# Risk Wise

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# Acknowledgements

Compiled by Sean Nicklin, Ben Cornwell, James Dodd, Jacqui Griffiths and Sean Townsend
Designed by Paul Robinson
Project manager: Stuart Fairbrother

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# Foreword

**WALTER J. AMMANN, CHAIRMAN, IDRC DAVOS 2008 AND PRESIDENT, GLOBAL RISK FORUM (GRF) DAVOS**

The combination of the world's growing population with expanding urbanization and generalized globalization has greatly aggravated the risk potential to all communities and nations. While hazards worldwide are well identified and known, the number of disasters is increasing, striking all parts of society in all regions of the world. Urban risk has become a planetary phenomenon. Climate change will worsen humanity's overall vulnerability. New principles, policies, and strategies, innovative mechanisms and methods have to be designed to address the variety of risks that face communities, from natural hazards to technical and biological risks, from pandemics to terrorism. A global collaborative global risk reduction management process becomes increasingly important as the risk landscape gains in complexity. Safety and security need to be considered in a holistic manner. Science, knowledge and know-how, practice, policy development and decision-making have to be linked in the search for sustainable solutions.

The need for an 'integral risk management' approach has led to the creation of the Global Risk Forum (GRF) Davos, a foundation established under Swiss law in the Alpine resort of Davos, also known for its annual gathering of the World Economic Forum. GRF Davos will contribute to closing gaps between science, policy and application by bringing together a broad group of experts, practitioners, scientists and key players from civil society and the private sector in the areas of risk prevention and risk management.

GRF Davos reflects the necessity to involve and to create interaction between all key players, from line ministries and disaster and risk management authorities to academic institutions and the private sector. Public-private partnerships have to play a substantial role in the context of risk management, vulnerability assessment and disaster reduction. GRF Davos supports and contributes to those indispensable global efforts. Its activities are carried out by three main institutional pillars, which complement each other:

***International Disaster and Risk Conference (IDRC)*** — A platform for all stakeholders involved with disaster and risk management that meets alternatively in Davos and in another part of the world to promote inter- and trans-disciplinary exchanges and share experiences. Project fairs will create momentum for public-private partnership initiatives.

***Risk Academy*** — A think tank and a solution provider, a knowledge and know-how transfer instrument that provides continuous education courses and training sessions, and organizes workshops for the dissemination of topical knowledge and new technologies from the academic and scientific world to business and society. Besides its own research activities, the Risk Academy is a broker and a facilitator for research and development activities in international cooperation.

***GRF Platform for Networks*** — A web-based 'professionals' platform' where practitioners, experts, novice to experienced scientists, and decision-makers in disaster and risk management have an opportunity to share their knowledge, experiences, projects, problems, and ideas, and to join other specific virtual circles. The tool may be used for a periodic risk check, globalization processes, evolving economic interdependencies, mobility, socio-political changes, and climate change to name but a few.

IDRC Davos 2008 is proud to be Lead Programme Partner of Risk Wise and to be able to provide each participant with this comprehensive and timely publication. On behalf of GRF Davos and IDRC Davos, I would like to express my appreciation to Tudor Rose and Sean Nicklin in particular for their cooperation, for their initiative to publish this volume and for selecting and organizing all the relevant articles. I am equally grateful to all the authors and institutions that have amiably contributed to this valuable book for the sake of our common goal: sustainable disaster and risk reduction.

Walter J. Ammann
Chairman, IDRC Davos 2008 and President, GRF Davos

# Contents



Image: UNEP

Image: Lloyd Homer GNS


Image: Ernest Goh

**STATEMENT FROM SALVANO BRICENO**
**DIRECTOR, SECRETARIAT OF THE INTERNATIONAL STRATEGY FOR DISASTER REDUCTION**

Disasters are not 'natural' unchangeable facts of life, but are a result of human vulnerability to natural hazards. The way that we build, organize and manage our communities and environment can make the difference between a disaster, and just bad weather.

We need to expand our thinking beyond the 'ambulance at the bottom of the cliff' approach to disasters. To save lives when hazards first strike, and to protect hard-won development gains from being wiped out, decision-makers at all levels need to bring disaster risk reduction into the mainstream of their work. This requires a shift in mindset when it comes to disasters – from fatalism to empowerment, beyond response and towards prevention.

No country or individual, rich or poor, is immune from natural hazards. No country is as prepared as it could be to protect its citizens from the growing threat, and most citizens of the world are not well equipped with disaster risk reduction knowledge for their own personal safety. Disaster risk reduction needs to be a part of everyday decision-making: from how we educate our children, to how we sow our fields, to how we plan our cities. Each decision and action can either make us more vulnerable or more resilient to disasters. Building a culture of safety and resilience must become a broad-based movement so that everyone becomes aware of ways to reduce disaster risk.

With these thoughts, I welcome the publication of this book and the work of the International Disaster and Risk Conference, for building momentum worldwide on disaster risk reduction. More collaborative efforts such as these are vital, as we work together towards a world without needless losses from disaster.

Sálvano Briceño
Director, Secretariat of the International Strategy for Disaster Reduction

**STATEMENT FROM BADAOUI ROUHBAN,**
**DIRECTOR, SECTION FOR DISASTER REDUCTION, UNESCO, PARIS**

Natural disasters are on the rise. Ever larger populations are at risk, mostly in the developing countries. Vulnerability is growing because of unsustainable development. Humankind is facing an increasing burden of risk, largely because of lack of preventive action and because of decisions about development that are sometimes inappropriately taken at the local, national and international levels.

Women and children are the most vulnerable and bear the heaviest burden of disasters' impact. Disaster reduction therefore is an important part of the United Nations' Millennium Development Goals for abating poverty.

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.

Communities will always have to face natural hazards. But hazards become disasters only when lives are lost and livelihoods swept away. Despite the rising 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.

Over the last four decades, scientific knowledge about natural hazards and the technological means of confronting them has expanded greatly. We must and can through science promote a better understanding of natural disasters: where, when and how they might occur, and what their intensity may be. We must and can continue to improve early warning systems and utilize communication technologies more effectively for the dissemination of alerts about impending disasters. We must and can promote and enforce sound engineering and construction principles. And we must and can be ever more vigilant about the protection of land, natural resources and cultural heritage.

This is no time for gentle reminders about the necessity to pay attention to the risks of disasters; it is time for a loud alarm-call that summons an adequate response, a response empowered by a firm political will. There is now an urgent need to address this issue in a determined and sustainable manner, involving all stakeholders and, most importantly, local governments and communities, households and investors. Mainstreaming disaster risk reduction at the national level and prioritizing risk management in national policies and strategies is a starting point to accelerate progress. Strengthened international partnerships, using the United Nations and other international entities will help bring together the diversity of skills and resources from all nations.

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. We need to educate people — in particular young people — about disasters and their far-reaching implications for the way we live. In this way, a culture of prevention will gradually be put in place. In this way, there would be fewer deaths, fewer injuries and less destruction when such disasters strike.

Disaster reduction emphasizes the crucial role of human thought and action in minimizing risk. The specific realm of UNESCO is to assert the value of the human mind in addressing global issues including vulnerability to hazards and disasters. UNESCO welcomes this publication and is proud to be associated with it.

Badaoui Rouhban
Director, Section for Disaster Reduction, UNESCO

## STATEMENT FROM ACHIM STEINER, UN UNDER-SECRETARY GENERAL AND EXECUTIVE DIRECTOR, UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

From melting glaciers to expanding deserts — these images of environmental change have long captured public attention. With the threat of global climate change, the environment has moved from casual concern to the forefront of the international agenda. Society must now address the challenges of adapting to an altered environment while also strengthening efforts to prevent further damages that will increase human vulnerability. One need look no further than the latest findings of the Intergovernmental Panel on Climate Change or UNEP's Global Environment Outlook-4, which describe ever-sobering scenarios likely to play out on a far shorter timescale than was previously supposed. Patterns of disaster risk are changing, and the critical ecosystems that support community resilience are being lost at an alarming rate due to human mismanagement of natural resources and changes in climate.

For increases in global average temperature beyond 1.5-2.5°C, major changes in ecosystems are predicted, with consequences for biodiversity and ecosystem goods and services from water and food supply to storm and flood regulation. In Africa's Sahel, warmer and drier conditions have led to a reduced crop-growing season. Up to 600 million people could be at risk of increased water stress if temperatures rise by 2°C or more. Sea-level rise and unsustainable human development are also contributing to significant losses of coastal wetlands and mangroves and increasing damage from coastal flooding. Millions of people are projected to be flooded annually from sea-level rise by the 2080s. Densely-populated and low-lying areas where adaptive capacity is relatively low, and which already face other challenges such as tropical storms or local coastal subsidence, are especially at risk.

So the invoice for our climate-changing emissions includes an increase in the frequency and extremities of natural hazards. 'Climate proofing' economies to minimize vulnerability to future disasters is now crucial. Adaptation costs for climate change are, however, likely to be far lower than the cost of damage: annual economic losses from extreme events increased tenfold from the 1950s to approximately USD70 billion in 2003, of which natural hazards (floods, fires, storms, drought, earthquakes) accounted for over 80 per cent of insured losses.

The urgency of reducing disaster risk was already realized in 2005, when governments adopted the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters* in Kobe, Japan. Now, as the world's leaders come together to work towards a new international climate change agenda, it is clear that without a deep and decisive climate regime post-2012 and major efforts in reducing disaster risk, meeting the Millennium Development Goals will be tough.

The Bali Action Plan, which was endorsed at the United Nations Climate Change conference in December 2007, calls for enhanced action on adaptation through consideration of risk management, risk reduction strategies and means to address loss and damage associated with climate change impacts as significant elements of climate change adaptation.

It is within this context that the ISDR Partnership for Environment and Disaster Risk Reduction, coordinated by UNEP, has been formed to advance an integrated approach to climate change adaptation, disaster risk reduction and ecosystem services. The partnership is an initiative with global reach wherein UN agencies, NGOs and specialist institutes collectively aim to guide, scale-up and better coordinate environmental efforts in pursuit of disaster risk reduction and sustainable development.

*Risk Wise*, the partner publication to the International Disaster Reduction Conference 2008, reflects the voices of a broad range of actors involved. UNEP is pleased to contribute and encourages policy makers, planners and practitioners to consider carefully the opportunities presented in this volume and in the conference itself.

Achim Steiner
Executive Director of the United Nations Environment Programme

## STATEMENT FROM MARTIN DAHINDEN, DIRECTOR GENERAL OF THE SWISS AGENCY FOR DEVELOPMENT AND COOPERATION

It is a pleasure for Switzerland to host the second International Disaster and Risk Conference (IDRC) Conference in Davos in 2008. After 2006, we welcome once again delegations from all continents, representatives of governments, the private sector, science and civil society. The conference promotes and facilitates knowledge transfer from applied science and research to decision makers and practitioners, and plays a significant role in the implementation of the Hyogo Framework for Action 2005-2015 (HFA).

The HFA specifies among others the goal to support the creation and strengthening of national integrated disaster risk reduction (DRR) mechanisms, such as multi-sectoral national platforms, with designated responsibilities aiming at facilitating coordination and promoting disaster risk awareness across sectors.

With over 20 years of experience in disaster risk reduction, the Swiss Agency for Development and Cooperation (SDC) is co-organizing a Workshop on National Platforms at the IDRC 2008 jointly with the Swiss National Platform for Natural Hazards (PLANAT) and relevant counterparts from Germany and France.

During the workshop a country-specific action plan will be elaborated with the following aims:

- Further strengthen the existing national DRR coordinating mechanisms
- Improve the systematic coordination of DRR and climate change adaptation at the national level
- Reinforce coordination and information exchange among national platforms and countries at the regional level.

Several countries are represented and actively participate in this event in order to establish and develop their national DRR platforms, legislative frameworks, plans and activities. They do this by using synergies with upcoming processes and instruments to face climate change as well as increasing information and knowledge sharing. Furthermore, this initiative is intended to provide future opportunities for civil society, non-governmental organizations, academic institutions and the private sector to contribute to DRR.

DRR has advanced on the agenda of many countries, which is indeed a very positive development. Although the primary responsibility lies with states, international and multilateral organizations nevertheless have to keep on ensuring their high profile in this field.

Martin Dahinden,
Director General, Swiss Agency for Development and Cooperation

**STATEMENT FROM WALTER J. AMMANN,**
**CHAIRMAN, IDRC DAVOS 2008 AND PRESIDENT, GLOBAL RISK FORUM (GRF) DAVOS**

"Knowledge becomes more valuable if it is applied" Confucius (551-479 BCE)

Over the last decade it has become increasingly likely that various hazards will have catastrophic consequences. Emerging trends from disaster and risk management confirm that the world is more complex, less certain and more interdependent than ever before. The contributing factors for an increase in damages and victims include planet Earth's growing population, in hazard-prone areas in particular and especially along coastlines, rivers and in urban areas. It is a sad fact that the poorest part of humankind is especially exposed to risk, since they have little or no choice about where to live.

Additional factors for emerging risks include the constantly increasing values of buildings and infrastructures, rising volumes of traffic, rising demands on mobility, logistics, and communication, changes in how people earn their living and spend their leisure time, the ever more complex economic interdependencies that come with globalization, and many more. Climate change will aggravate this complex situation.

