted to develop greater understanding of aspects contributing to seismic risk. Over 70 cities worldwide participated in this study called Understanding Seismic Risk around the World. More than 30 cities joined RADIUS as associate cities.

An evaluation of RADIUS found that significant progress has been made in the management of earthquake risk in RADIUS cities. There has been an important increase of public awareness about the need to reduce urban risk, and new risk management programmes are underway.

In several RADIUS cities, new risk management organizations have been created or existing ones have been restructured to monitor the implementation of the project recommendations. RADIUS reports are available on the Internet.

Source: <http://www.geohaz.org/radius>.

The US National Institute of Building Sciences developed Hazards US (HAZUS), a standardized methodology for estimating potential losses from earthquakes, wind and floods, under agreements with FEMA. Using GIS technology, HAZUS allows users to compute estimates of damage and losses that could result from an earthquake. To support FEMA's mitigation and emergency preparedness efforts, HAZUS is being expanded into HAZUS-MH , a multi-hazard methodology with new modules for estimating potential losses from wind and flood (riverine and coastal) hazards. <http://www.fema.gov/hazus>.

Participatory vulnerability/capacity assessment methodologies

The relationship between vulnerability and capacity has increasingly been expressed in risk assessment methodologies in terms of vulnerability and capacities assessments (VCA).

Work has been done to incorporate issues related to social inequity into risk management at the local level. This includes participatory diagnosis, training methods, and analytical frameworks such as the capabilities and vulnerabilities analysis, which examine people's strengths and abilities, as well as their susceptibilities. It makes up a significant part of the overall VCA.

As part of this system, the socio-economic and gender analysis looks at disadvantaged social groups, incorporating them into the development process as effective change agents, rather than as beneficiaries. IFRC is very proactive in promoting the vulnerability/capacity approach.

Box 2.27

Vulnerability and capacity assessments and the International Federation of Red Cross and Red Crescent Societies (IFRC)

Vulnerability and capacity assessments (VCA) are a key tool used by the IFRC for risk analysis with more than 40 country-specific assessments completed.

The use of VCAs is based on the premise that they are not solely for disaster preparedness but intended to advance overall capacity-building. It is an interdisciplinary approach involving health, organizational development, and related Red Cross and Red Crescent programmes.

In 2002, this formed the basis for programme implementation in five North African countries, Mongolia, and other countries in East Asia. More VCA activities are planned and a training workshop has been developed by the IFRC in order to use VCAs on a wider basis.

Source: *Vulnerability and Capacity Assessment*, IFRC, 2002.

Table 2.6

Community risk assessment based on vulnerability and resilience

Contextual aspects	Analysis of current and predicted demographics. Recent hazard events; economic conditions; political structures and issues; geophysical location; environmental condition; access/distribution of information and traditional knowledge; community involvement; organizations and management capacity; linkages with other regional/national bodies; critical infrastructures and systems
Highly vulnerable social groups	Infants/Children; frail elderly; economically disadvantaged; intellectually, psychologically and physically disabled; single parent families; new immigrants and visitors; socially/physically isolated; seriously ill; poorly sheltered.
Identifying basic social needs/values	Sustaining life; physical and mental well-being; safety and security; home/shelter; food and water; sanitary facilities; social links; information; sustain livelihoods; maintain social values/ethics.
Increasing capacities/reducing vulnerability	Positive economic and social trends; access to productive livelihoods; sound family and social structures; good governance; established networks regionally/nationally; participatory community structures and management; suitable physical and service infrastructures; local plans and arrangements; reserve financial and material resources; shared community values/goals; environmental resilience.
Practical assessment methods	Constructive frameworks; data sources include: local experts, focus groups; census data; surveys questionnaires; outreach programmes; historical records; maps; environmental profiles.

Source: IFRC, 2002.

Box 2.28

Ecociudad – participatory risk assessment in Peru

Lima is situated along the boundary of two tectonic plates, making it highly prone to earthquakes. There is an ever-present risk of the fires, landslides and flash flooding that result in death and destruction every year. These risks have been increasing as a result of uncontrolled urban growth. The experience of the Peruvian NGO Ecociudad highlights a number of high-risk concerns in the local community:

- Houses are located on the banks of a river exposed to the threat of collapse in the event of a flood or landslide
- Human settlements are situated in numerous areas prone to landslides and subject to periodic earth tremors
- Informal markets and more established commercial centres are densely crowded and highly vulnerable to fire.

Community meetings have been convened to map the threats, vulnerabilities and capacities based on participation of the inhabitants and their local knowledge. This process has led to the establishment of volunteer brigades specialized in emergency rescue. Other settlements located along the river are being relocated by a neighbourhood committee collaborating with the government.

The work carried out by *Ecociudad,* a Peruvian NGO, provides another example of vulnerability/capacity mapping, where communities have participated with enthusiasm. Working with environmental management issues related to disaster risk reduction, *Ecociudad* has supported community-based risk mapping in Caquetá, a neighbourhood in Lima with a very hazardous landscape <http://ciudad.org.pe/eco>.

Emergency Management Australia released the findings of a study on the assessment of personal and community resilience and vulnerability in 2001, in conjunction with a number of related agencies.

The need for such a report followed a series of events including the 1997 wildland fires around Melbourne, and the 1998 floods in East Gippsland. The study outlines comprehensive guidelines on the concepts and processes of vulnerability and resilience for practical application in community risk assessment.

