



United Nations  
Educational, Scientific and  
Cultural Organization

# **DISASTER PREPAREDNESS AND MITIGATION**

## **UNESCO's role**

2007

## Acknowledgements

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Cover photo: Collapse of buildings caused by the devastating earthquake which occurred in Bam, Iran on December 26, 2003.

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Back cover photo: A tornado approaching Vulcan, Alberta, Canada in 1927. © Historic NWS collection.

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## Seeking a conceptual shift From reaction to prevention

Walter Erdelen,  
*Assistant Director-General for Natural Sciences*

Operating at the interface between education, science, the social sciences, culture and communication, UNESCO has a vital role to play in constructing a global culture of disaster preparedness and mitigation. The Organization is closely involved in the conceptual shift in thinking away from post-disaster reaction to pre-disaster action.

Disaster reduction makes humanitarian sense – because putting adequate warning and mitigation measures in place can save lives – and it makes economic sense as well because an ounce of prevention is usually worth a pound of cure.

Over the last four decades, scientific knowledge about natural hazards and the technological means of confronting them has expanded greatly. Yet despite the ample availability of knowledge and expertise, vulnerability is growing because of unsustainable development, climate change and extremes of weather increase the scope and cost of disasters. Ever larger populations are at risk, mostly in the developing countries. Disaster reduction therefore is an important part of the United Nations' Millennium Development Goals for abating poverty.

Disaster reduction emphasizes the crucial role of human thought and action in the minimization of risk. This means that we need to educate people – in particular young people – about disasters and their far-reaching implications for the way we live.

To mitigate the risks stemming from natural hazards such as earthquakes, tsunamis, hurricanes, floods, windstorms, landslides, volcanic eruptions, droughts and wildfires, those at risk must be informed of dangers and the protective measures available, and well versed in the skills of prevention and resilience. In this way, there would be fewer deaths, fewer injuries and less destruction when such disasters strike. Communities will always have to face natural hazards. But hazards become disasters only when lives are lost and livelihoods swept away. Mankind is facing an increasing burden of risk, largely because of the decisions about development that are sometimes inappropriately taken at the local, national and



international levels. For example, populations are often concentrated on natural flood plains or along known earthquake fault lines.

The destruction of forests and wetlands is harming the capacity of the environment to withstand hazards, and eliminating defences that nature has evolved over time. Climate change increases the risk of storms, drought and coastal flooding.

UNESCO is strongly committed to the Hyogo Framework for Action 2005-2015, which was adopted at the 2005 Kobe World Conference on Disaster Reduction. The United Nations Decade of Education for Sustainable Development (2005-2014), which UNESCO is coordinating, is a second strategic instrument for reducing and mitigating disasters.

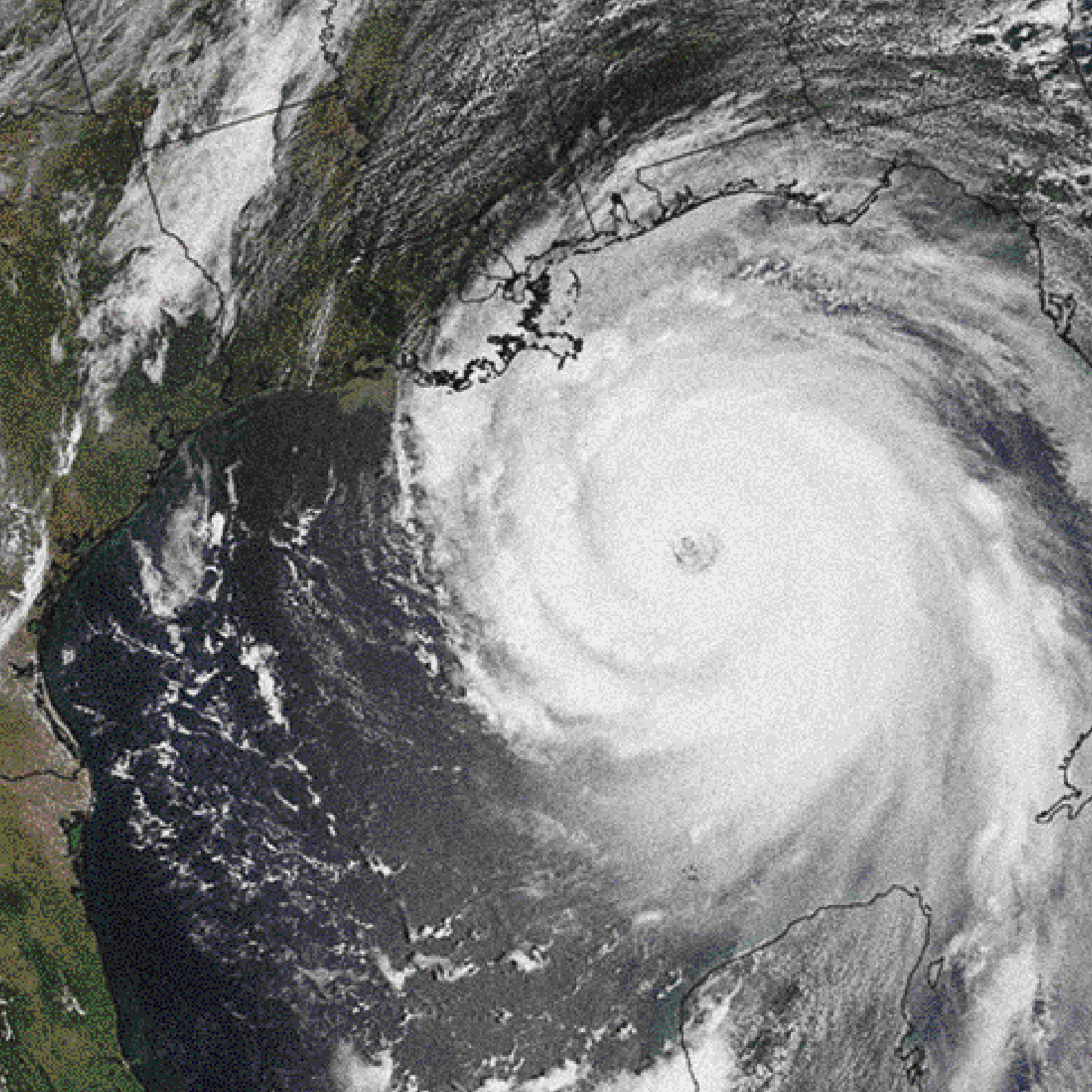
Disaster reduction requires new partnerships that draw together stakeholders from all levels of society, across different regions, sectors and disciplines. Governments, academic and scientific communities, non-governmental organizations and international organizations, along with the communities at risk and the media are all essential contributors in building a culture of resilience.