Reducing these risks poses a serious challenge to civil society. The World Conference for Disaster Risk Reduction, organized by UN/ISDR in Kobe, Japan in January 2005 after the tsunami catastrophe, culminated in the Hyogo Framework for Action (HFA). This brought consensus that to achieve risk-resilient, sustainable societies, the management of unexpected events such as natural hazards, pandemics and diseases, man-made hazards, terrorism or environmental migration needs to be approached in an integrated way. To cope with global risks, new frameworks, principles and strategies, mechanisms and methods must be found, and the outcomes validated.

A global collaborative risk reduction management process becomes increasingly important as the risk landscape gains in complexity and interdependency. Joint and multidisciplinary efforts are necessary, with a close link to the necessary climate change adaptation efforts. A proactive, risk-based pre-disaster prevention instead of a purely hazard related, reactive post-disaster recovery management approach is key for the future.

To create the necessary political will in global, regional and national terms, scientists, experts and practitioners from government, business, civil society and non-governmental organizations must interact with key players from ministries and disaster management and development authorities, with a strong emphasis on implementation both at a strategic and operational level, particularly in the 'last mile'.

In line with the HFA, the UN Millennium Development Goals and the principles of the UNESCO-led Decade of Education for Sustainable Development, GRF Davos will contribute to such integration efforts by addressing a broad range of risks and threats including natural hazards, technical, biological and chemical risks, climate change, pandemics and terrorism, to promote a consistent and systematic risk management approach, serve as a bridge and strengthen links between practice, science, policy and decision-making in the search for sustainable solutions to the complex risks facing society today. *Risk Wise* will certainly contribute to bridging problems and their root causes, and linking governance and science to the technology perspectives of problem solving by adding the lessons and new knowledge gained from recent complex disasters. Together, we can reduce disasters and risks, and in so doing, help save countless lives.

Walter J. Ammann
Chairman, IDRC Davos 2008 and President, GRF Davos

# Today's education for tomorrow's disaster risk reduction

*Sálvano Briceño, Director, Secretariat of the United Nations International Strategy for Disaster Reduction*

**As people around the world, political officials and practicing professionals all become increasingly aware of the serious consequences that disaster risks pose for their societies, there is a growing demand for education to spur the better management and anticipated reduction of those risks.**

A global movement to build communities and nations that are resilient to disasters is being promoted through the United Nations International Strategy for Disaster Reduction (ISDR). This movement is represented internationally by the joint efforts of the members of the Global Platform for Disaster Risk Reduction, which includes UN agencies and programmers, the World Bank, regional and international organizations, civil society organizations, academia and above all — governments.

The group is committed to increasing the wider awareness of disaster risks and engaging the resources necessary to make people safer from disasters. This can only happen when well-planned strategies are guided by national authorities and local officials. It is also vital that these plans can be implemented through the daily practice of specialists, educators, businesses and local leaders in civil society. In this way communities will become more resilient.

Image: Steve Evans

The Global Platform for Disaster Risk Reduction will help communities become more resilient

Efforts to increase learning opportunities at many different levels, focused knowledge management, the purposeful exchange of information and experience, and the use of additional types of communication provide the basis for shaping today's education for tomorrow's disaster risk reduction. Education is universally recognized as the basis of growth and development, but it is also fundamental to sustaining understanding and commitment across generations — including living with and reducing risks.

By looking first at the opportunities provided by the Global Platform for Disaster Risk Reduction, and then at the characteristic attributes of education and joined professional practice for improved disaster risk reduction, I hope to encourage even more dedication to creating a safer world.

## The ISDR Global Platform for Disaster Risk Reduction

The Global Platform is a progression from the earlier commitments made by 168 countries at the World Conference of Disaster Reduction at Kobe, Japan in January 2005. This collective dedication was most astutely expressed in the adoption of the Hyogo Framework for Action 2005-2015: *Building the Resilience of Nations and Communities to Disasters*.

### A call to action

We must act with renewed commitment to save lives and livelihoods from the effects of natural hazards – particularly in developing nations, where the world's poorest are also the most vulnerable. We must act with even greater urgency given the impact of climate change. Scientists warn that more extreme weather is on the way, with rising sea levels and more intense storms and droughts. This could affect millions of people.

Risk reduction is our front-line defence against these threats. Risk reduction is also about common-sense practices that help protect communities when earthquakes strike or floods threaten. Practices that can save lives in mega-cities tottering close to the edge of disasters as a result of poor land usage, unsafe buildings, over-population and environmental degradation.

*Ban Ki-moon, Secretary-General of the United Nations in his opening statement at the first session of the Global Platform for Disaster Risk Reduction in Geneva, 5-7 June 2007.*

The goal of the Global Platform for Disaster Risk Reduction, as the main body of the ISDR system, is to sustain worldwide momentum to build the resilience of nations and communities to disasters.[1] It provides the main global forum for representatives of governments and other stakeholders including UN agencies, regional bodies, international financial institutions, civil society, the private sector and the scientific and academic communities to:

1. Assess progress made in implementing the Hyogo Framework for Action
2. Enhance global awareness of disaster risk reduction
3. Share experiences among countries and learn from good practice
4. Identify remaining gaps and actions needed to accelerate national and local implementation of the Hyogo Framework.

The Global Platform meets every two years, under the chairmanship of the United Nations Under-Secretary General for Humanitarian Affairs. The first session was held in June 2007 in Geneva, Switzerland and was chaired by John Holmes. The second session of the Global Platform is scheduled to take place in Geneva, Switzerland 16-18 June 2009.

This first session brought together over 1,100 participants including representatives of 124 member states of the United Nations, and 105 regional, inter-governmental and non-governmental organizations engaged in the International Strategy for Disaster Reduction. In meeting together, these participants also engaged the interests of international financial institutions, civil society, the private sector and the scientific and academic communities to raise awareness of disaster risk, to share experience and to guide the ISDR system.

To address these needs, the participants were drawn from many professional interests and various programme sectors, particularly those related to development and humanitarian fields along with environmental and scientific subject areas relevant to disaster risk reduction. They all shared the purpose of supporting countries to increase their commitments and capacities for disaster risk reduction through the implementation of the Hyogo Framework for Action.

As such, the event now serves as the global forum for disaster reduction and provides for the coming years' strategic guidance and coherence for implementing the Hyogo Framework. This needs to be grounded in developing more opportunities and abilities for sharing experiences and expertise among all its stakeholders. In practical terms, this means the development of more and better ways to accomplish the following actions:

*Raising awareness and understanding about reducing disaster risks by* — increasing the profile of disaster risk reduction as part of development and climate change adaptation; recognizing that it is 'everyone's business', advancing as a multi-stakeholder undertaking, but with governments playing a central role; and re-enforcing policy and decision-makers' commitments to implement the Hyogo Framework for Action.

*Sharing experience by* — learning from good practice and others' experience; and providing practical guidance for nations and communities to reduce disaster risks.

*Guiding the ISDR system by* — assessing progress made in implementing the Hyogo Framework, and identifying obstacles, critical problems and emerging issues that must be addressed to enhance national and local implementation; and improving cooperation and concerted action by the international community to support national and local implementation of disaster risk reduction.

To appreciate what this means in practical terms, and how that may guide future educational directions and emphasis, the opening remarks of Under-Secretary General John Holmes to the first session of the Global Platform are noteworthy:

"To be genuinely convincing, we need to know what we can and must do in practice. First, we must priori-

Image: Program on Emergency Preparedness and Disaster Relief, of the Pan American Health Organization (PAHO/WHO)

This young Mexican family practices protective action in preparing for an earthquake

Image: UN/ISDR, Tine Ramstad, 2006

Community training in Tajikistan

tize those countries and areas at greatest risk from earthquakes, floods and other natural hazards. We must build 'smarter and safer' where populations are most vulnerable. Second, we must act to protect the world's investment in development. We can reduce these huge losses by weaving risk reduction policies into the overall fabric of international lending and development policies. Finally, we must continue to strengthen the institutional pillars that support disaster risk reduction, through reinforcing our partnerships — amongst ISDR members, between government and non-governmental organizations, and between the public and private sectors."

**Sustained educational and technical support for the Global Platform**

In considering how sustained educational and technical support may be accomplished most effectively, there may be some value in taking a cue from the three primary principles of McDonald's global hamburger marketing strategy — famously referred to as: 'location, location and location'. In the case of developing deep and sustained understanding for the commitment and engagement of disaster reduction, it may be altered somewhat to 'education, education, and education'. While there is indeed much that can, and should be done in national governments, through local communities, and with private sectors, the area of greatest presently unrealized opportunity for impact is through our schools and educational programmes. In countries and communities around the world, education, training and schools in their many types are universally valued and unquestioned as being in the public interest. They extend honour and respect for past knowledge, even as, more importantly, they represent investments in the future.

For individual people, education is an accessible tool extended by key social institutions that provide knowledge and shape behaviour. Educational systems at all levels of personal and professional development, should be the first line of awareness and enlightenment – but how many departments of education or local school boards consider themselves to be at the forefront of public well-being and protection from disaster risks? The media and other public communicators are also crucial means of providing sustained and informed public education. Public and commercial advertising both seek to influence the public's knowledge and habits, but to what extent are shared public risks and concerns currently evident in advertising campaigns?

At another level of education, scientific, technical and other 'practitioner' communities can do much to guide and inform the work of governments. There is a considerable amount of experience that they can draw upon to carry out the practical work of implementation — whether their skilled individuals are employed by universities, companies, government departments, local authorities or civil society organizations. While one may most immediately look to educators for individual examples of specialist knowledge, as a group practitioners are too seldom sought or engaged for their considerable power of collective influence.

As disaster reduction becomes more widely embraced with more professional and public interests involved, a new group of educators will become essential. These are the communicators and 'connectors' who have the skills, abilities and contacts that make them unequalled in being able to bridge gaps between single or otherwise self-focused academic or professional disciplines. However to be effective and useful in advancing the understanding and practice of disaster reduction they have to be identified, enlisted, informed and engaged. It may be timely to ask to what extent the 'disaster and risk management communities' have yet sought such connectors, translators and motivators as crucial collaborators for education?

Taken together, these comments may illustrate some of the current limitations. Namely, not enough attention or resources are yet devoted by existing institutions either for 'applied education for disaster risk reduction' or in efforts to express 'risk communications' sufficiently. These concerns may apply between different professions, or amongst various academic departments and study programmes within individual institutions. They can also exist between people who generate knowledge and convey technical abilities through research and education on one hand, and other professionals who are primarily involved in using that knowledge in practice.

Effective communication and shared understanding of common values and concerns has frequently been cited as an area of frustration or disappointment between technical experts and decision or policy makers. Equally, one may cite often-varying viewpoints on disaster risks of local concerns expressed by the public, in contrast to the roles and responsibilities demonstrated by government officials at various levels.

Many of these unfulfilled opportunities for more emphasis on education, for greater disaster risk awareness and understanding have been seen in evidence following crises such as: the Indian Ocean tsunami, the devastation and social disparities associated with Hurricane Katrina, the often politically motivated

Image: UN/ISDR, Tine Ramstad, 2006

UN/ISDR visits building in Tajikistan site to look at reinforcements inside the house

debates about the seriousness of climate change and its causes, or the unfortunately recurrent despair of children frequently being the victims of collapsing schools during earthquakes.

**Opportunities beckon through shared efforts**

Fortunately, there are an increasing number of opportunities to address such concerns. The necessary educational and technical support for practical accomplishment of the objectives of the Global Platform for Disaster Risk Reduction can only build upon existing professional and academic networks, thematic or sector subject areas and other similar mechanisms. While there are several key networks and partnerships that have developed within the ISDR Global Platform (such as those dedicated to education, health issues, early warning, climate change, wildland fire, municipal and local authorities), there are many others that represent important academic disciplines and professional practices for disaster reduction.

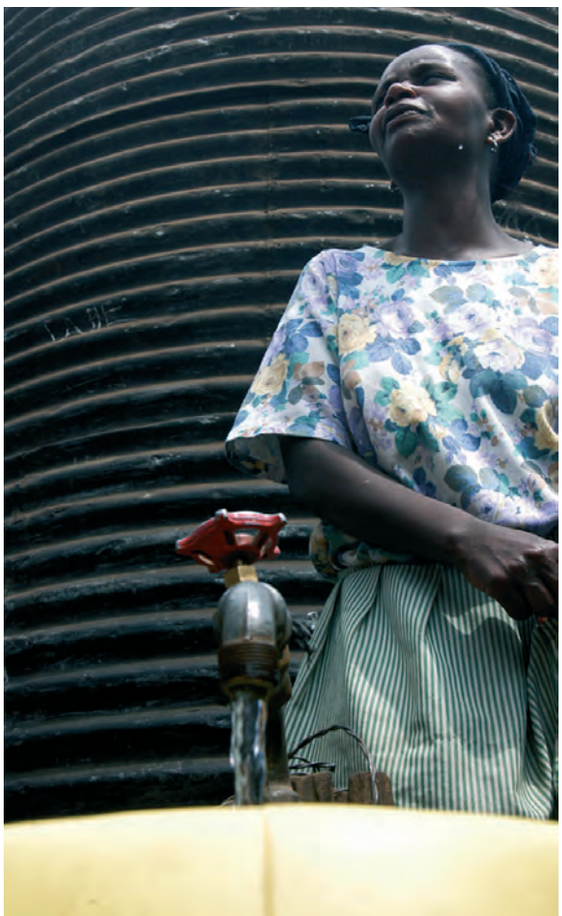
By fostering the growth of networks and otherwise stimulating cross-disciplinary study, research and education, the ISDR Global Platform progressively seeks to engage the entire range of academic and professional interests. There is much to be gained from finding effective means to apply their many resources, as well as to facilitate the easier exchange of experience *beyond* individual practitioners.

