UNITED NATIONS

International Strategy
ISDR
for Disaster Reduction

"Growing cities - *growing threats*"

With more than half the world's population now living in cities, we have undoubtedly entered an "urban millennium". Cities, with their myriads of educational, economic and cultural opportunities, hold the promise of growth and development. However, this rural to urban migration has not been sustainable, providing a daunting future for many cities. Well-known hazardous zones are increasingly being encroached upon by human development. In an effort to meet the desire for businesses to be closely clustered with strategic partners or competitors, developers continue to build in earthquake zones, or in areas without adequate road, water and electricity infrastructure. Increasing numbers of affluent urban dwellers are seeking to escape the intensity of city life by building costly homes in coastal areas despite the increasing occurrences of high winds and flooding. For the world's poor caught between spiraling land and transportation costs, the choice is a stark one; living in so-called 'informal settlements' located in the least desirable locations next to hazardous industries, flood plains or areas prone to landslides. The Marmara earthquake of 1999 in Turkey provided a vivid example of this trend. In the 1990s, 60 to 70 percent of urbanisation occurred illegally, often in areas which are adjacent to industrial zones and known to be highly seismic. With land speculation and rent amounting to 30% of GNP by 1998, there was little incentive to enforce existing planning and building codes.

Existing databases which attempt to quantify damages caused by disasters are far from being comprehensive. However the trend is clear, the highest financial losses occur in developed countries while the greatest losses measured in terms of fatalities and development losses are experienced in developing countries. Damage to a business headquarters may run into the millions of dollars, but a rapid recovery is possible if appropriate business continuity and insurance policies are in place. While the poor may experience comparatively negligible financial losses, without the resources required for recovery such as dependable and affordable transport, water, sewage and electricity infrastructure, they are caught in a vicious cycle of increasing vulnerability. The facts are clear, not only do natural disasters exacerbate existing social, physical and economic problems but they will continue to increase in number and severity as long as the sustainability of our cities is considered to be subordinate to competing development priorities.

"*What can be done?* – Tools for Disaster Mitigation"

Mitigation is essentially a local concern. Communities are the first to experience and react to a disaster. Land usage, planning and construction standards are most often decided upon and enforced at the local level. Promoting a culture of prevention within local authorities and communities must therefore be the central focus of any national disaster management strategy. Central to this effort must be the application of mechanisms and tools for enforcing existing building codes and zoning by-laws. Mitigation is far less expensive to implement when accounted for in the planning and construction stage, rather than after a building or infrastructure element is built. When carried out effectively, mitigation prevents the loss of life, reduces damages, and minimises the recovery costs. The following techniques for coping with natural hazards and disasters have been proven to be useful in minimising losses.

Design and construction methods

Infrastructure, including transportation, water, electric, gas, drainage, storage facilities and communication networks are indeed a city's "lifeline". The design and construction of hazard-resistant structures are one of the most cost-effective mitigation measures. Developing and enforcing building codes and standards of construction greatly reduces risks posed by natural hazards. Construction workers, engineers, urban planners and building inspectors and local leaders all have a crucial role to play in ensuring that the built environment does not pose an unnecessary risk. Local authorities have a key role to play in the code enforcement process. Any code of course is only effective if it is adequately enforced. While Florida was long regarded as having one of the most rigorous building codes in the United States, Hurricane Andrew proved that a state of the art code is of little use if it is not adequately enforced. Engineering standards of buildings, homes and lifelines are determined by the degree to which informed decisions are made by its leaders and residents who ultimately determine how effective a particular engineering solution will be in response to a particular hazard.

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Building Disaster Resistant Infrastructures

"Growing cities - *growing threats*"

Land use planning and management

Creating and implementing comprehensive city development strategies and land use plans provides a number of opportunities to mitigate damages caused by hazards. Since location is the key factor which determines the level of risk associated with a certain hazard, land-use plans are a useful tool in identifying the most suitable usage for vulnerable areas. Local governments have a key role to play given their considerable influence over factors such as: building standards, land and property markets, land and housing taxation, planning processes, and infrastructure construction and management. It is up to communities ultimately to balance proposed measures against criteria such as necessity, effectiveness and affordability. By disseminating information about hazards to communities, developers, investors, and builders, local governments can reduce losses as well as achieve wider developmental goals by making human settlements healthier, productive and sustainable for all.