## Enlisting science and technology in disaster risk reduction programmes

Maciej Nalecz,  
*Director, Division of Basic and Engineering Sciences*

UNESCO has many programmes in place that deal in one way or another with the study of natural hazards (earthquakes, volcanic eruptions, landslides, floods, tsunamis, droughts) and the mitigation of their effects. These programmes help us understand the mechanisms of natural hazards and to analyse why some of these hazards turn into disasters.

In the case of seismology and oceanography, the organization has contributed to studies going back to the 1960s. But the translation of scientific and technological advances into concrete disaster





mitigation measures and into disaster preparedness through education and information campaigns has to be pursued more systematically.

We must through science and technology promote a better understanding of natural disasters: where, when and how they might occur, and what their intensity may be.

We must continue to improve early warning systems and utilize communication technologies more effectively for the dissemination of alerts about impending disasters.

We must be ever more vigilant about the protection of land, natural resources and cultural heritage. And we must promote and enforce sound engineering and construction principles.

Nevertheless, progress in the science and technology of natural hazards, and of related coping mechanisms, have made it possible to introduce significant changes in our response to natural disasters.

Major progress has been made in the development of global meteorological models and their application to large-scale weather prediction.

Although earthquake prediction is still not possible, considerable ability exists today for more accurate forecasts and advisories of several impending hazard events.

Warnings of violent storms and of volcanic eruptions hours and days ahead save many lives and prevent significant property losses. Modern technologies have been developed that reduce the exposure to natural hazards of the natural and built environment.

Owing to progress in design and construction engineering, earthquake-resistant structures, including high-rise buildings, critical lifelines and industrial facilities, are technically feasible and are becoming a reality.







# Introduction

Badaoui Rouhban,  
*Chief, Section for Disaster Reduction*

Despite the increasing frequency and severity of the catastrophes that strike humankind, it is becoming increasingly possible to prevent and mitigate the effects of disaster. Of all the global environment issues, natural hazards are in some ways the most manageable. The risks are readily identified. Effective mitigation measures are available. And the benefits of vulnerability reduction greatly exceed the costs. Yet, while disaster relief captures the imagination of the public, disaster prevention often ranks relatively low on public agendas. Relief and rehabilitation constitute the primary form of disaster risk management and account for most of spending on disaster-related activities annually, leaving a very low balance for prevention.

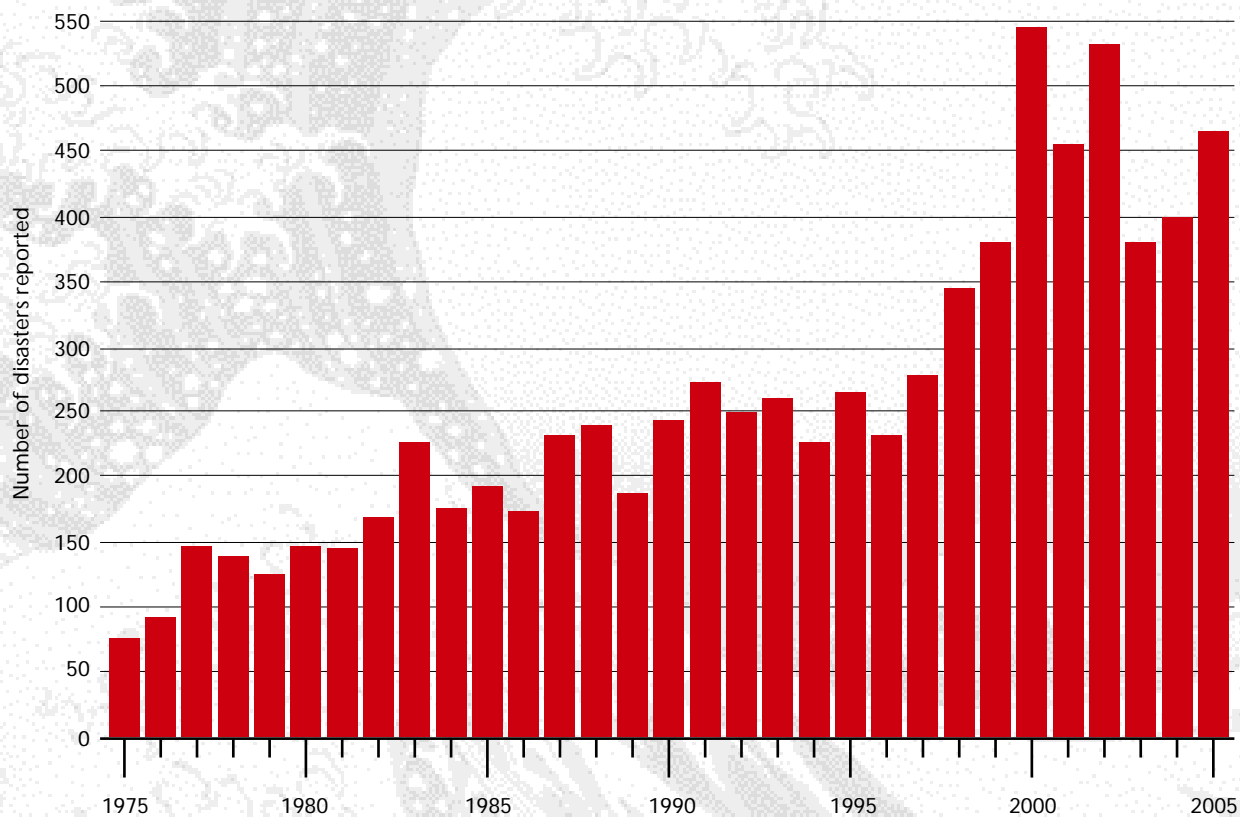
Cost-benefit analyses suggest that appropriate investments in prevention could substantially reduce the burden of disasters, which falls disproportionately on countries that are already desperately poor. A dollar invested in disaster preparedness and mitigation will prevent four to eight dollars in disaster losses.

The new, emerging approach, which is being advocated by UNESCO, stresses the merit of mitigating and preventive measures through scientific understanding and technological know-how. This approach also depends on imparting information effectively, involving local communities, making disaster prevention part of education and raising the awareness of the public.

In June 2006 at UNESCO Headquarters, the Organization had the privilege of launching, alongside the United Nations International Strategy for Disaster Reduction, a world campaign on education entitled "Disaster Risk Reduction Begins at School." The campaign aims to promote disaster reduction education in school curricula and to improve school safety by encouraging the application of strict construction standards.