The ISDR Global Platform is already committed to establishing a Science and Technical Committee to guide and strengthen the scientific and technical basis of the ISDR. It is envisaged that the committee will advocate and guide the necessary actions related to scientific and technical issues within the ISDR system, including the promotion of innovation, setting future agendas and determining priority questions. At a practical level, the committee will also be influential in initiating studies and reports, proposing the establishment of panels or working groups, as well as other means to advance cross-sector activities.

Another example can be seen in the ISDR secretariat's agreement with the Global Risk Forum and the organizers of the International Disaster Reduction Conference (IDRC), Davos 2008, which aims to foster the development and focused management of professional and academic networks. There are shared interests in stimulating useful academic relationships for educating about disaster reduction subjects, and also in finding cost effective means to manage practitioner or professional networks that can link the many technical, scientific and other specialist abilities necessary for disaster reduction.

There are obvious mutual benefits, in that the ISDR system can draw upon IDRC conference events as leading forums for science and technical knowledge exchange, as well as for communicating successful accomplishments in disaster risk reduction. They have the potential to be key international and regional professional forums for advancing ISDR system and thematic partnerships, especially by fostering scientific and technical professional networks for wider professional dissemination of disaster and risk related information. ISDR's initiation of the PreventionWeb database system[2] is one such instrument that can provide technical and academic practitioners wider access and opportunities for engagement with the governments and other organizational members of the Global Platform for Disaster Risk Reduction. Together, these activities can increase the reporting on programme activities, and the access and utility of collected records, listings, databases or professional resources of shared interest. This can, for example, include information about academic, disaster reduction-related training, capacity development, or professional resource materials.

Image: Sean Hawkey



Kibera in Nairobi is the biggest slum in Africa with around 1 million inhabitants. Potable water and waste management are not government supported and are resolved by community based organisations

By seizing upon these professional opportunities of collaboration and working together through the ISDR Global Platform, we can use today's education for tomorrow's disaster risk reduction and realize the objectives of the Hyogo Framework for Action.

**Hyogo Framework for Action 2005-2015: building the resilience of nations and communities to disasters**

Priorities for Action:

1. *Make disaster risk reduction a priority* — ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
2. *Know the risks and take action* — identify, assess, and monitor disaster risks, as well as enhance early warning
3. *Build understanding and awareness* — use knowledge, innovation, and education to build a culture of safety and resilience at all levels
4. *Reduce risk* — countries can build resilience to disasters by investing in simple, well-known measures to reduce risk and vulnerability
5. *Be prepared and ready to act* — strengthen disaster preparedness for effective response at all levels.

# Ecosystems and community resilience: the co-benefits of partnerships

*Glenn Dolcemascolo, Jen Stephens and Andrew Morton, United Nations Environment Programme; Carolin Schaerpf, United Nations International Strategy for Disaster Reduction*

**Ecosystems are our lifeline; they are the basis for human well being and human security. In addition to their well-known contribution to livelihoods, healthy ecosystems can reduce vulnerability to natural hazards, and they are our first line of defence in adapting to climate change. Protecting these vital services will take the combined efforts of disaster managers, development practitioners and environmental managers. This article begins to consider the benefits of adopting an integrated approach to the issues of ecosystem management, sustainable development, disaster risk reduction and climate change adaptation, and points to the need for stronger partnership between practitioners and stakeholders in these fields.**

Over the last decade, the global community has come to recognize that the ever-increasing impact of natural hazards such as floods, wildfires, hurricanes and earthquakes poses serious challenges to development. In addition to the devastating toll measured in human lives and suffering, disasters erode, and in many cases, reverse hard-earned gains in terms of political, social and educational progress, as well as infrastructure and technological development. Often it is the poorest and least developed countries that are hardest hit. Guided by the 'Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters', the global community is moving to reduce disaster risk as an integral and necessary component of sustainable development and climate change adaptation.

Image: UNEP

Cooperative efforts to plant and conserve mangroves in places like Indonesia protects an important ecosystem service for local residents

**Environmental degradation**

The *Millennium Ecosystem Assessment (MEA)*[1], which involved the work of more than 1,360 experts worldwide, provides compelling evidence that ecosystems are essential for human well being through the services they provide. These 'ecosystem services', or the benefits people obtain from ecosystems, include provisioning of products such as food, fuel and fibre; regulating services such as climate regulation and disease control; and non-material benefits such as the spiritual or aesthetic.

The demand for ecosystem services has grown at an unprecedented rate. Between 1960 and 2000 the world population doubled to 6 billion people and the global economy increased more than six-fold. Increased demand for services (food production increased roughly 2.5 times; water use doubled; wood harvests for pulp and paper production tripled) corresponds with dramatic changes in the Earth's ecosystems. The last two decades alone have witnessed the loss of 35 per cent of global mangroves. The MEA reports that forests have now effectively disappeared in 25 countries and another 29 have lost more than 90 per cent of their forest cover.

In parallel, work by many organizations within the environmental community has advanced a broader understanding of the linkages between the health of the environment and the extent of human loss, suffering and economic damage resulting from natural hazards. Healthy ecosystems provide natural defences; for example, wetland ecosystems function as natural sponges that trap and slowly release surface water; mangroves, dunes and reefs create physical barriers between communities and coastal hazards, and forests play a critical role in soil stabilization and influence the risk of floods and landslides. Simply stated, healthy ecosystems can reduce human vulnerability to natural hazards — degraded environments commonly amplify the negative impacts.

The need to reverse environmental losses and the attendant consequences on poverty are reflected in the Millennium Development Goals (MDGs), particularly MDG 7 which calls for, among others, integration of the principles of sustainable development into national policies and programmes; a reversal in losses of environmental resources, and the reduction of biodiversity loss.

Image: UNEP

The condition of ecosystem services has direct effects on livelihoods

**Climate change**

Designing development interventions without consideration of how climate change will affect programme outcomes is no longer an option. The Intergovernmental Panel on Climate Change (IPCC) *Fourth Assessment Report* affirms that "since the IPCC Third Assessment, confidence has increased that some weather events and extremes will become more frequent, more widespread and/or more intense during the 21st century; and more is known about the potential effects of such changes." Climate change will also affect the underlying vulnerabilities of communities worldwide. The report, for instance, indicates that "for increases in global average temperature exceeding 1.5-2.5°C and in concomitant atmospheric carbon dioxide concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions, and species' geographical ranges, with predominantly negative consequences for biodiversity, and ecosystem goods and services."[2]

As the governments of the world work toward a new international climate change agreement to follow the Kyoto Protocol, they have drafted the 'Bali Action Plan' which was adopted at the United Nations Climate Change Conference in Bali in December 2007. The Bali Action Plan calls for enhanced action on adaptation, including consideration of "disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change."

**Co-benefits and the efficiency of an integrated approach**

Patterns of disaster risk are already changing and the critical ecosystems that support community resilience are being lost at an alarming rate due to human mismanagement as well as changes in climate. An integrated approach to climate change adaptation, disaster risk reduction and ecosystem services must be adopted if development programmes and the MDGs are to be achieved. Evaluating the effects of interventions in one field of development programming on others can lead to mutually beneficial outcomes.

The idea of co-benefits has been used widely in discussions of climate change, referring specifically to 'joint primary benefits resulting from the selection of one instrument aimed at reaching several targets', and is used as a means to weigh options through benefit-cost analyses in the policy selection process.[3] This approach is equally useful when looking at community vulnerability and resilience. In this sense, 'co-benefits' refer simply to multiple benefits in different fields resulting from one policy, strategy or action plan. Achieving co-benefits requires integration or the overt design of development programmes to meet multiple needs: poverty alleviation, protection of ecosystem services and biodiversity conservation, disaster risk reduction and climate change adaptation.


Image: UNEP

Uninhibited deforestation makes development unsustainable and has a large price for both present and future generations

Integrated programming in these fields has a solid economic basis. While failure to adopt an integrated approach can be counter-productive to the goals of any of these areas of intervention, seeking co-benefits is an efficient means of utilizing funds.

**Disaster risk reduction**

The goal of disaster risk reduction as described in the Hyogo Framework for Action is "the substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and states." Risk reduction involves a broad range of interventions including such diverse measures as developing early warning systems, ensuring safe building practices, public awareness and spatial planning.

Maintaining the protective services of healthy ecosystems is an important contribution to disaster risk reduction. A review carried out by IUCN as part of the 'Mangroves for the Future' initiative points to studies that have calculated these contributions. In Sri Lanka, for example, each square kilometre of mangroves has been estimated to provide USD8,000 in storm protection.[4] In Indonesia, mangroves provide USD600 per household in coastal erosion control,[5] and in Southern Thailand mangroves offer USD3,000 per hectare in coastline protection and stabilization.[6] The work of the climate change adaptation community enables us to characterize future risk and helps to revitalize commitment to integrated planning and field level action.

Disaster risk reduction is inherently multi-sectoral, but also requires actions at various scales. Efforts to build national level capacities and political commitment need to be complemented by work to extend the capacity of field-level practitioners who are capable of designing and delivering risk reduction measures at the community level. The disaster risk reduction community will benefit from an integrated approach since it provides access to and leverages the efforts of the very large and well-established global environmental-sustainable development community, which has been working on the ground in most of the world's poorest and vulnerable countries for several decades.

**Environment and sustainable development**

Over 30 years ago in Stockholm, world leaders agreed on the urgent need to respond to the problem of environmental deterioration. Twenty years later, in 1992, at the United Nations Conference on Environment and Development in Rio de Janeiro, world leaders agreed that the protection of the environment and social and economic development are fundamental to sustainable development and adopted a global programme entitled 'Agenda 21'. In 2002, world leaders met again and laid out a plan for implementing the agenda and again recognized that poverty eradication, changing consumption and production patterns and protecting and managing the natural resource base for economic and social development are overarching objectives of and essential requirements for sustainable development.[7]

Environmental managers employ a wide range of approaches and instruments in their efforts. Economic valuation of ecosystem services is one approach that can assist planners to better understand the costs and trade-offs of proposed development interventions. Every loss of ecosystem services has a livelihood cost for local communities, neighbouring communities and future generations. The cost falls disproportionately upon the poorest communities who rely heavily on primary resources for their livelihoods, and who often have less access to government-sponsored protection from natural hazards. While the

Image: UNEP

Climate change is expected to increase the frequency of extreme climate events, including prolonged dry periods and, in many areas, increased risk of wild land fires

actual dollar values are case-specific, mostly comparing to alternative manmade structural measures to achieve somewhat definitive price tags for a particular ecosystem service, it is conclusive that changes in these services affect human well being in many ways.[8] Often the ecosystem services are undervalued, particularly when considering the disproportionate value to local and poorer communities.

Environment-sustainable development practitioners certainly benefit from growing demand for maintaining the ecosystem services that accompany efforts to promote community resilience in a changing climate; they also benefit from the refined instruments, methods and field-based actions prompted by the disaster risk reduction and climate change adaptation communities. But perhaps the greatest benefit of disaster risk reduction and climate change adaptation to the goals of environmental and sustainable development is the increased likelihood that these development programmes will not be derailed by costly diversions of human, natural and financial resources that inevitably accompany disasters.

**Climate change adaptation**

Efforts to mitigate or reduce greenhouse gas emissions need to be complemented by efforts to adapt to climate change. The IPCC defines adaptation as 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.'[9] Other definitions treat an adaptation as a process or the outcome of a process that leads to a reduction in harm or risk of harm associated with climate change and variability[10] or efforts to 'moderate, cope with and take advantage of the consequences of climatic events.'[11]

Because the consequences of climate change, in some regions, will include increased damages from sea-level rise, flooding, drought and other climate-related hazards, the capacity to reduce disaster risk provides governments with a first line of defence in adapting to a changing climate. Similarly, efforts to protect ecosystems services, particularly those efforts that anticipate the impacts of climate change on ecosystems and design their interventions accordingly, are a second cornerstone of adaptation. Ecosystems are essential to human well being, and the demand for these services will continue to grow as communities around the world take steps to moderate, cope with and take advantage of new conditions.

**Concluding thoughts**

The considerations presented in this chapter offer an initial view of benefits derived from adopting an integrated, partnership based approach. Ecosystems are our lifeline; the changes that have been made to them have contributed to overall improvements in human well being and economic development, but these improvements have been achieved at a cost. The degradation of ecosystem services has not only exacerbated poverty for some groups of people, it has also exacerbated their vulnerability to natural hazards.

The target population for development assistance often coincides with the population facing the most loss in times of disaster; so partnering knowledge and capacities and visibly integrating disaster risk reduction as one distinct but increasingly important ecosystem service adds significantly to the economic rationale for the maintenance of healthy ecosystems. Disaster risk reduction, environment, sustainable development and climate change adaptation all need an inter-sectoral approach. There are many co-benefits that can be achieved through creating partnerships; there are many collateral costs of not doing so.