Hazard regulation

Mitigation tools that seek to control hazards are used to protect existing at-risk developments and infrastructures. Flood control is perhaps the oldest form of mitigation through dams and reservoirs. But they can also increase the vulnerability of those who live downstream, as was the case in Mozambique in 2000. Therefore, warning systems to predict, forecast and alert local communities have a valuable contribution to make by keeping people out of harms way. There have been huge technological advances allowing for extremely accurate monitoring, prediction and forecasting of extreme weather conditions. However, the ability to deliver this vital information to the public has not enjoyed similar success. Local mechanisms for communicating risk are in most cases very weak. Even where such systems exist, very often communities do not respond appropriately to them, either because the message is poorly constructed or because of a lack of choice. For many people, the perceived threat of losing their property to "looters" is a greater threat than that posed by a severe weather warning broadcast by officials.

Some conclusions

Despite considerable scientific and technical advances in the field of disaster mitigation, a consensus regarding how to comprehensively reduce vulnerability to a wide-variety of hazards has yet to emerge. One of the reasons for this has been a preoccupation among experts to limit their concerns to establishing normative standards for planning, construction and design of infrastructure and buildings. The challenge of how to implement these standards and reduce underlying vulnerability is on the other hand rooted within the comparatively murky sphere of developing individual, community and local, regional and national government capacity. There is of course no denying of the importance of scientific, technical and planning tools, however this approach will continue to provide disappointing results if underlying capacities within economic, social and political spheres are not adequately addressed.

While disasters will always be with us, progress can be achieved in minimising their effects upon cities by empowering communities through information. In this way they can become full participants in hazard reduction strategies as opposed to victims of circumstance. Disaster reduction can and must be coupled with policies that serve wider city development goals. In this way, our cities can be built to withstand environmental hazards in a more sustainable manner.

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Examples of Disaster Reduction Initiatives

Risk Assessment Tools for Diagnosis of Urban Areas against Seismic Disasters (RADIUS).
United Nations Initiative towards Earthquake Safe Cities

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Earthquakes are among the most deadly and destructive of natural hazards, killing approximately 1.5 million people between 1900 and 1990. Urban seismic risk is rapidly increasing, particularly in developing countries. Following the successful completion of the RADIUS initiative in 1999, the Secretariat for the International Strategy for Disaster Reduction (ISDR), the successor arrangement to the Secretariat of the International Decade for Natural Disaster Reduction (IDNDR), published the final report of the initiative in 2000 and produced the RADIUS CD-ROM which contains the final reports and the tools developed throughout the project. It is the intention of the Secretariat to assess what changes in risk management RADIUS has made in communities. The Secretariat also intends to promote the application of the tools developed under RADIUS in other earthquake-prone cities. For more information on RADIUS, please visit: http://www.geohaz.org/radius.html.

With financial assistance from the Japanese Government, the IDNDR Secretariat launched the RADIUS Initiative in 1996. The goal of the initiative was to help people understand seismic risk and raise public awareness as a first step toward seismic risk reduction. The major focus was to promote capacity building in local government at the city level. Nine cities selected for case studies developed an earthquake scenario and a risk management plan by involving diverse sectors of the community. These seismic damage scenarios describe human loss, damage to building and infrastructure and their effect on urban activities. The action plans propose new priorities for urban planning and for the improvement of existing urban structures and emergency activities. The initiative raised public awareness of seismic risk, promoted information exchange among cities and created a worldwide network. Tools were also developed based on the experience of the case studies: 1) the guidelines to implement RADIUS-type risk assessment projects; 2) the software to estimate preliminary damage in case of an earthquake disaster. A limited number of copies of the RADIUS report with the CD-ROM can be obtained free of charge from the Secretariat for the ISDR.