This initiative is fully consonant with UNESCO's priorities in contributing to disaster resilience through knowledge, education, information and public awareness. The experience of countries prone to natural disasters emphasizes the highly positive effects of education on disaster risk management. It produces children and adults who know what to do when an earthquake strikes and community leaders who have learned to warn their people in time.

# Natural disasters reported



← In the background, painting from Katsushika Hokusai, *The Great Wave*.

## The nature of **the problem**

What the philosopher John Stuart Mill referred to as Nature's harvest of "injustice, ruin and death" – droughts, earthquakes, epidemics and storms – shows no sign of abating. On the contrary, changes in global weather patterns and the degrading of the environment mean that such calamities are increasing in terms of frequency, complexity, scope and destructive capacity.

The United Nations called the 1990s the International Decade for Natural Disaster Reduction. It might just as well have been called the decade of natural disasters – with a catalogue of flooding, earthquakes, landslides and droughts rarely seen in such profusion. This pattern has continued into the 21st century with spectacular catastrophes such as the Indian Ocean tsunami, the northern Pakistan earthquake and the inundation of New Orleans.

The doubling of the world's population in the past 40 years and in particular the quintupling of the urban population over the same period has put many more people at risk. With greater urbanization and the infrastructure that this entails, economic losses have soared dramatically. The loss from natural disasters in the 1990s exceeded the losses of the four previous decades combined.

The August, 2006 report of the UN Secretary-General on implementation of the International Strategy for Disaster Reduction said that in the period from June 2005 to May, 2006, there were 404 disasters with nationwide consequences in 115 countries, including the death of 93,000 people and economic losses totalling 173 billion US dollars. Another UN report, "Delivering as One," issued in November, 2006, estimated that 91 million people had their lives devastated by natural disasters in the first eight months of 2006.

Hazards are part of nature but often turn into disasters as a result of human actions or inactions. Severe flooding may be exacerbated by deforestation and building in natural flood plains. Failure to impose building codes and use known earthquake-resistant techniques mean that buildings collapse and kill people even in relatively low-level tremors. Destroying nature's natural defences such as wetlands and coastal swamps leaves people at the mercy of tropical storms.

Looming above all this is the threat of global climate change and rising sea levels as a result of increased greenhouse gas concentrations in the atmosphere, which the Intergovernmental Panel on Climate Change (IPCC) says is caused by human activity.

The Indian Ocean tsunami, or yet another frightening hurricane season, with the inundation of a major modern metropolis like New Orleans, gives rise to fears that the magnitude of such events is growing with time.

Half of humanity lives within 100 kilometres of a sea coast or a sea-navigable waterway while of the world's 10 largest cities, eight are located on the coast. If the predictions of permanent shifts in weather patterns and significant increases in ocean levels made by the Intergovernmental Panel on Climate Change come to pass, it is clear that today's disasters will be eclipsed in future and that many other cities and ports will suffer the watery fate of New Orleans. The IPCC studies predict that climate change will increase droughts, heat waves and fires in some areas. In others, more intense tropical storms and higher precipitation will increase floods, landslides and mud slides.

What is not generally realized is that many disasters could have been greatly mitigated with adequate forethought and preparation, and that the cost of this mitigation would have been small compared to the cost of relief and recovery efforts. Reducing and mitigating disaster risks has not been high on many governments' agenda because politicians are all too often disinclined to allocate scarce resources to preventing something that may not occur during their period of office and that will tend to remain invisible where prevention is successful.

Natural disasters are unjust because they strike hardest at some of the world's poorest countries, which are the least well placed to defend against themselves or to recover afterwards – countries like Honduras, Guatemala and Nicaragua that lost more than their entire gross domestic product in hurricane Mitch in 1998 and are still struggling to recover. That single storm set back development in the region by decades. In the Indian Ocean, economic development in the Republic of Maldives was pitched back by the 2004 tsunami, and it may take many years before islanders can regain the levels of prosperity they enjoyed before the disaster struck.

Such disasters are among the biggest obstacles to achieving the UN's Millennium Development Goals for poverty reduction. Thus, reducing the risks of natural hazards is becoming an important development issue in its own right.

The sheer scope of the socio-economic impacts of natural disasters is at last slowly bringing about a shift in approach away from disaster relief and toward disaster prevention, with risk reduction increasingly considered as a priority development tool in its own right. There is a growing realization in the international community that risk reduction, disaster relief and sustainable development are closely related. Vulnerability to disasters is linked to poverty, and vice versa.

UNESCO is closely involved in raising public awareness and improving education about natural disasters, two certain ways of helping vulnerable populations to cope with risk.

“The Indian Ocean tsunami of December 2004 and the devastating impact of Hurricane Katrina and Hurricane Rita in the United States of America have many aspects but one crucial factor is the importance of public awareness, preparedness and information transmission,” UNESCO’s Director-General, Koichiro Matsuura, told the organization’s General Conference in 2005.

“Again, education – whether formal, non-formal or informal – can save lives,” he continued. “This is why, in its response to the tsunami disaster for example, UNESCO has placed great emphasis not only on building the infrastructure of a global early warning system that will include the Indian Ocean, the Atlantic Ocean, the Caribbean and Mediterranean Seas in addition to the Pacific Ocean, but also on strengthening national capacities for collecting and processing data as well as on training the public to respond quickly when key information is transmitted. To do this effectively, UNESCO is working in close coordination with its United Nations partners at international and country levels, and is drawing upon all of its resources – scientific knowledge and know-how; policy guidance and capacity-building; the cultural adaptation of learning materials; and improved communication systems. Thus, education is key but adapted to need and circumstance.”

# The **five** Hyogo commitments

Immediately following the Indian Ocean Tsunami of December, 2004, governments met in Kobe, Japan for the second World Conference on Disaster Reduction.

They adopted what is known as the Hyogo Declaration and agreed upon a Framework for Action for the decade between 2005 and 2015 aimed at building the resilience of nations and communities to disasters. The Framework is linked both to the Millennium Development Goals and to the UN Decade of Education for Sustainable Development (2005-2014), which is led by UNESCO.

The Framework includes the following five commitments:

## **Make disaster reduction a priority**

Governments should integrate disaster risk reduction into their laws, programmes and plans, and ensure the participation of local communities in planning.

## **Know the risks and take action**

Countries should define and understand potential risks so that they can develop early warning systems adapted to the needs of each community.

## **Build understanding and awareness**

Governments should provide information, include disaster reduction in formal and informal education, and ensure that invaluable local knowledge about disaster risks is preserved and transmitted.