# Preparing now — international cooperation for future resilience

*Tony Pearce, Director General, Emergency Management Australia, Attorney-General's Department, Australian Government*

**Australia is a relatively isolated island continent which experiences an extreme range of disaster-related crises. Completely bound by oceans, the country is somewhat less vulnerable to many diseases and migratory disturbances suffered by the interlinked continents in the northern hemisphere. Yet it suffers from some of the worst droughts, bushfires, heatwaves and floods on Earth, is bombarded by devastating cyclones and severe storms, and is vulnerable to much coastal storm impact including the threat of tsunami.**

On top of all this the country must accommodate climatic variation from monsoon and desert temperatures upwards of 55 degrees Celsius, down to icy conditions of minus 10 degrees or more. And this is not including the country's Antarctic territory. Australia has a current population of around 21 million who reside mostly on the eastern seaboard.


Image: courtesy NSW SES

State Emergency Service and ambulance officers evacuate elderly residents from a flooded nursing home, June 2007

So it is not surprising that, as a developed western democracy, Australia has needed to make substantial advances in emergency management and has developed sophisticated community safety procedures. All this has led to a remarkably low death rate from natural disasters in recent decades.

The nation's premier emergency management body — Emergency Management Australia (EMA) — was originally created as the Natural Disasters Organisation in 1974, just a few months before the northernmost city of Darwin was completely destroyed by cyclone, forcing the evacuation of almost its entire population of 35,000 residents. We have learned a great deal since that event and are now envied by many countries for the extent of public preparedness and degree of community safety.

Though Australia has an indigenous history going back millennia, its westernized civilization is just 220 years old. Now it has the widest mix of nationalities of any nation and continues to embrace immigration from across the globe. We have three tiers of government — federal, state and local. However, under the country's constitution it is the state governments that take the lead responsibility for emergency response.

### Towards self-reliance

Australia, like other countries, faces a raft of new challenges brought about by the impact of climate change. It is inevitable that we will see an increase in the impact, intensity and severity of natural disasters over the coming decades. These challenges should be respected, not feared. They should be seen as creating opportunities for us to test the bounds of our ability and ingenuity. In doing so these challenges should allow us to be better placed to ensure that by working together within our country, and within our region, we are truly delivering enhanced public safety outcomes towards more resilient communities.

However, emergency managers in this country recognize that there is a need for a paradigm shift in the approach to emergency management by both governments and communities — a shift from expectation and dependence towards self-reliance and resilience.

In recent decades, the number of people affected by what could be called 'climate disasters' such as droughts, floods, landslides and storms has been rising. Recent natural disaster events include the Indian Ocean

Image: EMA

EMA staff focus on planning in the organization's Incident Management Facility

tsunami, Hurricane Katrina, the Pakistan earthquake, and wildfires in California and in Greece. Within Australia — the 2003 Canberra wildfires, the Category 5 Tropical Cyclone Larry that impacted Queensland in March 2006, the Victorian highlands' bushfires and extreme east coast storms of 2007.

Current evidence points very clearly in one direction: namely, that climate change will increase the risk of exposure to climate disaster. Globally, there has been a five-fold increase in the number of people affected by disasters over the last four decades.[1] It has been estimated that natural hazards cost Australia AUD1.25 billion annually.[2]

Climate change is also likely to have important ramifications for security, our existing capacity to respond to natural disasters, and the global balance of power. It is expected to cause increased numbers of refugees as a result of flooding in low-lying states and increase the range of certain diseases — and in turn, such stresses may bring about conflict.

In a 2006 report by the respected Lowy Institute in Australia, it was noted that there will be international security consequences of climate change especially for our country's Asia-Pacific neighbourhood. This report highlighted the implications of temperature increases and sea level rises on food, water, energy, infectious disease, natural disasters and environmental refugees, and asked whether scientists may have underestimated climate change risks.[3]

Adding to this, Australian Federal Police Commissioner Mick Keelty APM recently commented that food and water shortages may cause mass migration and that "climate change is going to be the security issue of the 21st century." Australia's present government has stated in its plan for International Development Assistance and Climate Change that the impacts of climate change "have security issues which cannot be ignored".[4] Clearly, the number of people affected by disasters is predicted to worsen, with even modest temperature rises associated with climate change.[5]

Evidence shows that strategic investment in disaster mitigation will reduce disaster damage and ad hoc relief payments over time.[6] The development of long-term and sustainable mitigation strategies is a key to Australia's future security in the disaster management context.

**Focus on mitigation**

Key mitigation strategies that EMA has managed for the Australian Government over recent years, in partnership with other national, state and local governments, include the following.

*Natural Disaster Mitigation funding programme* — This has the objective of shifting the focus from response to cost effective, evidence-based measures that contribute to communities being better able to withstand the effects of natural disasters. These measures include natural disaster risk management studies, warning systems, community education initiatives and structural works to protect against damage, such as flood levees, cyclone shelters and bushfire asset protection zones.

*Working Together to Manage Emergencies project* — A funding scheme to provide grants to local communities — with the objective of developing self-reliance at both the community and local government level in order to enhance community safety and build the capability of communities to prepare for, respond to and recover from


Image: EMA

Sky-crane water bombing helicopter *The Incredible Hulk* on arrival in Australia's capital Canberra in December 2007 — shown in front of Parliament House

disasters and emergencies arising from any hazard. It provides funds to implement emergency risk management initiatives, identify vulnerabilities and provide training for local government staff.

*National Emergency Volunteer Support Fund* — A fund to boost the recruitment, retention and training of volunteer organizations at the frontline of emergency management.

*Bushfire Mitigation Program* — The objective of this is to identify and address mitigation priorities to enable communities to better prepare for, respond to and withstand the effects of bushfires.

*National Aerial Fire-fighting Arrangements* — To ensure equitable national access to aerial fire-fighting equipment.

*Tsunami Warning Implementation Program* — This is aimed at providing a comprehensive tsunami warning system for Australia; to support international efforts to establish an Indian Ocean tsunami warning system; and to contribute to the facilitation of tsunami warnings for the South West Pacific.

*An inclusive programme for culturally and linguistically diverse communities* — This has the objective of raising awareness in such communities of emergency management facilities, enhancing community resilience to the effects of disasters, and increasing community engagement in emergency management volunteer activities.

*National Forum on Emergency Warnings to the Community* — This works to improve delivery of emergency warnings to all communities including disabled, culturally diverse and remote and indigenous communities.

*Urban Search and Rescue Capability Development Project* — This enhances Australia's overall capability through the provision of training, policy and equipment.

*Capability Research and Development Program for Chemical, Biological and Radiological events* — To improve Australia's ability to prevent, prepare for, and respond to such incidents.

Fortunately, the increasing awareness of the likely consequences of natural disasters in Australia has resulted in a further strengthening of relationships between Australia's Federal Government and state and territory governments, as well as the imperative for us to work with our regional partners in building our emergency management capacity.

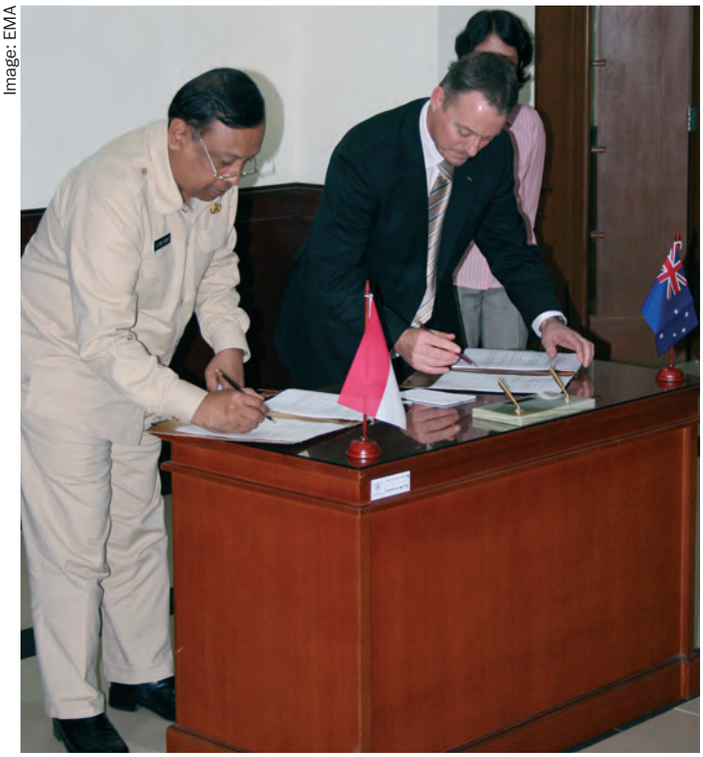
EMA, a division of the Federal Attorney-General's Department, continues to work closely with state and territory emergency management organizations and related Australian Government agencies. There are also strong links with local government bodies, non-government agencies, community-based organizations, volunteers in the emergency sector, academia and researchers, the business community, industry bodies and individuals. There is a clear effort to increase Australia's capacity and capability to deal with the potential consequences of threats to citizens.

Meanwhile EMA's international partnerships have also been expanding as Australia takes a greater role in regional emergency and disaster response and recovery.

**International effort**

On an international level, EMA has contributed to the efforts of its neighbours by:

Image: EMA



Syamsul Ma`Arif, Executive Officer in Charge of the Indonesian National Coordinating Board for Disaster Management (BAKORNAS PB) and Tony Pearce, Director General, EMA, signing a partnership arrangement concerning disaster management, December 2006

Image: EMA

An EMA officer oversees the loading of tarpaulins to cover homes damaged in Tropical Cyclone Larry, Queensland, March 2006

- Managing a whole-of-government disaster risk management institutional strengthening project in the Solomon Islands
- Reviewing the disaster management capacity and processes of the Sri Lankan Government
- Working with the Indonesian National Coordinating Agency for Disaster Management.

The aim of these projects has been to help develop capacity and capability and to coordinate holistic disaster management programmes and responses at all levels for these countries.

EMA also maintains relationships with a range of regional organizations with a role in disaster management, such as the South Pacific Applied Geoscience Commission and Association of South East Asian Nations. It has also taken a significant interactive role with all 21 Asia Pacific Economic Cooperation forum economies, by managing exercises to increase communication between member economy emergency management organizations.

Our international partnerships strengthen our ability to jointly manage natural disasters. Further cooperation will enable us to develop best practice mitigation strategies, which in turn, will lead to a new level of regional resilience in managing the impacts of climate change.

**Exposed communities**

The 2007 *National Climate Change Adaptation Framework* recognized that Australia's coastal urban communities and remote communities are particularly exposed to the risks associated with extreme events. Australia has established a future framework that states:

"Climate change impacts need to be factored into natural disaster management risk reduction, emergency services planning, and recovery management, especially for areas more vulnerable to extreme events. Community awareness and developing a culture of preparedness in conjunction with emergency services will contribute to effective adaptation responses."

Building upon the recognition of the role of investment in limiting the impact of natural disasters, and in building community resilience, as evidenced by the various programmes currently administered, the Federal Government is currently undertaking a comprehensive review of homeland and border security arrangements.

This review is part of the newly elected Australian Government's commitment to examine the need for change in our homeland and border security arrangements. It will consider the roles, responsibilities and functions of departments and agencies involved in security, to optimize the coordination and effectiveness of their efforts.

Climate change, along with the world disaster environment and the increasing level of community and political expectations placed upon the emergency management sector, will no doubt heavily influence the development of future Australian emergency management strategies.

In his recent address to the East Asia Forum regarding advancing Australia's global and regional economic interests, Australia's Prime Minister, the Hon Kevin

Image: EMA

Bushfire devastation in South Australia, 2005

Rudd MP, said: "Australia today lives in an increasingly joined-up world. If Australia fails to engage with the global economic, security and environmental challenges, we will simultaneously fail to deal with their impact on our own country. In order to advance Australia's interests at home, we must increasingly be engaged with other nations in responding to the challenges to those interests abroad."[7]

To this end, managing public reaction, ensuring efficient cross-government coordination, and having the necessary capability prior to, during and following disasters irrespective of their cause, are critical components in Australia's emergency management environment.

EMA will be working with its partners in government and within our region to:

- Develop a national adaptation research plan on climate change impacts and adaptation options for disaster management and emergency services
- Look at developing national public education and preparedness programmes at the grass roots to build disaster-ready, resilient communities
- Encourage communities to be more self-reliant and harness the power of volunteers to develop self-reliance
- Enhance greater coordination across governments and in building partnerships with the private sector, to increase resilience and ensure that we are at least halfway resourced to limit the impacts of and respond to large-scale events
- Improve disaster management capacity building for developing countries in our region in order to aid their own community resilience efforts.

**Future challenges**

One of the challenges for the future is to manage community expectation in such a way that it becomes realistic. The days of working to the community and providing to them what we decide they need are long gone. Today we must work with the community and our regional partners to ensure that they have ownership of their own safety outcomes, to better be able to provide a facilitation role, and to better understand exactly what level of support will be required come that fateful day when we have to assist them to deal with an emergency.