Community Based Mitigation in Peru

Lima – Preparing communities for disaster

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Lima is situated along the boundary of two tectonic plates. This makes the Peruvian capital prone to the natural threat posed by earthquakes. Fires, landslides and flooding caused by gullies result in death and destruction every year. Disasters have been increasing in frequency and severity as a result of accelerated urban growth from increased migration of the rural poor into vulnerable urban areas. In Caquetá, Ecociudad, an NGO dealing with environmental management and disaster preparedness, has supported community based risk-mapping. This exercises has highlighted a number of high-risk areas, including:

- Houses located on the banks of the Rimac river which could collapse in the event of a flood or landslide.
- Human settlements situated in areas prone to landslides and minor earth tremors.
- Markets and formal and informal commercial centres that are densely crowded and vulnerable to outbreaks of fire.

Community meetings mapped out threats, vulnerabilities and capacities based on local knowledge. This process has led to the establishment of volunteer fire brigades specialised in emergency rescue. Human settlements located along the Rimac river are currently being relocated by a neighbourhood committee in collaboration with local and central government.

Examples of Disaster Reduction Initiatives

Information Management in India

The Vulnerability Atlas

In keeping with the objectives of the Yokohama Strategy for a Safer World, the Government of India took the initiative to develop appropriate instruments which enable the shift in national policy from post-disaster response to pre-disaster pro-active action, dealing with earthquakes, cyclones and floods. With high vulnerability and a rising frequency, these natural hazards have resulted in huge losses of housing stock and human lives in recent years. To counter this trend, a Vulnerability Atlas was developed together with other recommendations to help set up appropriate strategies and programmes for disaster mitigation and the reduction of losses of existing housing stock and achieving desired safety levels in future constructions.

The Vulnerability Atlas of India has proved to be an innovative tool for assessing district-wide vulnerability and risk levels of existing housing stock. It is being utilised as a valuable in order to develop micro level action plans for reducing the impact of natural disasters. A country-wide information dissemination and awareness programme has helped house holders, disaster managers, the administration at state, district and local levels, in understanding their respective roles and responsibilities in pre-disaster actions.

The Atlas has also helped state governments and local authorities to strengthen regulatory frameworks by suitably amending the building by-laws, regulations, masterplans and land-use planning regulations for promoting disaster resistant design, construction and planning practices. The documents and methodologies for vulnerability and risk assessment and technical guidelines for disaster resistant constructions have shown high potential for transfer, adaptation and replication in varying conditions.

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Local Government Capacity Building in New Zealand

Wellington – Re-engineering the role of the Emergency Manager

New Zealand is part of the “Circum-Pacific Ring of Fire” which comprises a number of highly seismic and volcanic areas. Consequently, natural disasters have a significant impact on its relatively small population, with annual flood losses amounting to US$ 75 million and earthquake losses topping US$ 6 million. Following the 1994 earthquake in Northridge, California, the Wellington City Council, together with the New Zealand Fire Services, began a series of local and international consultations. A consensus emerged over the fact that the current disaster management regime was focused almost exclusively upon response and preparedness measures. One report noted that, (as is the case in most countries), emergency managers were unable to contribute to land-use management decisions, vulnerability assessments and risk management programmes.

Following the recommendations made, the Government of New Zealand started the implementation, over the last 4 years, of a variety of legislative and policy reforms which have resulted in the following developments:

- Broadened responsibilities for local authority emergency managers, who are increasingly responsible for and trained in developing community capacity for risk identification, vulnerability reduction and disaster resilience.
- The establishment of decentralised Emergency Management Groups whose membership comprises neighbouring local authorities, emergency services and utility companies. This approach ensures that the National Emergency Management Strategy is focused on the local level, while enhancing co-operation and co-ordination of human and technical resources across the country.
- A comprehensive risk management approach which integrates disaster management into environmental and community management at national and local levels.

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Examples of Disaster Reduction Initiatives

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Two projects supported by the World Bank count among examples of best practices to reduce disaster vulnerability in Latin America: the Argentina Flood Rehabilitation Project and the Rio Flood Reconstruction and Prevention Project.

Flood resistant infrastructures in Argentina

The Argentina Flood Rehabilitation Project (AFRP) was aimed at rapidly reconstructing destroyed infrastructure and restoring conditions conducive to long term growth in more than one third of Argentina. The challenge was immense; the flood plain is comparable in size and complexity to the Mississippi and its tributaries. Located in the northeast of the country, the area is home to 10 million people and includes a delta formed by the conjunction of three great rivers: the Paraguay, Paraná, and Uruguay. It comprises Argentina's most developed agricultural and industrial zones, an extensive transportation network, and two hydroelectric dams. In the past, makeshift protective earthworks had been built, but without a basic understanding of the local topography.