## **Reduce risk**

Countries should apply safety codes to ensure that schools, hospitals, homes and other buildings do not collapse in earthquakes; avoid sitting communities in hazard-prone areas such as flood plains; and protect forests, wetlands and reefs that act as a natural barrier to storms and flooding.

## **Be prepared and ready to act**

Governments and regional or local authorities should conduct risk assessments; adopt contingency plans; test preparedness by such measures as evacuation drills; and ensure emergency services, response agencies, policy makers and development organizations are coordinated.



# Who does what?

## Activities of international organizations

UNESCO forms part of a network of UN agencies, inter-governmental groups, and non-governmental or civil society organizations that are teamed together as part of the International Strategy for Disaster Reduction.

### **International Strategy for Disaster Reduction (ISDR)** <http://www.unisdr.org>

The ISDR promotes disaster reduction as an integral component of sustainable development. It is a global framework in which countries, institutions and individuals can cooperate, and is coordinated within the United Nations by an Inter-Agency Secretariat located in Geneva.

### **United Nations Development Programme (UNDP)** <http://www.undp.org>

The UNDP has operational responsibilities at national level for natural disaster mitigation, prevention and preparedness. It works to ensure that disaster risk considerations are factored into national and regional development programmes, and that countries take advantage of disaster recovery to mitigate future risks and vulnerabilities.

### **United Nations Environment Programme (UNEP)** <http://www.unep.org>

UNEP provides leadership and encourages partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. Through its Global Resource Information Database, UNEP provides world-wide environmental information and early warning about environmental hazards.

### **United Nations Children's Fund (UNICEF)** <http://www.unicef.org>

UNICEF generally works on warning, prevention, preparedness and recovery activities for the care of children and women in disaster-prone areas. Since the Indian Ocean tsunami, UNICEF, in conjunction with governments and a wide array of partners, has built temporary schools, rehabilitated water systems, organized family care for children who lost their parents, and has kept children healthy through immunization and other health initiatives.

### **UN-Habitat** <http://www.unhabitat.org>

The Disaster Management Programme of UN-Habitat is based on the idea that the rehabilitation of social and economic conditions following disasters or conflicts offers a unique opportunity to rethink past development practices, improve the sustainability of human settlements and prepare communities to prevent against future risks and threats.

**World Meteorological Organization (WMO)** <http://www.wmo.ch>

The WMO coordinates global scientific activity to provide the advance warnings that save lives and reduce damage to property and the environment. The organization deals with hazards related to weather, climate and water, which account for nearly 90% of all natural disasters. WMO also contributes to reducing the impacts of forest fire, volcanic ash and human-induced disasters, such as those associated with chemical and nuclear accidents.

**World Health Organization (WHO)** <http://www.who.int/en>

The WHO deals with disaster preparedness connected with health. Its purpose is to reduce avoidable loss of life and the burden of disease and disability in disaster-affected countries. It works with other international organizations and non-government organizations as well as local authorities and civil society in responding to health emergencies.

**Food and Agriculture Organization (FAO)** <http://www.fao.org>

The FAO's objective is to strengthen the capacity of communities to prepare for natural disasters. It deals with immediate food issues, and plays an important role in reversing degradation and reducing vulnerability to hazards. This is complemented by a special program for food security. The UN World Food Programme is focused on emergency and post-disaster food relief and support for rehabilitation.

**International Atomic Energy Agency (IAEA)** <http://www.iaea.org>

The agency is concerned with the zoning of nuclear power plants in areas prone to seismic activity, and it has been actively concerned with the design of reactors that can withstand the most severe natural disasters. A core element of the IAEA's work is to help countries to upgrade nuclear safety and to prepare for and respond to emergencies.

**The World Bank Group** <http://www.worldbank.org>

The group promotes disaster risk management as a priority for poverty reduction, linked to environmental management. It concentrates on reconstruction measures that strengthen resilience to future disaster and identify innovations in risk transfer and financing.

**Other organizations**

A number of intergovernmental and non-governmental organizations are engaged in disaster reduction. They include: the International Federation of Red Cross and Red Crescent Societies, the Council of Europe, the Asian Disaster Reduction Centre, the Asian Disaster Preparedness Center, Caribbean Disaster Emergency Response Agency, the International Council for Science, the International Social Science Council, ActionAid International, the International Council of Engineering and Technology, Register of Engineers for Disaster Relief, the International Consortium of Landslides and the International Council on Monuments and Sites.

# UNESCO's contribution

The Hyogo Declaration and Framework for Action encompass UNESCO's strategy for dealing with disaster reduction. This includes capacity building in vulnerable nations, research on natural hazards, coordination of early warning systems, the promotion of education and public awareness, and the integration of disaster reduction into development and anti-poverty programmes.

Working alone or in collaboration with other UN agencies and outside scientific bodies, UNESCO has been a catalyst for international, inter-disciplinary cooperation in many aspects of natural disaster reduction and mitigation. It plays an important role in several international and intergovernmental scientific programmes that provide the framework for its current and future strategies. These include the International Basic Sciences Programme, the International Hydrological Programme, the Man and Biosphere Programme, the International Geoscience Programme, the Management of Social Transformations Programme and the programmes of the Intergovernmental Oceanographic Commission.

In concert with other United Nations agencies and other parties, UNESCO is facilitating the development or strengthening of disaster-management institutions at regional and international level in several hazard-prone Member States. It pays particular attention to building and strengthening cooperative capabilities through concerted action among the various UNESCO networks.

As the UN's agency for science, UNESCO has been intimately involved in disaster reduction for the past 45 years, with studies on earthquakes and oceanography dating back to the 1960s. It has since expanded into many areas as it pursues multidisciplinary actions to study natural hazards and mitigate their effect.

Through its broad mandate and expertise in the natural and social sciences, education, culture and communication, UNESCO is helping countries build their capacity to cope with disasters; it provides a forum for governments to work together, and it provides essential scientific and practical advice in disaster reduction.



## Earth, wind and fire: The hazards stalking mankind

The vast majority, about 94 percent, of natural disasters result from four major causes – earthquakes, storms, floods and droughts. Three quarters of the world's population live in areas that were affected by these phenomena at least once between 1980 and 2000. Earthquakes and volcanic eruptions cause on average almost half of all natural disaster casualties, but windstorms and other weather-related events cause the most economic damage.

Following are descriptions of the principal kinds of risks and the part UNESCO is playing in reducing them.

### Earthquakes

Some 50.000 earthquakes occur on average every year as the Earth's tectonic plates shift and adjust, including some of potentially devastating magnitude releasing awesome amounts of energy. But scientists have no way of knowing beyond the broadest indications when and where tremors will occur next.