With a focus on our government working together to build partnerships with the private sector, including volunteers, and to develop evidence-based national mitigation programmes, we can expect to see a less complacent community, better prepared to withstand the increasing impacts of natural disasters upon Australia.

Furthermore, in engaging with our international partners, we aim to see best practice emerge in our emergency management practices, as well as a heightened level of resilience and, in particular, strong partnerships able to withstand disasters that could have a collective impact upon us.

To paraphrase our Prime Minister's view: When a disaster strikes nationally, the approach to response and recovery will need to be global. Through cooperation we can reduce the impact of an emergency on our communities.

# Rising to the disaster-resilience challenge

*David Applegate, National Science and Technology Council Subcommittee on Disaster Reduction, USA*

**The month of May 2008 was the deadliest for natural disasters since the devastating Sumatra earthquake and tsunami struck the Indian Ocean region in 2004. The tremendous loss of life resulting from the typhoon that swept across Burma's Irrawaddy Delta in early May and the earthquake that struck Sichuan province in China a week later were each solemn reminders of the continued vulnerability of communities exposed to the forces of nature. Collectively, such disasters represent a global challenge for all nations to strengthen the resilience of their communities in the face of extreme meteorological, hydrological, and geological events that are facts of life on an active planet like ours. How those events affect us reflects not only the power of nature, but also the decisions we make in how we build our societies.**

Rising to the disaster-resilience challenge will take the collective action of government at all levels, non-profit organizations, the private sector, and above all individuals trying to do what is best for themselves, their families and their communities. Science and technology can play a critical role in supporting the quest to achieve disaster resilience.

To better define this role, the US National Science and Technology Council's Subcommittee on Disaster Reduction (SDR), which includes representatives from 22 departments and agencies across the Federal government, has identified six 'grand challenges' for disaster reduction that, if addressed, could greatly reduce societal vulnerability:

- Provide hazard and disaster information where and when it is needed
- Understand the natural processes that produce hazards
- Develop hazard mitigation strategies and technologies
- Recognize and reduce vulnerability of interdependent critical infrastructure
- Assess disaster resilience using standard methods
- Promote risk-wise behaviour.

The SDR developed this set of challenges to define a ten-year strategy that illuminates critical areas for future US government investment in science and technology designed to reduce the impact of natural and technological hazards.[1] The Subcommittee recently produced a series of hazard-specific implementation plans, identifying the priority science and technology investments needed to make progress toward meeting these challenges.

The first of these challenges is to provide hazard and disaster information where and when it is needed. Implementing this challenge requires robust monitoring systems with the capability to reach those in harm's way and provide emergency responders with the information they need when they need it. Such systems are only as good as their weakest link, which in many cases is the link to the people at risk. Improving communications to the most vulnerable populations, so that they can take actions to protect themselves, requires education.

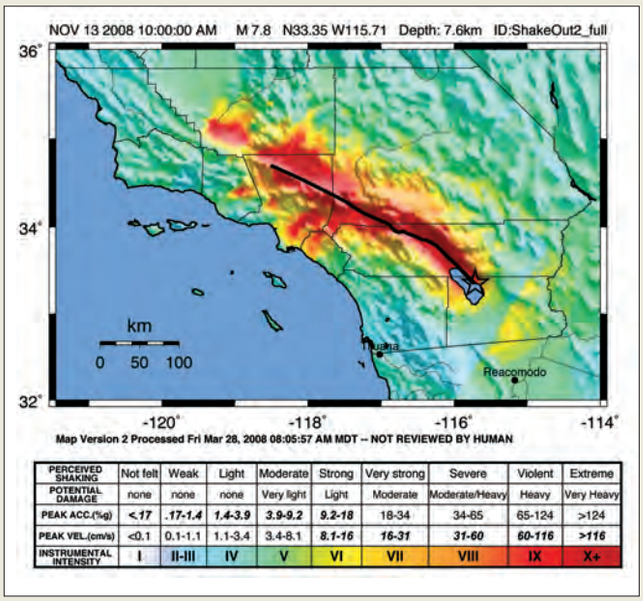
The second challenge is to understand the natural processes that produce hazards. Support for targeted research can harness advances in computing power and draw upon the data being generated by global observational systems to improve predictive modelling. Basic research on the natural processes that produce hazards will allow scientists and engineers to better understand how and when they become hazardous. For coastal hazards, an assessment of the impacts of climate change on coastal inundation is essential.

**US National Science and Technology Council implementation plans**


A set of 14 implementation plans were recently produced by the US National Science and Technology Council (NSTC) identifying priority investments in science and technology to address the Grand Challenges for Disaster Reduction laid out in the 2005 NSTC report of that name, also shown. The original report and implementation plans are available at www.sdr.gov

Source: US National Science and Technology Council

**Southern California Earthquake Scenario**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

This ShakeMap depicts expected ground shaking from a magnitude-7.8 earthquake on California's southern San Andreas Fault. These estimated shaking intensities were used as the basis for developing a scenario exploring the economic and social impacts that such an earthquake would have on the more than 20 million people who live in southern California.[2] In November 2008, the scenario will be used as the basis for emergency response and public preparedness exercises in order to improve the risk-wise behaviour in southern California communities. The colours reflect the Modified Mercalli Intensity scale with warmer colours representing areas of greater damage

Source: US Geological Survey

The third challenge is to develop hazard mitigation strategies and technologies that can reduce the impact of extreme events on both the built environment and vulnerable ecosystems. Scientists must invent — and communities must implement — affordable and effective hazard mitigation strategies, including land-use planning and zoning laws that recognize the risks of natural hazards. In addition, technologies such as disaster-resilient design and materials, as well as smart structures that respond to changing conditions, must be used for development in hazardous areas. Meeting this challenge will also require developing an understanding of the social, cultural, and economic factors that promote or inhibit adoption and enforcement of these and other promising mitigation technologies. Getting the right incentives in place for mitigation is the key to successful loss reduction.

The fourth grand challenge is to reduce the vulnerability of infrastructure. One of the greatest obstacles to recovery in any disaster is the delayed restoration of critical infrastructure such as transportation, drinking water, electricity, and gas distribution systems. A key implementation step is establishing the technical basis for revised codes and standards for critical infrastructure and essential facilities. Using integrated models of interdependent systems, additional vulnerabilities can be identified and then addressed. Protecting critical infrastructure provides a solid foundation from which the community can respond to hazards rapidly and effectively. Paradoxically, advancements in technology can increase society's vulnerability because of reliance on distant resources and just-in-time inventory delivery, with the result that the economic impact of a natural hazard event can be much broader than its storm track or rupture zone.

The fifth challenge is to develop standardized methods for communities to measure and assess disaster resilience across multiple hazards. A key implementation step is developing and distributing community assessment tools that can be applied to setting priorities in order to maximize resilience. Federal agencies must work with universities, local governments, and the private sector to identify effective standards and metrics for assessing disaster resilience. With consistent factors and regularly updated metrics, communities will be able to maintain report cards that accurately assess the community's relative level of disaster resilience.

The final challenge is to promote risk-wise behaviour. The costs of natural disasters are rising as people increasingly move into harm's way in low-lying coastal areas, the wildland-urban interface and geologically active regions. In order to achieve 'hazards literacy' and sustained risk reduction, hazards must be real to people. Scenarios are a tool that can spell out the impacts of likely events on high-risk areas, combining scientific and engineering knowledge with local planning and emergency management expertise to deliver a comprehensive picture of potential losses to encourage mitigation measures.

From a global standpoint, these grand challenges reflect the contributions that science and technology can make towards achieving the Hyogo Framework for Action. Adopted in 2005 during the World Conference on Disaster Risk Reduction in Kobe, Japan, the agreement calls on participating countries to:

1. Ensure that disaster risk reduction is a national and local priority
2. Identify, assess and monitor disaster risks, and enhance early warning capabilities
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels
4. Reduce the underlying risk factors
5. Strengthen disaster preparedness for effective response at all levels.

The common goals of the Hyogo Framework and the grand challenges reflect a shared commitment to building more disaster-resilient communities. Each of the hazard-specific implementation plans includes a section that identifies the same set of desired outcomes for meeting the grand challenges: a nation where relevant hazards are recognized and understood; where communities at risk know when a hazard event is imminent; where individuals can live safely in the context of our planet's extreme events; and where disaster-resilient communities experience minimum disruption to life and economy after a hazard event has passed. Through the application of science and technology, the US will strive to achieve these outcomes at home, as well as encourage their application around the globe.

# US Grand Challenges for Disaster Reduction: interagency priority actions for human and ecosystem health hazards

*Nathalie Valette-Silver, National Oceanic and Atmospheric Administration, National Ocean Service and Josephine Malilay, Centers for Disease Control and Prevention, National Center for Environmental Health; Human and Ecosystem Health Working Group of the Subcommittee on Disaster Reduction, USA*

**The United States of America's 'Grand Challenges for Disaster Reduction', crafted by the President's Office of Science and Technology Policy, National Science and Technology Council's Subcommittee on Disaster Reduction (SDR), outlines a ten-year strategy. Six 'Grand Challenges' were identified to enhance community resilience:**

- Provide hazard and disaster information when and where it is needed
- Understand the natural processes that produce hazards
- Develop hazard mitigation strategies and technologies
- Reduce the vulnerability of infrastructure
- Assess disaster resilience
- Promote risk-wise behaviour.

To meet these challenges, the 25 Federal departments and agencies that comprise the SDR have identified and prioritized science and technology actions and investments to improve communities' capability to better prepare for hazards and prevent and recover from disaster events. Fourteen implementation plans were developed to address actions for the most frequent hazards in the US (e.g. drought, coastal inundation, earthquake, flood, heat wave, hurricane, land slides and debris flow, technological disasters, tornado, tsunami, volcano, wildfire, winter storm, and human and ecosystem-related health hazards).

While frequently occurring hazards focus primarily on natural processes or are man-induced, the hazards wrought upon the health of humans and ecosystems merit a separate category. Human and ecosystem health hazards are conditions that predispose a person to adverse health outcomes (e.g. death, illness, injury or disability) or result in the deterioration of ecosystem structure and services (e.g. acid rain, habitat degradation, animal and plant illness or death, introduction of

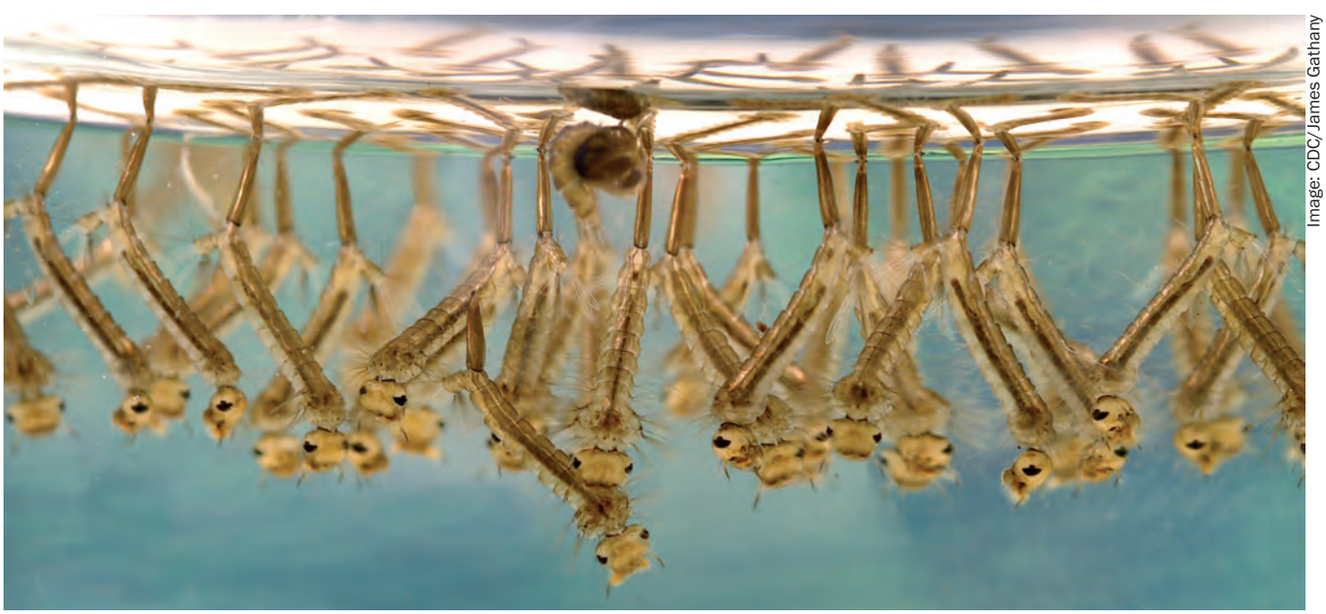


Image: CDC/James Gathany

*Culex* larvae found collecting in standing water in an Atlanta, Georgia residential area. In the US, West Nile virus is transmitted by infected mosquitoes, primarily members of the *Culex* species

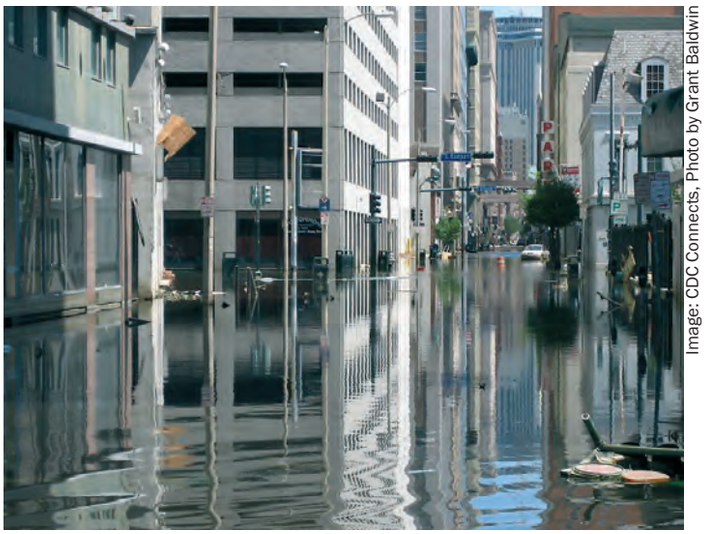


Image: CDC Connects, Photo by Grant Baldwin

A flooded street in New Orleans, Louisiana after Hurricane Katrina reflects the depth of the problem facing residents and rescue workers. Filthy, contaminated floodwaters posed a public health threat

invasive species, community changes, loss of biodiversity). These hazards can produce disasters or can accompany and amplify the effects of other disasters.