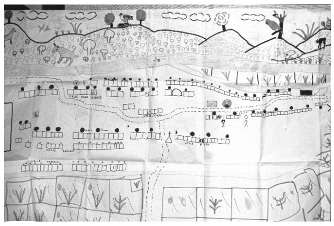
Box 2.29

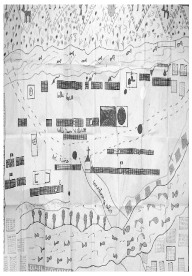
Preparing risk maps – community tools that build awareness and invite participation

As part of the 2001 World Disaster Reduction Campaign, a risk mapping contest was launched. This was one of the ISDR awareness and promotion activities in keeping with the year's theme, "Countering Disasters, Targeting Vulnerability".

The winners of the contest were:

Local Communities Category
First: Daw San Yi U Tin Ko Ko, Myanmar
Second: CTAR Piura, Comité Regional de Defensa Civil, Piura, Peru





Children's Category
First: Shree Bal Bikash Secondary School, Kathmandu District, Nepal
Second: Instituto Nacional de Berlin, 1er Año de Bachillerato Tecnico Vocacional, Usulutan, El Salvador

A risk map is a map of a community or geographical zone that identifies the places and the buildings – homes, schools, health facilities and others – that might be adversely affected in the event of hurricanes, earthquakes, tsunamis, floods, volcanic eruptions, landslides, and other natural hazards and related technological or environmental disasters. The production of a risk map requires consideration of areas and features at risk within the community or geographic zone, consultation with people and groups of varying expertise, and the discussion of possible solutions to reduce risk.

The purpose of the risk mapping contest was to challenge people to produce a risk map for their local geographic zone or community. The exercise provided an opportunity for schoolchildren, teachers and local communities to read, research and learn key concepts of disaster reduction, as well as consider vulnerability and the potential threat of natural hazards to their local surroundings. By increasing public awareness about disaster reduction, more disaster management measures could be developed and implemented in all sectors of society.

The risk mapping contest encouraged participants to consult and interact with the various actors in natural disaster reduction such as public authorities, health-care workers, NGOs and environmental experts. Communication and interaction between different people allowed for more effective collaborative efforts towards building a culture of prevention from natural disasters.

The risk mapping contest was an integral part of the overall 2001 World Disaster Reduction Campaign, and made a valuable contribution in its capacity to reach its target audience, schoolchildren and local communities.

These efforts demonstrate that risk assessments prepared by people working together can become powerful educational tools raising the level of public awareness about shared disaster risks.

Future challenges and priorities

Risk assessment

The notions of hazard, vulnerability and capacity are the foundation for an effective strategy of risk reduction and the operational basis for a culture of prevention. While identification and monitoring activities related to hazard assessments have been improved, some aspects of the overall risk assessment process remain weak.

In particular, incorporating people's risk perceptions, and the socio-economic and environmental contexts where they live, is essential in the identification of risk scenarios. New trends in hazards and vulnerability also challenge the procedures and conventional methodologies and call for an integrated and comprehensive risk assessment.

Recognition and analysis of the changing nature of hazards and vulnerabilities is needed. The influence of ecological imbalances such as climate change is affecting the frequency and intensity of hazardous natural phenomenon. Additionally, environmental degradation is exacerbating the impact of natural hazards.

Risk assessments need to reflect the dynamic and complex scenarios to properly feed into disaster risk reduction strategies. Multiple hazards and comprehensive vulnerability/capacity assessments that take account of the changing patterns in disaster risk are starting points for raising risk awareness.

The emergent trends in hazards and vulnerability described in this chapter pose major challenges to the overall risk assessment process. These changes affect not only the formal procedures of risk assessment in place, but also the prevailing patterns of risk perception.

Community knowledge of hazards has been challenged by complex and new forms of danger. The repercussions of environmental degradation on current vulnerability and hazard patterns and the increasing exposure to technological hazards raise a different range of concerns. An integrated and effective process of risk assessment needs to engage these challenges to truly provide the foundation for disaster risk reduction in the 21st century.

Special areas of concern in relation to risk awareness and assessment are the following:

Data and methodology

Data is the primary input for identifying trends in hazards and vulnerability. For many countries, relevant data is unavailable or inaccurate. Often, information collected by governments and at the local level is not gender-specific although gender is indeed a primary organizing principle before, during, and after disasters. There is a need to work towards the standardization of all issues related to the technical soundness, political neutrality, methodologies and processes related to the collection, analysis, storage, maintenance and dissemination of data.

In terms of methodologies, there are many different conceptual models attempting to examine the same things. Still, one of the major issues is how hazard, vulnerability, and risk assessments can be used to reduce risk. Mechanisms of integration are needed so that issues and proposed remedial initiatives are not fragmented when presented to decision makers.

Improved visibility and higher priority to reduce vulnerability and strengthen capacity

Reducing vulnerability to risk still falls mainly under the responsibility of the public authorities. Data regarding disaster impact, especially concerning small and medium scale disasters, as well as the social and environmental considerations of impact, are still lacking. Political authorities usually see economic considerations as highly influential in their decision-making. Without a quantitative measurement of risk it is difficult for political decision makers to factor risk reduction into legislative agendas and development planning efforts. Following this, fiscal commitments need to be specified in national budgets.

An enhanced conceptual framework must be expressed to emphasize capacity as a key factor in the disaster risk formula, including the incorporation of vulnerability and capacity in tools such as risk indexes. UNDP's Global Risk Vulnerability Index and the framework to guide progress on disaster risk reduction being developed by ISDR are good examples of timely efforts leading to that objective.

Culturally relevant and gender-inclusive analyses of capacities and vulnerabilities in disaster contexts are more likely when communities undertake their own assessments. A number of models for gender-sensitive and participatory vulnerability/capacity assessments at the community level are now available.

An overall challenge is to review and document how risk assessments have contributed to modify risk and how they are being utilized in the decision-making process.