UNESCO has supported the establishment of international, regional and national centres for the recording, exchange and analysis of seismological data. It helps train engineers and scientists and has been behind the creation of specialized centres for earthquake engineering and seismology in the former Yugoslav Republic of Macedonia, Britain, Japan, Peru and Iran.

In other regional actions, UNESCO and the US Geological Survey have been jointly involved since 1993 in a network of expertise, stations and institutes as part of a Programme for Reducing Earthquake Losses in the Enlarged Mediterranean Region. An important feature of this programme is that it makes it possible for countries which are politically antagonistic to one another to exchange scientific data.

Likewise, UNESCO since 2001 has collaborated with the US Geological Survey and earth science organizations on the Programme for Reducing Earthquake Losses in South Asia.

Similar projects, such as the Programme for Assessment and Mitigation of Earthquake Risk in the Arab Region, have been funded, equipped and staffed with UNESCO's help. More recently, UNESCO

has cooperated with Libya to establish a digital seismological network, which is designed to provide high-quality data for research projects in regional and global seismology.

Regional disaster reduction programmes have been carried out with the help of UNESCO field offices. Thus, for example, UNESCO Tehran office is providing advice and at the same time benefiting from the experience in the reconstruction of the ancient city of Bam and the reduction of similar risks in Iran, one of the countries most exposed to earthquake hazard.

The huge growth of urban populations along known seismic fault lines makes it increasingly likely that a disaster to surpass that of either San Francisco or Tokyo will occur sooner or later.

There are almost 450 cities worldwide with a population of more than one million, and with most population growth occurring in urban areas, sprawling mega-cities are becoming ever larger, attracting thousands of new inhabitants every day. Many of these places are situated along major earthquake faults.

Not only is the number of people at risk greater than ever, but the concentration of wealth and infrastructure in a modern mega-city could make an urban earthquake incalculably more devastating in economic terms than the Kobe earthquake of 1995, which caused economic losses of well over US\$ 100 billion, making it so far the costliest natural catastrophe of all time.

UNESCO seeks to mitigate disaster by supporting the development and implementation of quake-resistant building codes. For it is collapsing buildings that kill people, not usually the ground tremors themselves. Engineers know how to prevent floors pancaking on top of one another and how to create buildings that can absorb substantial shocks without collapsing, but many authorities fail to enforce earthquake hazard and building safety codes, even where these exist. Time after time, heavy casualties are caused not so much by earthquakes as by shoddy construction.

Earthquakes also provide scientists with a living laboratory: thus, a considerable amount about the behaviour of earthquakes is known as a result of many post-disaster reconnaissance missions conducted by UNESCO.

### Tsunamis

Earthquakes beneath the ocean floor, volcanic eruptions, submarine landslides and even meteorite impacts can touch off the monstrous waves known as tsunamis.

Barely perceptible in the deep ocean, a tsunami travels at the speed of a commercial jet plane but slows down when it hits shallow waters and rears up onto land.

The giant tsunami of December 26, 2004 caught countries around the Indian Ocean unprepared. Scientists were immediately aware of the massive earthquake on the sea floor off Sumatra that spawned the tsunami, but there was no way of sounding the alarm that a tsunami might be imminent.

Had an alert system, similar to that already operating in the Pacific Ocean been in place, many of the more than 240,000 people killed or missing in the Indian Ocean disaster would have had time to escape to higher ground.

Within a month of the calamity, governments at the Kobe meeting agreed to set up a tsunami warning system for the Indian Ocean and an initial network is in place since July, 2006 with help from the Pacific Tsunami Warning Center in Hawaii and the Japanese Meteorological Agency.

Going further, Member States of the Intergovernmental Oceanographic Commission of UNESCO decided at their General Assembly in June 2005 to coordinate the establishment of a global warning system for ocean-related hazards in close cooperation with other UN bodies.

Although tsunamis are most common in the Pacific Ocean where also more than half of volcanoes are located, the destruction of Lisbon in 1755 and Messina in 1908 are reminders that these events can strike anywhere in the world. Harnessing the capabilities of existing detection networks, a tsunami warning system for the North East Atlantic and Mediterranean is scheduled to be in place by the end of 2007. Planning is also underway for an early warning system for ocean-related hazards in the Caribbean.

Because not all submarine earthquakes result in destructive tsunamis, the killer waves cannot be detected by seismological observations alone. These have to be supplemented with deep-sea pressure sensors and satellite-linked buoys.

The complex science serves no purpose unless it can be converted into effective warnings, which requires the building of national centres to receive warnings from observation networks and relay them to communities in harm's way.

The tsunami warning systems will eventually form part of a global warning and mitigation network being coordinated by the Intergovernmental Oceanographic Commission. This, in turn, will be contributing to the Global Earth Observation System of Systems (GEOSS), a worldwide effort involving









60 countries, the European Commission and 43 international organizations. The integrated system will keep an eye on all likely hazards, including tsunamis, storms and floods.

## Floods

Flooding occurs anywhere where rainwater or snow melt exceeds the capacity of the soil to absorb it or rivers to carry it away. Floods range from deadly flash events that carry off people, livestock and property to slow inundations that can turn huge areas of land into shallow lakes.

In war-afflicted countries, floods often have the deadly effect of washing land mines out of marked areas.

As the leading UN agency for water-related issues, UNESCO in conjunction with the World Meteorological Organization inaugurated the International Flood Initiative during the 2005 World Conference on Disaster Reduction in Japan. The organization participates in all aspects of water resource research through the International Hydrological Programme.

Floods are among the most frequent and deadly of natural phenomena, affecting an average 520 million people a year. Almost half the people killed in the natural disasters of recent decades have been victims of floods, which also account for about one third of economic losses incurred worldwide.

Several factors explain this toll, particularly the denser occupancy of flood plains and other flood-prone areas, deforestation and unsuitable watershed land use.

Informal settlements around megacities in developing countries are particularly at risk. Jakarta, which has a population of about 12 million, exemplifies the problem. Situated in a coastal lowland area and criss-crossed by 13 rivers and numerous streams, it is frequently inundated.

UNESCO's office in the Indonesian capital has contributed to a flood mitigation project in a district subject to recurrent severe flooding. Under the project, community representatives were trained to communicate with the community as a whole and show how people could lessen the impact of future inundations. This was in line with UNESCO's aim to create communities that are well-informed and adequately prepared for such events.