**Impacts**

Recent concerns about an avian influenza pandemic and its potentially massive deleterious consequences to human and ecosystem health have mobilized the attention of the US and other governments around the world. This is one of the many hazards that the US and the world are facing.

Annual outbreaks of the West Nile virus since its 1999 emergence in the US have caused significant neuro-invasive diseases in humans, infections in at least 58 mosquito species, and unprecedented mortality in birds. The cost of the epidemic in Louisiana from June 2002 to February 2003 was estimated to be USD20.1 million.[1]

Similarly, in the environment, the geographic distribution, frequency and severity in the development of harmful algal blooms (HABs) appear to have increased over the past decades. This is possibly related to the increase in ocean temperature and in the quantity of nutrients reaching water bodies. Blooms can affect both human and ecosystem health, ranging from respiratory distress due to aerosolization of the toxins produced by the HABS to death due to ingestion of the toxins.[2] HABs also have large economic impacts. In the past, the cost of HABs to the US economy was estimated to be about USD50 million per year. Recently, the frequency and severity of major HABs outbreaks have increased, and costs can exceed USD50 million for one event alone.[3]

In the US, alien invasive species including plants, animals and microorganisms result in USD120 million in damage annually.[4] Invasive species affect agricultural and ecosystem productivity and the health of forests, rangelands and croplands as well as other land and aquatic ecosystems, and often result in serious economic losses.

Additionally, human and ecosystem health disasters can occur subsequent to other disasters such as earthquakes or volcanic eruptions. For example, major hurricanes such as Katrina and Rita, which devastated the Gulf Coast in August-September 2005, led to extensive short and long-term impacts on the health and well being of affected communities. Deaths from these events have almost reached 1,500, both in states directly impacted by the hurricanes and in those housing displaced persons.[5] Chronic and long-term effects have yet to be estimated.

In the environment, the progressive destruction of coral reefs, marshes and wetlands along the coasts is exacerbating negative impacts from hurricanes and tropical storms by reducing protection of coastal zones. As a result, extensive flooding and accompanying widespread pollution of soils and waters dramatically increase the magnitude of the original disaster events.

The SDR Human and Ecosystem Health Working Group (HEHWG) produced an implementation plan that summarizes the high priority science and technology actions to assist the nation in preventing and recovering from disasters. HEHWG identified research, modelling, forecasting and tool development to better support human and ecosystem health management in times of crisis. Short-term actions (1-2 years), mid-term actions (2-5 years) and long-term efforts (5+ years) were considered for each of the six Grand Challenges.

**Grand Challenge 1: Provide hazard and disaster information where and when it is needed**

*Short-term actions:*

- Research to understand the fundamental processes in human and ecosystem health that predispose people to adverse health outcomes or that result in ecosystem structure and function deterioration
- Improve human and ecosystem health monitoring systems and protocols to identify, describe, collect, analyse and interpret emerging infectious agents and other health hazards (e.g. organisms, toxic substances)
- Develop and improve timeliness and accuracy of human and ecosystem health forecasts
- Assess the impacts of natural resource use on ecosystem health and the capacity of ecosystems to respond to hazards.

*Mid-term actions:*

- Continue the development of new technologies to detect agents that threaten human and ecosystem health
- Develop searchable ecological and public health databases for early detection of emerging threats
- Use more comprehensive models to develop clear, actionable risk and vulnerability assessments based on diseases and environmental data from monitoring systems and global observations networks.

*Long-term efforts:*

- Develop and improve remote, in situ, permanent and mobile environmental and human health monitoring systems to collect and analyse data in real time
- Facilitate and increase coordination among terrestrial, aquatic and atmospheric monitoring systems.

Image: courtesy of P. Schmidt, Charlotte (FL) Sun

The infamous Florida 'red tide' occurs almost annually along portions of the state's Gulf Coast, causing beach and shellfish closures and negatively impacting Florida's tourism industry. Just one harmful algal bloom event can impose millions of dollars in losses upon local coastal communities

**Grand Challenge 2: Understand the natural processes that produce hazards**

*Short-term actions:*

- Use an interdisciplinary approach to expand and enhance the knowledge base of short-term, long-term, and cumulative risk factors and processes associated with hazard-related events to identify potential health and ecological adverse outcomes
- Increase the workforce competence for human health care workers and ecosystem resource managers to address health and ecological threats by improving training
- Assess the impacts of climate change and other global changes (e.g. increased input of nutrients in the environment, land-use changes, increased use of antibiotics in animal and food supplies) on human and ecosystem health.

*Mid-term actions:*

- Understand the baseline and status of ecosystem health and human public health in order to track and monitor the impact of disease-causing agents and other health hazards
- Research the evolution of health threats by using remote sensing capabilities and tools, laboratory detection techniques and instrumentation, methods for ground-based assessments, and improved modelling capabilities.

*Long-term efforts:*

- Understand the cumulative effects of stressors and hazards in human populations and ecosystems to better target causative agents and processes
- Integrate biological, physical, chemical and epidemiological models to provide accurate and timely forecasts of human and ecosystem health-related events and their impacts
- Improve the use of surveillance networks, remote and in situ environmental monitoring systems, genomics and cellular fingerprinting to better understand human and ecosystem health hazards
- Develop models and scenarios to identify the impact of human intervention on human and ecosystem health and to evaluate programmatic, scientific, environmental, psychosocial, and economic consequences of specific decisions.

**Grand Challenge 3: Develop hazard mitigation strategies and technologies**

*Short-term actions:*

- Improve guidelines for use by state and local government officials to prepare for and respond to human and ecological health threats
- Develop and pre-deploy stockpiles, tools and supplies that can be used at the onset of human and ecological health events requiring resources for response
- Develop improved, coordinated and geographically-focused human and ecosystem health mitigation plans to enhance region-specific and local emergency preparedness and response

- Recommend actions that can prevent or reduce adverse effects of hazards on human and ecosystem health
- Integrate new information about known and emerging human and ecosystem health hazards.

*Mid-term actions:*
- Use interdisciplinary knowledge from recurring and emerging health and ecological threats to provide the foundation for national and local preparedness and mitigation strategies
- Implement a comprehensive prevention and reduction strategy for known and emerging human and ecosystem health threats
- Develop and improve human and environmental decontamination gear, capabilities, plans and protocols for chemical, biological, radiological, and other hazardous substances
- Accurately model the outcomes of natural and technological hazards in specific geographic areas and the outcomes of various management decisions, scenarios, and land-use strategies on the environment.

*Long-term efforts:*
- Reduce human and ecosystem susceptibility to future hazards by rapidly restoring human and ecosystem health following a hazard
- Integrate new research about the potential human and ecosystem health impacts of climate change into mitigation strategies
- Sustain local capabilities to effectively mitigate the adverse impacts of human and ecosystem health hazards.

**Grand Challenge 4: Reduce the vulnerability of infrastructure**
*Short-term actions:*
- Assure that access to critical care facilities, emergency response and emergency management services is maintained following disasters
- Assess infrastructures in harm's way during any detrimental event and the associated potential risk to human or ecosystem health
- Properly repair critical infrastructure immediately following a disaster.

**Grand Challenge 5: Assess disaster resilience**
*Short-term actions:*
- Strengthen programmes for community training in emergency medicine and environmental preventive and corrective actions
- Assess availability of rapid response capabilities to quickly detect, diagnose and treat human and/or ecosystem injuries, disease and detrimental conditions (e.g. invasive species, climate change)
- Assess the capabilities available to prevent and control chronic human and ecosystem health conditions and other long-term adverse effects.

*Mid-term actions:*
- Restore human and ecosystem health from post-disaster conditions to pre-disaster states by instituting recovery programmes such as injury rehabilitation, mental recovery, suicide and domestic violence prevention, water system integrity evaluation, food and water safety and vector control (monitoring and surveillance), ecosystem and natural population restoration
- Develop pilot projects for recovery and restoration techniques (e.g. replanting of multiple species in areas decimated by diseases or parasitic invasion, restoration of coastal marshes, diagnostic tools for mental health)
- Evaluate the effectiveness, appropriateness and timeliness of responses to a hazard-related event
- Provide risk assessments to determine the likelihood and potential impacts of hazard-related events and to identify at-risk communities or areas.

*Long-term efforts:*
- Develop a database of lessons learned from past disaster events with human and ecological health impacts.

**Grand Challenge 6: Promote risk-wise behaviour**
*Short-term actions:*
- Create educational products and effectively communicate recommendations for protective action and preventive behaviour.

*Mid-term actions:*
- Develop protocols to evaluate the scientific basis and reach interagency agreement on best practices for individual actions before, during and after an event
- Communicate clear messages that can be understood by all in harm's way about the risks associated with an impending hazard.

*Long-term efforts:*
- Develop early warning systems that:
  - Incorporate research findings from the social sciences
  - Leverage the latest innovations in dissemination technologies
  - Provide actionable information in real time, based on solid scientific information and on state-of-the-art models to protect critical facilities, infrastructure, vulnerable populations and ecosystems.

**Expected benefits and future steps**
Expected benefits from these actions are the creation and enhancement of a more disaster-resilient America. Specifically, relevant hazards will be recognized and understood, communities at risk will know when an event is imminent, individuals at risk will be safe from hazards, and disaster-resilient communities will experience minimum disruption to life and economy after an event has occurred. Both the Grand Challenges and the accompanying Implementation Plans were endorsed by participating SDR Federal Agencies, the President's Offices of Science and Technology Policy and Management and Budget, and are expected to be shared with the Congress. On the basis of these plans, SDR member agencies are preparing future budget requests to allow them to undertake the necessary activities that will assist communities and the nation in achieving disaster resilience.

# Rapidly increasing disaster risks demand innovative, evolutionary disaster management technologies

*Ray Shirkhodai and Joseph Bean, Pacific Disaster Center*

**There is nowhere to hide. Natural and human-induced disasters happen everywhere. One day's sweet-scented breeze can be the next day's tropical cyclone wreaking havoc in paradise. That happened in Hawaii when Hurricane Iniki devastated the island of Kauai on 11 September 1992.**

### Disasters on the rise

It is no longer shocking to discover that meteorological natural disasters are happening more frequently and increasing in severity. As populations grow and move, hazards such as severe storms, flooding and drought, high winds, landslides, wildfires and other weather-related events are causing untold suffering to communities. Modern industrialized nations are not exempt. Canada suffered its longest and most severe droughts ever between 1984 and 2002. Similarly, one of the six strongest hurricanes ever recorded, Hurricane Katrina, hit the United States Gulf Coast on 29 August 2005, taking more than 1,800 lives and doing an estimated USD81.2 billion in damage.

Scientists around the globe are attempting to understand why hazardous weather is becoming more severe. That effort must begin with demonstrating that the increases in frequency and severity are genuine. Massachusetts Institute of Technology Professor of Meteorology Kerry Emanuel, writing in *Nature: International Weekly Journal of Science*, briefed readers on "an index of the potential destructiveness of hurricanes based on the total dissipation of power, integrated over the lifetime of the cyclone, and show[ing] that this index has increased markedly since the mid-1970s. This trend is due to both longer storm lifetimes and greater storm intensities."

Over recent decades, there has also been a marked increase in the damage caused by geophysical hazards — volcanic eruptions, earthquakes and resulting tsunamis. This is not because such events are becoming more frequent. Any apparent increase in the number of geophysical events, as well as the sharp rise in related damage estimates, can be accounted for by the fact that there are more people and communities in more at-risk places. So, a higher number of events are reported in detail, more lives are lost and more human-constructed environments affected or destroyed.

Human-induced disasters, from terror-related events to oil spills, from industrial accidents to acts of sabotage and the effects of deferred maintenance, are also becoming increasingly common and affecting more people.

Numbers alone cannot tell the story, but they help us picture the scale of the problem that disaster managers face: in 2006, disasters killed 23,000 and cost more than USD$34.5 billion.