Under the project, a modest approach was adopted. Priority was given to building protections to be effective well into the future. The AFRP avoided locales too difficult or costly to protect, and delimited zones where evacuation would be necessary in extreme cases.

Through this measured approach, the project substantially reduced vulnerability to flooding in the concerned area. With an estimated rate of return at 30%, the AFRP also helped to overcome social marginality in the communities were new housing was built.

The project was criticized for cost overruns and design shortcomings, and the lack of a sustainable disaster-specialized institution prevented the project of having a greater impact. Nevertheless, the flood control mechanisms and drainage improvements withstood the 1997/98 El Niño, a considerable achievement.

Flood reconstruction and prevention in Brazil

In Brazil, the ambitious Rio Flood Reconstruction and Prevention Project was designed to break the cycle of periodic flooding, that has destroyed the residences with such regularity that it has discouraged homeowners from investing in good-quality materials. The project was also an emergency response to severe floods that damaged the metropolitan area of Rio de Janeiro in March 1988.

Installing drainage infrastructure in Brazil's low-income neighborhoods presented technical challenges. For example, many favelas are located high on hills, so special devices had to be designed to reduce the velocity of descending water. Another technology elaborated and applied in Brazil for the first time was a garbage trap to collect the solid waste that blocks drainage canals.

The installation of flood-control dams and improvements to drains reduced the total floodable area by 40%. According to a World Bank audit, the project has produced yearly benefits of US$ 65 million for a total investment of US$ 78 million, and has a rate of return over 50%.

Residents in the formerly flood-prone area have become more confident and begun investing in small businesses and housing improvements. The heavy rainfalls in 1996, the most severe to test the efficacy of the newly built infrastructure, caused only minor damage in the concerned area. To permanently reduce vulnerability to future flooding, the flood-control infrastructure must now be adequately maintained.

Examples of Disaster Reduction Initiatives

Coastal environmental preservation

A case study of the Vietnam Red Cross

An environmental preservation project, undertaken by the Thai Binh branch of the Vietnam Red Cross, was designed to address two issues affecting the people living on the coast in the Thai Thuy district of Thai Binh province. With eight to ten typhoon storms striking the coast of Vietnam annually, tidal flooding often breaches sea dykes and causes economic losses to the local population engaged in aqua culture.

The project involved creating 2,000 hectares of mangrove plantations, which served two important purposes.

Firstly, the trees act as a buffer zone in front of the sea dyke system, reducing the water velocity, wave strength and wind energy. This helps protect coastal land, human life and assets invested in development.

Secondly, the plantations contribute to the production of valuable exports such as shrimp and crabs, high-value species of marine fish in cages, mollusk farming and the culture of seaweed for agar and alginate extraction. This offers new employment opportunities to help what was a vulnerable population to improve their livelihoods.

By helping to protect the sea dykes the mangroves contributed to the economic stability of the communes. All members of the community stood to benefit as their homes, livestock and agricultural land are better protected from the risk of flooding. Poor families, with little money to repair or replace material losses from storm damage, are the greatest potential beneficiaries.

The project area was struck by the worst typhoon in a decade two months before the project evaluation. Lack of any significant damage to the sea dyke and aqua culture pond systems in Thai Thuy provided the best possible indicator of the effectiveness of the mangroves.

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Encyclopedia of Housing Construction Types in Seismically Prone Areas of the World

The Earthquake Engineering Research Institute (EERI), a non-profit association headquartered in Oakland, California USA, has a project underway, jointly with the International Association of Earthquake Engineering, to use the world wide web to build an interactive, dynamic, web-based encyclopedia of housing construction types in all seismically prone areas of the world. The encyclopedia can be viewed on the web and users can also generate the encyclopedia in whole or in part as a conventional hard copy publication. Funding for this project is being provided by the EERI Endowment Fund and the Engineering Information Foundation of New York.