It should be remembered that although floods are the most far-reaching of natural disasters, they are also often part of nature's pattern. For example, they carry nutrients that allow for fertile flood plains,



A tornado that swept across Moore, Oklahoma, on May 8, 2003, left more than 300 million dollars in damage. The twister, rated F3 on the Fujita scale, struck only four years after the same area was devastated by an F5 tornado.  
© University Corporation for Atmospheric Research.



and the plains also form the spawning ground of many fish species. The problem therefore is often not to stop flooding in cases where it is helpful to the environment, but to reduce human vulnerability to flooding.

The International Flood Initiative aims at a holistic rather than fragmented approach to flood management by stimulating research, improving training in both informal and academic settings, networking information, empowering populations at risk of flooding and providing technical assistance. While the program is primarily designed to protect populations at risk, it also seeks to enhance the benefits of flooding and introduce adaptation strategies appropriate for each area.

### Tropical cyclones

Tropical cyclones – also known as typhoons or hurricanes depending on geographical location – are among the deadliest and most costly of natural disasters, mainly because of the massive surges of water they bring in their wake. A cyclone accompanied by an exceptionally high storm surge swept over the coastal wetlands of Bangladesh in 1970, killing 300,000 people.

A future rise in sea levels associated with global warming may mean bigger storm surges and more vulnerability to them as well as to tsunamis. In addition, increasing population density in coastal regions has increased human vulnerability to cyclones.

The inundation of New Orleans following Hurricane Katrina in 2005 is a harbinger of what could be in store for an increasing number of coastal cities if sea levels rise as feared as a result of global climate change and the loss of mass from glaciers and ice caps. There is also concern that a rise in sea-surface temperatures may increase the number and intensity of violent tropical storms reaching coastlines, and thus the number of surges.

According to the Intergovernmental Panel on Climate Change, “Many coastal areas will experience increased levels of flooding, accelerated erosion, loss of wetland and sea-water intrusion in freshwater sources.”

The Intergovernmental Oceanographic Commission of UNESCO has been involved since the mid-1980s in a long-term project on the management of beach resources and planning for coastline change in the Caribbean. The IOC is also one of the sponsors and hosts the Secretariat of the Global Ocean Observing System, one of the ultimate aims of which is to mitigate damage from natural hazards and pollution.





The IOC sponsors the World Climate Research Programme, which provides critical information to the Intergovernmental Panel on Climate Change. Together with the WMO, it coordinates ocean observations that feed into tropical cyclone forecasting.

### Climate Change

The Intergovernmental Panel on Climate Change has stated that warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea levels.

More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and sub-tropics, while the frequency of heavy precipitation events has increased over most land areas. Heat waves have become more frequent, and observations suggest an increase in tropical cyclone activity.

Climate change is a priority issue in many UNESCO programmes, including those concerned with the oceans, drylands, ecosystems and the management of resources.

The organization is closely involved in a number of aspects of observing, mitigating and adapting to climate change through such instruments as the World Climate Research Programme, the Drylands and Desertification Programme or the Global Coral Reef Monitoring Network.

Understanding the impact of climate on human society and the environment requires the kind of sound and unbiased research that UNESCO supports, and the translation of research results into advice for policy makers and information for the general public.

### Landslides

Both meteorological and seismological events can trigger massive movement of rock and soil on unstable slopes. In addition to causing deaths, injuries and property damage, they can disrupt roads and railways and rupture oil, gas, water and sewage pipelines.



Leafless, dead trees cast little shade on the sere earth below. In time, they will crumble into dry dust, blowing over the baked soil of northern Senegal. Meanwhile, the average annual temperature continues to rise and the rains to decrease. © FAO / H. Chazine.



UNESCO has a special responsibility in this area along with the International Consortium on Landslides (ICL), which it helped to create.

Landslides “wreak havoc today in almost every region of the world, constituting a hazard that is both ubiquitous and extremely damaging,” UNESCO Director-General Koichiro Matsuura told the ICL board in November, 2006. “They act as a serious brake on development efforts, in particular in least developed countries.”

UNESCO and the consortium plan to hold a World Landslide Forum aimed at strengthening global risk preparedness.

The Kyoto-based International Consortium on Landslides is an international non-governmental and non-profit scientific organization promoting landslide research and capacity building, and integrating landslide sciences and technology within the appropriate cultural and social contexts. It also coordinates international expertise in landslide risk assessment and mitigation studies and promotes a global, multidisciplinary programme on landslides.

### Droughts and desertification

Changing climate patterns are also held responsible for the increasing prevalence of drought in many parts of the world, but particularly in Africa, where it contributes to the spread of deserts and land degradation.

Climate change will undoubtedly be accompanied by surprising and complex effects that will vary from place to place, meaning that even as the risk of flooding increases in some areas, the scourge of drought will become more prevalent in others.

Desertification already threatens over one third of the earth's land surface, directly affects the lives of 250 million people and threatens another 1.2 billion in 110 countries. Tens of millions of those affected in sub-Saharan Africa are expected to swell migratory pressures toward northern Africa and Europe.

UNESCO has been involved in drylands research since the 1950s, and emphasizes the need for a developmental rather than a crisis management approach through its intergovernmental Man and the Biosphere Programme and the International Hydrological Programme. In 2006, UNESCO organized an international scientific conference in Tunis at which delegates stressed the need for interdependence and conservation of cultural and biological diversity, and the integrated management of water resources.







UNESCO and the International Hydrological Programme have agreed to facilitate the development of a Regional Integrated Drought Management Centre in sub-Saharan Africa.

Wild fires, often a corollary of arid conditions, occur along urban-wilderness interfaces, causing heavy property damage and leaving stricken areas susceptible to floods and landslides.

### Volcanoes

Volcanic eruptions are the one form of natural disaster that comes with a warning. Hot molten rock generates earthquakes and causes the ground to swell as it makes its way to the surface. Provided the volcano is being monitored, such signs become apparent weeks or even months before any volcanic activity. But there is no way of telling in advance how catastrophic an eruption will be or how long it will last. And sometimes the warning signs turn out to be false alarms. This and the lack of means in developing countries explain why only a few of 800 active and 500 potentially active volcanoes are monitored on a regular basis.

Because eruptions are predictable, it is usually possible to move populations at risk and reduce or prevent loss of life. But little can be done to control damage to crops or property caused by mud-flow, lava-flow and ash deposits once an eruption is under way.

Volcanoes play a fundamental role in life's sustainability on earth, and eruptions ought not to be disasters. The fact that they sometimes are is almost entirely the result of inappropriate settlements in risk-prone areas.