Lives are at risk everywhere every day. Tragic as that is, communities, countries and international regions suffer much more than the loss of citizens. When a cyclone, for example, kills dozens or hundreds, it often displaces and dispossesses hundreds of thousands, even millions; and wipes out or seriously damages economic gains, infrastructure development, social order and political stability. While a disaster-affected community searches for the missing and mourns the dead it must service, supply and resettle the affected survivors, and find ways to reintegrate and re-employ them. Meanwhile, production is commonly at a standstill, followed by a protracted period of interrelated social, political and economic disorder and recovery.

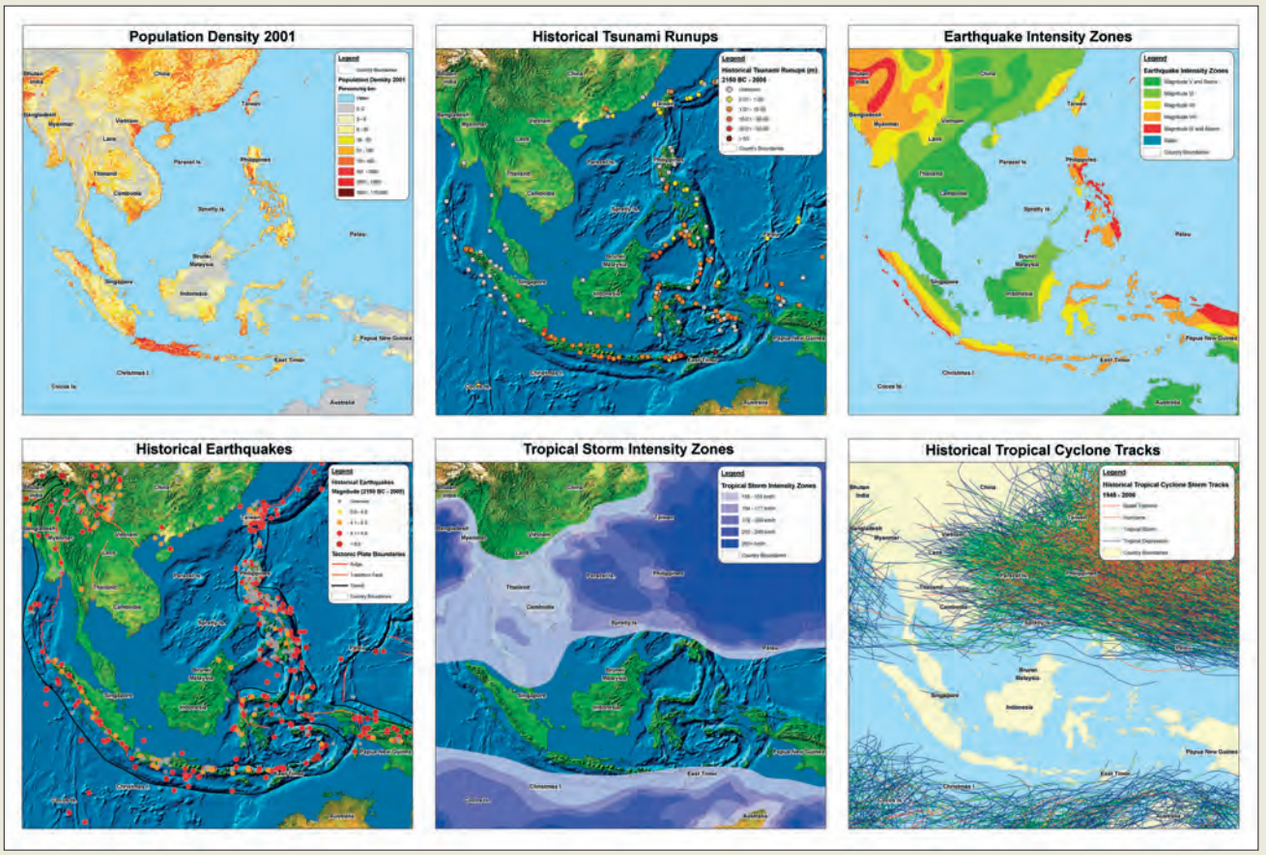
### Responding on behalf of billions

The disaster-response capacity of communities, nations and regions is not merely keeping pace with disasters. In terms of preventing loss of life, disaster management practices are gaining ground. Lives are being saved, although larger populations in at-risk areas reduce the effect of that good news when other loss statistics are examined.

The United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA)'s IRIN News, reviewing the impact and costs of disaster in 2005 said: "While the number of lives lost has declined in the past 20 years — 800,000 people died from natural disasters in the 1990s, compared with 2 million in the 1970s — the number of people affected has risen. Over the past decade, the total affected by natural disasters has tripled to 2 billion. According to the UN Bureau for Crisis Prevention and Recovery, some 75 per cent of the world's population lives in areas that have been affected at least once by either an earthquake, a tropical cyclone, flooding or drought between 1980 and 2000."

The IRIN authors add: "Disasters are closely linked to poverty; they can wipe out decades of development in a matter of hours." Poor communities, regions and nations are heavily affected by disasters. Not only do they have fewer resources to assist with recovery, their infrastructure, homes and other constructions are more often and more completely destroyed, and the livelihood

**ASEAN countries regional natural disaster risk overview**




Data streams from sensors, satellites, buoys and other sources can be time-consuming and challenging.
Visualized data, like the risks to ASEAN nations pictured here, can be immediately understandable

Source: Shaded Relief, © WorldSat International Inc. 2001, Digital Chart of the World, NOAA/NGDC, UNISYS Weather, ORNL LandScan 2001

of their citizens is often linked to natural environments or cultivated lands that are also destroyed or altered.

Industrialized nations, where the dollar-values associated with losses can be staggeringly high, struggle with the costs of disasters. Developing nations, where the value of the loss is lower because there is less to lose, often pay for their shortcomings in terms of greater loss of life and more extreme economic setback.

Regardless of any comparisons in raw dollar amounts, natural disasters cost developing countries from six per cent to fifteen per cent of gross domestic product (GDP), on average. Progress is being made on this front. Cyclone Val cost 230 per cent of Samoa GDP in 1991; Cyclone Heta cost only nine per cent of GDP in 2004.

With human lives and livelihoods at stake, every measure capable of reducing risk and mitigating the impact of natural and human-induced disasters must be used to the fullest. This includes incorporating what is known of potential disasters in the planning of development and infrastructure, and taking steps today to lessen the effects of future disasters.

Not if, but when a disaster occurs, it is vital to have the appropriate science and technology in place to support complete, concise, accurate and actionable communication within agencies, between organizations and right down to the last mile of early warning to those potentially affected.

## What can be done?

Although science and technology cannot prevent disasters from occurring, recent experiences and successes offer real hope for reducing disaster impacts. This is predominantly achieved by using the latest science and technology in a) increasing the timing and accuracy of disaster warning, b) applying Risk and Vulnerability Analysis (RVA) techniques for better planning and mitigation, and c) building capacities and partnerships to proactively take advantage of advances in disaster risk reduction. Simply put, if disasters are defined as the intersection of phenomena and presence, science and technology can now help to limit the overlap of the principal components, reducing the risks and impacts.

Reducing disaster risks is a multi-dimensional problem requiring a multi-dimensional solution; science and technology alone cannot achieve the ultimate results. The work of culturally sensitive institutions in raising awareness at the community level is also important, approaching the problem from bottom-up.

How can science and technology reduce risks? First, by improving the timeliness and accuracy of disaster warnings, and improving the speed and clarity of alerts disseminated

to decision makers and at-risk populations. Since the 2004 Indian Ocean tsunami, considerable efforts have been directed toward establishing disaster early warning systems at regional, national and local levels. Challenges in this approach involve lack of infrastructure and/or interoperability in systems reaching the last mile. However, advances in technologies are promising to overcome many of these challenges.

Second, we can best understand risks by using the latest science and technologies. Statistical and historical disaster data, used in conjunction with indicators estimating a society's ability to respond to and/or recover from disasters, are improving disaster management capabilities. These studies indicate which communities are most at-risk and exactly how. The results can support better planning, mitigation and policy decisions. Urban planners may use this knowledge to limit development in an area. Similarly, a study indicating increased risk due to a concentration of population with special needs can lead officials to consider special evacuation measures.

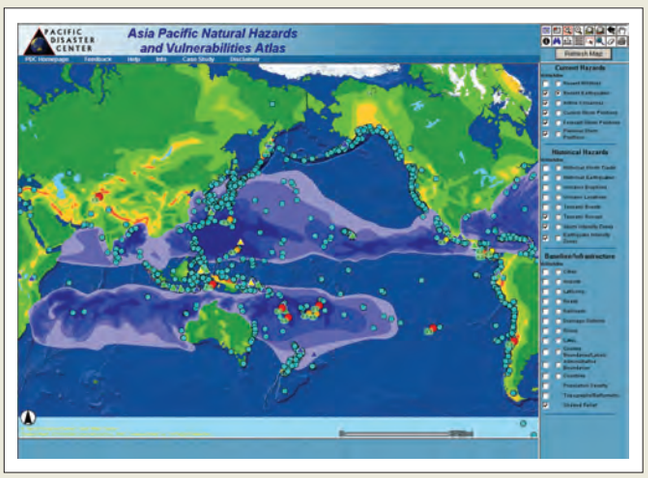
Lastly, technologies can help to better visualize and communicate risk, and to readily and widely share disaster risk reduction information. Advances in communication technologies make it increasingly easy to build disaster-resiliency. Similarly, various modelling and visualization techniques can be used to convey, in simple forms, otherwise complex risk information, raising awareness and building knowledge about risks.

### PDC's approach

Pacific Disaster Center (PDC) and its partner organizations — national governments, military commands, transnational collaborators, etc. — deliver proven best practices and subject matter expertise to save lives and foster disaster-resilient communities.

PDC provides expertise, tools, technologies and innovative solutions in the areas of disaster preparation, mitigation, response and recovery for emergency managers and decision makers. As an applied science, information and technology centre, working to reduce disaster risks and impacts to people's lives and property, and to local, national and regional economies, PDC links scientists with at-risk communities.

**Asia Pacific Natural Hazards and Vulnerabilities Atlas**




Pacific Disaster Center's Asia Pacific Natural Hazards and Vulnerabilities Atlas is a web-accessible tool that evolves as data resources and disaster management toolsets are developed

Source: Shaded Relief, © WorldSat International Inc. 2001.

PDC's evolving approach to emergency management shifts the emphasis from reactive, focusing on response and recovery operations, to proactive, with the focus on mitigation and preparedness. The vast streams of data now available from sensors and satellites, observers and responders are overwhelming. What is needed is clear situational awareness that can be shared in real time or near-real time — information products that are instantly understandable and, when possible, fully visualized. By analysing, aggregating and integrating information resources, then using concise models rather than charts, and map viewers rather than spreadsheets, understandable and immediately actionable information is provided. Where an avalanche of incomprehensible data inspires fear and confusion, a well-designed and sharable data presentation structure becomes an integrated decision support system, ultimately saving lives and making communities more resilient.

The overall strategy of PDC is to promote disaster management as an integral part of national-to-local economic and social development.

### Fostering disaster-resilient communities

A wide and growing array of data streams is available to disaster managers, including seabed sensors and ocean surface buoys, satellites, wave and water level gauges, seismometers and other land-based devices. What matters is the ability to acquire the right data and to produce reliable, timely and sharable information on which to base decisions and actions. To accomplish this, broad collaborations and mutual support are essential. Some of the methods employed by PDC are listed below.

*Decision support* — PDC worked with the National Disaster Warning Center (NDWC), Thailand from December 2005 through February 2007, providing technical assistance in order to enhance NDWC's disaster management capabilities, systems and practices. The focus of the project was on the dissemination of early warnings, especially warnings associated with tsunamis. PDC, with its partners — Lockheed Martin Information Technology, Sun Microsystems, and the Environmental Systems Research Institute (ESRI) — provided NDWC with technical solutions, systems integration and human resources training to achieve its strategic objective of establishing a scalable and world-class disaster management and emergency communications facility.

The PDC-NDWC collaboration began with an information and communications technology (ICT) gap analysis, and development of a concept of operations in relation to the decision support system. Other steps included a hazard-related data inventory, a proposed system architecture including cost estimates, a business continuity plan and train-the-trainer sessions to establish and ensure sustainable capacity. The primary product of the NDWC project was PDC's integrated decision support system (IDSS), Disaster All-hazards Warning, Analysis and Risk Evaluation (DisasterAWARE).

PDC's first IDSS was deployed for US Southcom in the Caribbean. The customized Thai version was an evolutionary leap, capable of reconfiguration and expansion

Image: Todd Bosse for PDC

The same natural phenomena that make life possible, like the floods that produced the fertile valleys of Vietnam, become natural hazards when they intersect with human populations in unmanaged ways

to meet future needs. Other versions, tailored to the needs and specifications of specific regions and nations, including Vietnam, are also being developed.

*Information sharing* — Realizing that disaster information sharing must be an integrated component of disaster risk reduction efforts in the region comprising the member countries of the Association of Southeast Asian Nations (ASEAN); the ASEAN Committee on Disaster Management (ACDM) and PDC developed a joint framework for establishing a Disaster Information and Communication Sharing Network, or DISCNet. The stated objective of the programme was to "enhance regional disaster management capacity and readiness" by:

- Developing a more effective 'information clearinghouse' mechanism to promote regional collaboration and strengthen national capacities in disaster risk information dissemination
- Ensuring disaster management information sharing among ASEAN member countries that will lead to the development of a framework for regional integrated decision support
- Enhancing disaster management readiness by supporting regional exercises (table-top or otherwise)
- Strengthening the capacities of ACDM to integrate its disaster information management system with other entities in the global arena.