Countries and Structural Types on Web site as of June, 2001

http://www.eeri.org (click on housing encyclopedia)

Argentina (confined brick; adobe block)
Chile (walls cast in-situ; moment resisting frame; reinforced hollow unit masonry, confined masonry; confined brick/block masonry)
Colombia (unreinforced brick masonry (URM); moment resisting frame for gravity loads; clay brick)
Cyprus (moment resisting frame for gravity loads)
El Salvador (adobe block)
Greece (reinforced concrete (RC) frame; load bearing stone masonry)
India (rubble stone; URM with flat and pitched roof; mud wall; gravity load frame with URM infill; URM in cement mortar with RC floor/roof)
Indonesia (URM in cement mortar with RC floor/roof)
Iran (steel moment resisting frame; braced frame; confined brick)
Italy (moment resisting frame; URM in mud/lime mortar; rubble stone)
Kyrgyz Republic (precast wall panel structure)
Malaysia (reinforced frame structure with timber roof)
Nepal (rubble stone)
Peru (confined brick; adobe block)
Russia (concrete block; large block walls; precast wall; wood panel)
Slovenia (rubble stone/stone masonry)
Syria (moment resisting frame; concrete frame)
Taiwan (concrete frame with masonry infill)
Turkey (RC frame with masonry infill)
USA (wood frame)
Uzbekistan (precast concrete frame)
Venezuela (confined brick/block masonry)
Yugoslavia (precast prestressed concrete frame; confined brick/block masonry)

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International Strategy ISDR for Disaster Reduction

Examples of Disaster Reduction Initiatives

This endeavor is linking over 160 volunteer engineers and architects from 45 different countries (to date), enabling them to develop and share data, and providing them with the tools to improve housing vulnerable to earthquakes, thereby saving lives and reducing future economic losses. The ultimate goal is to make a product that is useful not only to design professionals but to housing and community development experts as well as international agencies concerned with sustainable development and hazard reduction.

The project steering committee has developed a standardized form that is used by the project participants to describe various construction types in the different countries. The form consists of over 60 questions, covering relevant aspects of housing construction including architectural features, the structural system, seismic deficiencies and strengths, performance in past earthquakes, available strengthening technologies, building materials used, the construction process, and insurance. The steering committee has identified over 30 generic structural systems covering global housing construction made out of masonry, concrete, timber, and steel. An important feature of the form is that it is able to describe features of both nonengineered rural housing (e.g. adobe masonry) and urban highrises (e.g. concrete shear wall buildings, prefabricated concrete panel buildings, etc).

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The first phase of the project is to collect as many forms as possible from as many countries as possible and post them on the web. A user can download any or all of these forms as .pdf files. Visit http://www.eeri.org and click on the Housing Encyclopedia to view the forms that are currently available, both as short, one page summary forms, and longer, more detailed, 20 to 30 page forms.

The next phase of the project is to develop a web-based database of this information so that a user can search by various parameters, including: country; urban/rural construction; seismic hazards; building function; building materials; structural system; seismic vulnerability rating; and economic level of inhabitants. A user can generate graphs, tables, and presentations, view photos and drawings, and print out short and long forms.

Users of the encyclopedia will be able to compare strengths and vulnerabilities of the various construction systems and strengthening technologies that have been tried in different countries for the various construction types and building materials.

The encyclopedia will also be able to give a general indication of the number of people living in the various construction types, and an indication of each country's perception of the vulnerability of a particular construction type. The web site will also contain basic information on the nature of earthquakes, the earthquake behavior of buildings, and global housing statistics compiled from the World Bank and United Nations indicators. Some of these variables include percentage rural/urban population; house price to income ratio; average household income; land use by city; and housing in compliance.

The encyclopedia will also include country-specific information. There will be one contribution per country providing this background, which will include: background on seismic hazard and seismic codes/standards; the size and general rate of increase in urban/rural housing stock in the country; density of urban/rural housing; general weather patterns; and general information on housing losses in past earthquakes, including number of units lost, and type of construction most vulnerable. The project is planned for substantial completion by the end of 2002. However, the web information will remain and can continue to evolve indefinitely, creating a new form of encyclopedia.

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