UNESCO's office in the Samoan capital, Apia is working with researchers to document and reinforce local knowledge, with a particular emphasis on volcanic hazards. Such use of local knowledge as a starting point for disaster-reduction planning is highly relevant across the Pacific region.

With respect to volcanoes as well as to other geohazards, UNESCO promotes the use of modern technologies. The organization is cooperating with the Charter of Space and Major Disasters and has the possibility of obtaining space imagery for geohazard studies immediately after a disaster occurs, especially in developing countries. In partnership with the Global Earth Observation System of Systems, it is seeking how to use remote sensing and ground observations to build a global capacity to mitigate geohazards.





# Education and public awareness

## Local people matter

It is clear that some disasters are caused or worsened by human actions that exacerbate existing levels of risk and vulnerability, which is why it is a mistake to try to cope with hazards in isolation from broader social, economic and environmental factors and without involving people at the local level.

Quite often the people who are affected by a disaster, and who are sometimes themselves the cause of them, such as the inhabitants of slums built on flood plains or on hillsides prone to mud slides, live on the fringes of society and are uninvolved in risk-reduction measures, which they may actually regard as a threat.

But experience and numerous projects have shown the positive effect of education in reducing disaster risk. Children who know how to react in case of an earthquake, community leaders who are taught to issue timely storm warnings and whole communities that have been taught how to defend themselves against hazards can dramatically reduce casualties and loss of livelihood when disaster strikes.


In 1994, UNESCO launched the Management of Social Transformation (MOST) programme, which mobilizes social scientists in finding solutions to the serious problems faced by countries experiencing rapid change, as well as developing a dialogue with policy makers and fomenting greater cooperation with natural scientists. Under new policy guidelines, the MOST project focuses on building efficient bridges between research, policy and practice. The programme promotes a culture of evidence-based policy-making – nationally, regionally and internationally.

The best science and technology in the world are of little value unless they can be turned into effective disaster warnings that ordinary people can understand. The International Federation of Red Cross and Red Crescent Societies (IFRC) says that it is “striking” how many disasters “could have been avoided with better information and communication.” But for many, it says in its 2005 World Disasters Report, disaster arrives “suddenly, unannounced.”

Societies all over the world have developed specific sets of knowledge and practices to avoid or mitigate the effects of natural disasters, but these are poorly documented and little understood. UNESCO is committed to making such knowledge an integral part of disaster-reduction planning. Through its







The Indonesian coast, between Banda Aceh and Meulaboh, Indonesia, after the earthquake and the tsunami of 26 December 2004. © UNESCO/Evan Schneider.

programme on education for sustainable development, the Bangkok office of the Organization coordinates a regional effort in which six Asian countries developed disaster educational materials that are locally relevant and culturally appropriate. The key to the success of disaster readiness in countries like Cuba, for example, the IFRC says is “putting people, not just technology, at the centre of their warning systems” with measures as simple but effective as sending messengers around with a megaphone to warn of an approaching storm.

It also entails detailed mapping of hazards, storing toxic products in a safe place, identifying refuges and evacuation routes in advance, lowering reservoir levels and burying emergency supplies of food and water, as happens in Bangladesh. It is necessary not only to have emergency response plans in place – such as evacuating people and stepping up law enforcement – but some clear ideas about post-disaster recovery.

“Building awareness from the bottom up is as valuable as transmitting information from the top down,” the IFRC report says. Putting it bluntly, timely information may be the only form of disaster preparedness that the most vulnerable can afford.

Cuba is often mentioned as a leader in prevention strategy, because its methods demonstrably work. Six major hurricanes that struck Cuba between 1996 and 2002 killed a reported 16 people compared with thousands elsewhere in the Caribbean. In September 2004, Hurricane Ivan battered the western part of Cuba with 260-kilometer-an-hour winds. More than 1.5 million people were evacuated to higher ground ahead of the storm, which destroyed thousands of houses. Of the 64 deaths caused by the storm throughout the Caribbean, none was reported in Cuba.

Compare that with what happened in the Asian tsunami, where scientists with information about the killer waves had no way to communicate a warning to people in the path of the disaster even with hours at their disposal.

In Cuba, disaster preparedness begins in the classroom and is an integral part of the country's civil defence system. Local involvement is a vital part not only of being ready to confront natural hazards but also to recover if disaster strikes.

Small island countries are at particular risk from a wide range of natural hazards, including tropical storms, earthquakes and volcanic eruptions. Island communities in the Pacific and the Caribbean have adapted to these hazards and have built locally specific knowledge and practices to minimize loss of life and livelihoods when disasters strike.



A number of collaborative activities have been undertaken on educational and communication aspects of disaster mitigation, such as the preparation of an information kit for the media, as well as disaster preparedness teaching materials through a joint initiative between UNESCO and the Caribbean Disaster Emergency Response Agency.

### Global disaster reduction education campaign

A young girl, Tilly Smith saved dozens of lives in the Indian Ocean disaster because she remembered what she had been taught about tsunamis in a geography lesson before going on holiday to Thailand with her parents. UNESCO aims to have such lessons made part of school programmes everywhere. In 2006, it hosted the launch of a campaign entitled "Disaster Risk Reduction Begins at School" to increase awareness of disaster reduction and ensure that the subject is taught in schools. It also campaigns to create schools buildings capable of resisting natural hazards such as earthquakes by developing and applying appropriate construction codes.

The vulnerability of children in natural disasters was demonstrated by the earthquake that struck Pakistan in October 2005 when more than 16,000 children perished at school. In addition, if they are left standing after an earthquake, schools are usually the first places to be turned into rescue and relief centres. UNESCO's Islamabad office has helped provide a professional support to reconstruction of schools and educational system in Pakistan.

UNESCO plays a pivotal role in a "cluster" of international, government and non-government organizations pledged to build "a culture of resilient communities" based on knowledge, innovation and education." This platform of stakeholders seeks to integrate education about disaster reduction into school curricula and make schools themselves resistant to hazards by encouraging the application of construction standards that can withstand any kind of natural hazard.

Awareness is not only taught in the classroom but is passed on informally from generation to generation – and this knowledge, essentially local and traditional needs to be tapped as well. The case of the indigenous people of the Andaman Sea who call themselves the Moken provides a striking example. By reading the signs of the sea, the Moken headed for high ground or to the deeper ocean before the 2004 tsunami struck, and reportedly survived the disaster without suffering a single casualty.







# Protecting cultural heritage

The organization is the leading guardian of the world's heritage. As such, UNESCO is closely involved in risk assessment and rescue operations to protect monuments and urban historic centres, sites, museums, and archives, in cooperation with other international conservation institutions.

UNESCO has thus implemented numerous projects to safeguard cultural sites and objects in the wake of disasters, including the 1950 earthquake in Cuzco, Peru or the 1966 flooding in Florence and Venice or, more recently, the Citadel of Bam (Iran), and the temples of Prambanan (Indonesia) severely damaged by earthquakes in 2003 and 2006 respectively.

UNESCO has published several manuals and guidelines on protecting cultural sites, including a policy document in 2006 entitled "A Strategy for Reducing Risks at World Heritage Properties." The organization recognizes that protecting patrimony plays an essential part in a culture of disaster prevention. Cultural and natural heritage and intangible artistic skills are important in themselves, but they also contribute to sustainable development, which includes the mitigation of disasters.

## Post-disaster situations

UNESCO's contribution to the overall United Nations system's response to disaster situations has considerably increased over the past few years.

UNESCO advocates the integration of risk reduction in national reconstruction efforts and, more generally, calls for policy advice and capacity building to improve prevention measures as part of the reconstruction agenda.

UNESCO supports the enhancement of local capacities to handle post disaster rehabilitation including:

- reconstruction of educational systems;
- promotion of cultural diversity including restoration and protection of threatened cultural and natural heritage;
- reinforcing and promotion of independent and pluralistic media;
- drawing lessons for future risk mitigation;
- rebuilding global scientific capacities for disaster reduction.

# Disaster risk reduction is **necessary,** **possible** and **cost effective**

## The way forward

UNESCO's future strategy will build on the expertise and networks of its international scientific and educational programmes. It will stimulate regional partnerships and networks devoted to the collection and dissemination of information about hazards and disaster reduction, tapping the knowledge not only of scientists but of indigenous peoples. It will continue to work for the protection of schools and the cultural heritage.

The organization will involve natural and social scientists as well as its education and communications sectors in creating interdisciplinary platforms to improve disaster risk management.

In particular, under programmes planned for the 2008-2013 period, the Intergovernmental Oceanographic Commission will continue to build on its response to the Indian Ocean tsunami, consolidating its work in both the Indian and Pacific Oceans, as well as expanding tsunami early warning systems to Africa, the South Pacific, the Mediterranean Sea, the northeast Atlantic and the Caribbean.

UNESCO will promote the expansion and integration of warning systems in partnership with the International Strategy for Disaster Reduction and the World Meteorological Organization.

Investment in risk reduction makes sense in view of the scale, destructiveness, human tragedy and material loss caused by natural disasters.

The economic losses are becoming steadily more onerous. In the 1990s they were (counting in constant sums) three times higher than in the 1980s, almost nine times higher than in the 1960s and 15 times higher than in the 1950s.

According to the World Bank, "Accelerated changes in demographic and economic trends have disturbed the balance between ecosystems, increasing the risk of human suffering and losses. Today's populated areas – cities and agricultural zones – constitute an increasingly valuable asset base. Potential human, social and economic losses from natural disasters grow year by year, independently of nature's forces. Increased vulnerability requires that natural disaster management be at the heart of economic and social development policy of disaster-prone countries."

Despite the evidence that the number of extreme events is increasing as a result of global climate change and population pressures, disaster relief rather than risk prevention is generally considered as far more important by aid donors and non-government organizations, as well as by the affected countries themselves.

It is, of course, morally difficult to refuse disaster aid. In addition, relief is action-oriented, makes a good story for the media and it is easy to quantify and thus ready accountable to donors. It is more difficult to put figures on disaster risk reduction, particularly if it is successful and therefore unperceived.

Yet once a disaster has occurred, it is often painfully evident with the benefit of hindsight that an ounce of prevention would have been much better than a pound of cure. Take as an example the case of Mozambique, one of the world's poorest nations, which suffers from periodic cyclone damage and flooding.

After a warning in 2000 that it was likely to receive abnormally high rainfall, Mozambique asked aid donors for US\$2.7 million to enable it to carry out immediate preparedness and mitigation activities, but received less than half this amount.

The flooding that then ensued in southern Africa, of which Mozambique bore the brunt, was the worst in living memory, with at least 700 people killed, 650,000 displaced and 4.5 million affected, totalling about a quarter of the population.

Rivers across the region burst their banks, washing away all the economic progress that Mozambique had made since its long civil war. Aid workers said the floodwaters, which submerged vast areas of land and destroyed much of the country's infrastructure, caused more destruction than the civil war itself.

Subsequently, Mozambique made three successive appeals totalling US\$160 million for emergency assistance, all of which were met, and a further US\$456.48 million dollars was pledged at an International Reconstruction Conference in Rome later that year.



Investment in disaster prevention and mitigation is entirely consistent with planning targets for sustainable development. Over-reliance on disaster response and recovery rather than on reducing risks in the first place may be counter-productive, according to some experts, because it encourages fatalism and acts as a disincentive to the very policies that can substantially reduce loss of life and destruction of property when hazards strike.

Natural hazards cannot be eliminated. But unnatural hazards – those caused or exacerbated by man's actions – can be minimized provided that communities are informed and resilient, and ecosystems are allowed to perform as they should. In this sense, disaster reduction is an integral part of sustainable development and the global fight against poverty.

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## **For more information** about programmes and activities mentioned in this brochure

### **Natural Sciences**

<http://www.unesco.org/science/>

### **Division for Science Policy and Sustainable Development**

<http://www.unesco.org/science/psd/>

### **Division of Basic and Engineering Sciences**

[http://portal.unesco.org/sc\\_nat/ev.php?URL\\_ID=1489&URL\\_DO=DO\\_TOPIC&URL\\_SECTION=201&reload=1049188728](http://portal.unesco.org/sc_nat/ev.php?URL_ID=1489&URL_DO=DO_TOPIC&URL_SECTION=201&reload=1049188728)

### **Division of Ecological and Earth Sciences**

<http://www.unesco.org/mab/index.shtml>

### **Division of Water Sciences**

<http://www.unesco.org/water/>

### **Intergovernmental Oceanographic Commission**

<http://ioc.unesco.org/iocweb/index.php>

### **UNESCO Climate Programmes**

<http://ioc3.unesco.org/unesco-climate/index.html>

### **Education**

[http://portal.unesco.org/education/en/ev.php-URL\\_ID=48712&URL\\_DO=DO\\_TOPIC&URL\\_SECTION=201.html](http://portal.unesco.org/education/en/ev.php-URL_ID=48712&URL_DO=DO_TOPIC&URL_SECTION=201.html)

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### **World Heritage Centre**

<http://whc.unesco.org/>

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### **UNESCO worldwide**

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