The collaboration of PDC and ACDM reached its first major milestone with the publication of *Information & Communication Technology Assessment for ASEAN DISCNet* in 2005, an analysis of the ICT capacities and capabilities of ten countries. PDC and ACDM have an ongoing partnership, which includes the development of the Online Southeast Asia Disaster Inventory, OSADI, launched at the tenth Meeting of ACDM in October 2007.

PDC's dedication to information exchange and access to shared information is perhaps epitomized by the Asia Pacific Natural Hazards Information Network (APNHIN), an online community of providers and consumers of disaster management data. Provider-members of APNHIN include the USGS, NOAA and other US Government organizations as well as GISTDA Thailand, the Pacific Risk Management Ohana and others.

*Risk modelling and mapping* — PDC worked with the State of Hawaii, Department of Land and Natural Resources (DLNR), on its dam safety programme throughout Hawaii. After a catastrophic dam failure on the island of Kauai in March 2006, dam owners were mandated to prepare, maintain and implement emergency preparedness plans for each dam or reservoir. A key element for each plan was a map defining the potential downstream inundation should the dam fail, giving an assessment of the critical infrastructure and population at risk. PDC was contracted to prepare these analyses on behalf of the dam owners. A critical DLNR objective for PDC was modelling potential failures and creating inundation maps of all registered dams for emergency planning purposes. PDC has provided maps and consequence assessment reports for all 135 dams. They will be used in the creation of evacuation maps and plans.

*Capacity building* — A significant element in disaster management is the capacity to plan for, respond to and recover from disasters, in terms of equipment, facilities, human resources, skill sets, standard practices, and policies and procedures. PDC has worked with many of its beneficiaries and partners to improve their systems, develop information sharing applications, and bring staff training to the train-the-trainer level, stabilizing the expertise within the organization. PDC conducts exhaustive analyses of data holdings, policies, practices and procedures, to point out gaps and deficiencies and lay out plans for maintaining and upgrading capacity over time.

**Being wise about risk**

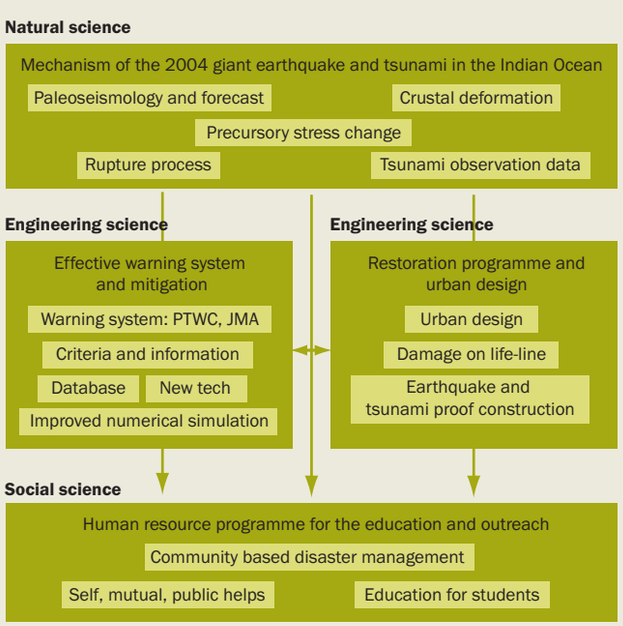
Information alone is not an answer to the challenges of disaster management in a world of more than six billion people, who are crowding ever more densely into disaster-prone regions while weather hazards are increasing in number and severity. Analysis, integration, visualization and sharable presentation of data are necessary to provide instantly actionable decision support. The necessary information and communications technologies exist, and they are being improved every day.

# Restoration programme from giant earthquakes and tsunamis

*Prof. Teruyuki Kato and Prof. Kenji Satake, Earthquake Research Institute, The University of Tokyo*
*Prof. Fumihiko Imamura, Graduate School of Engineering, Tohoku University*

**A giant earthquake occurred on 26 December 2004 off Sumatra Island, Indonesia, rupturing through the Andaman and Nicobar Islands (hence named the Sumatra-Andaman earthquake) and generating a tsunami across the Indian Ocean. The Pacific Tsunami Warning Center issued the first information bulletin only 15 minutes after the earthquake. However, this information did not reach the coast, because there was no tsunami warning system in the Indian Ocean. As a result, the earthquake and tsunami caused about 230,000 fatalities. The tsunami devastated not only the source region of Sumatra-Andaman but also the coast of Thailand, Myanmar, India, Sri Lanka, the Maldives and even Africa. In addition to local residents, many foreign visitors who came from Europe, Japan and elsewhere lost their lives in beach resorts such as Andaman on the coast of Thailand.**

**The structure of the restoration programme, which aimed to investigate problems of earthquakes and tsunamis, and integrate acquired knowledge**




Source: Teruyuki Kato and Fumihiko Imamura

Given such a huge natural disaster, numerous questions and problems were raised among concerned scientists. These range across a wide variety of scientific disciplines including natural sciences, engineering and social science. Many experts and researchers worked to answer these questions. This research is invaluable not only for accumulating knowledge about natural hazards but also for preventing and mitigating disasters in the future, as well as finding better ways of post-disaster restoration. In order to utilize such knowledge acquired through individual research, it has to be integrated in a systematic manner as 'disaster science'.

This article summarizes our project on restoration after giant earthquakes and tsunamis. The project aimed not only to investigate various problems of earthquakes and tsunamis but also to integrate the acquired knowledge. A primary key for this purpose is to build a researchers' community among different disciplines and countries, which, we believe, is indispensable for integrating research results and for building a society resilient against earthquakes and tsunamis.

**Project**

The project consisted of four major themes:

1. Mechanism of the giant earthquake and its prediction
2. Development of human resources for enforcing human power against natural disasters
3. Effective use of a tsunami warning system and mitigation of tsunami hazard
4. Restoration programme and city planning considerations due to the disasters caused by giant earthquakes and tsunamis.

Each theme consisted of three-five research subjects. The programme strongly encouraged synergetic efforts among an international community of related scientists through international workshops/symposia as well as related field researches.

The term of the project was three years: April 2005 to March 2008. The yearly budget of JPY50 million (USD455 thousand) was granted from the Japanese Government. In addition to 16 principal investigators for each research subject, more than 34 researchers

Image: Hirokazu Iemura

Tsunami memorial poles are built along evacuation routes, and also serve as education tools to convey the memory of the disaster to future generations

participated and 28 researchers cooperated in the project. An advisory committee was established for monitoring the project.

**Outline of results**

*Mechanism of the giant earthquake and its prediction* — Seismological investigations indicated that the Sumatra-Andaman earthquake was a typical subduction-zone type event. The Indian plate is subducting beneath Sumatra and the Andaman Islands, causing the upper plate to be dragged and deformed up to a certain limit. When the stress reaches its maximum strength, the continental plate rebounds and generates an earthquake. The 2004 earthquake, with a magnitude of 9.1 and a source about 1,200 kilometres long, was the largest in the world over the last 40 years.

The most popular but controversial question is whether such a large earthquake is predictable. Stress concentration might occur before the event and an accelerating stage of stress relaxation might exist, being visible as precursors. We investigated seismicity and stress change and found that there might have been a significant change in seismic activity before the 2004 earthquake. Though it has to be evaluated more carefully, the accumulation of such possible evidence of a precursor to a large earthquake is important.

On the other hand, after-effects of a large earthquake are readily visible as post-seismic crustal deformations, and such research has become increasingly important for earthquake studies. Several teams deployed GPS stations in Indonesia, the Andaman Islands and Myanmar. A GPS site established in Aceh, Indonesia, has registered more than 50 centimetres of land displacement in less than two years after the earthquake, and this is still continuing. Preliminary investigation of data from new and existing GPS stations suggests post-seismic slow slip around the co-seismically slipped area, though decades of monitoring are necessary for clarifying the stress readjustment process.

Since the recurrence interval of large earthquakes is very long (a few to several hundred years for a subduction-zone event), geological surveys are important to examine the earthquake history. The 2004 Sumatra-Andaman earthquake and the accompanying tsunami left geological traces that would be permanently preserved. Uplifted corals appeared above the sea surface on islands off Sumatra or North Andaman Island. Sand brought by the tsunami was traced inland along the Sumatran, Thai and Indian coasts. Geological studies found evidence showing that a giant earthquake similar to the 2004 event occurred in the same region several hundred years ago. If such paleoseismological studies were made before the 2004 earthquake, scientists would have anticipated a giant earthquake in this region.

*Development of human resources for enforcing human power against natural disasters* — It is essential to develop human resources for enforcing human power against earthquakes and tsunamis. Education and training residents as well as other practical countermeasures in local communities are important for this purpose.

A questionnaire survey in Banda Aceh found that the local people's knowledge of tsunamis was very low before 2004. To the question, 'Did you know that tsunamis would come after a big earthquake?', only three per cent answered 'yes'. A further finding is that, even if people had started evacuation immediately after the earthquake, not everybody would have been able to survive. The practical implication is that education, socialization, escape routes, evacuation structures, warning systems and wave resisting structures are

among the important factors that will allow people to survive future earthquake and tsunami attacks.

Another important aspect of society is to bring current experience to future generations. Since the tsunami was a rare event, people may forget the disaster easily. We need to keep reminding the population about the tsunami disaster. One way is to build tsunami memorial poles with the height of tsunami run-up throughout the affected areas. We built 85 poles in the city of Banda Aceh. They were built along the evacuation routes, so that the people can run toward the lower poles. The tsunami memorial poles are also education tools which are expected to last and convey the memory of the disaster to future generations.

The Asian Disaster Reduction Center (ADRC) team, an agency for building capacities in Asian countries through education and training, made teaching materials for disaster prevention in Indonesian and other languages, from an interactive consultation with schoolteachers.

These field exercises, with experts interacting with local communities, are very useful for building local capacity. However, the number of experts is far smaller than the number of people to be trained and/or educated. The roles of practitioners such as non-governmental organizations/non-profit organizations, schoolteachers and community leaders are thus very important to extend and disseminate acquired research results and knowledge to the public. Synergetic works between experts and practitioners are thereby created and result in effective work being carried out.

*Effective use of a tsunami warning system and mitigation of tsunami hazard* — The basic question raised was: 'Can we save people with a tsunami warning system?' One of the reasons for such a large number of casualties is the lack of tsunami experience/awareness in the community and no tsunami warning in the affected area.

We investigated the tsunami information/warning and people's response to the 2004 and other recent tsunamis. There are three stages for carrying out safety evacuation after an earthquake: the first is to collect tsunami warning information and data on natural phenomena such as strong and abnormal ground shaking; the second is to make an evacuation decision based on risk perception, and the third is to select a proper route and place for safety evacuation. Unless the three stages are completed adequately, people cannot survive. We found that the balance between a tsunami warning and the risk bias of individuals is important. If the risk contents on the warning overcome the individual risk bias, they would make the decision to evacuate.

Moreover, in daily life, functions with risk communication and education are important to reduce risk bias. Awareness education must include at a minimum:

- The creation of evacuation procedures to evacuate residents from tsunami hazard zones
- The implementation of an education programme for schools to prepare students
- The conduct of periodic practice drills to maintain preparedness levels
- The involvement of community organizations to educate all sectors of the population at risk.

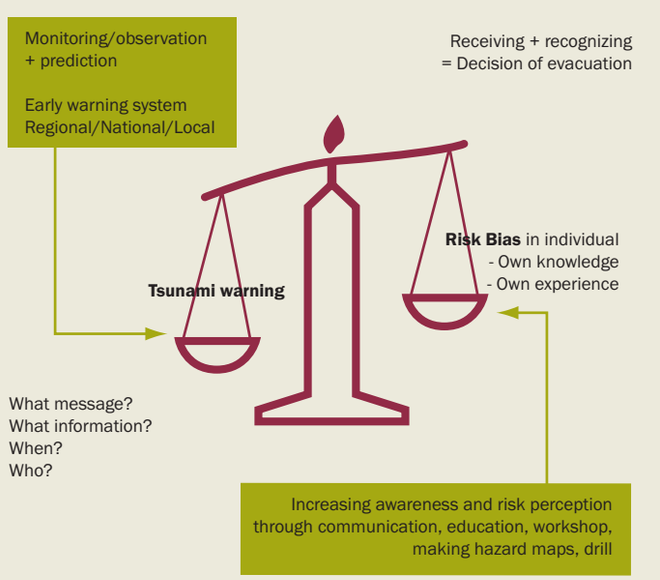
In order for effective use of the tsunami warning system, appropriate threshold and segmentation of warning areas should be set. For this purpose, historical tsunami data and literature was investigated and compiled as a database by the Japan Meteorological Agency (JMA). JMA worked together with the Pacific Tsunami Warning Center and provided such information to related countries around the Indian Ocean.

A new tsunami monitoring device which uses GPS buoys for detecting tsunamis offshore has been developed in Japan. The system uses real-time monitoring of the sea-surface height and transmits the observed data to users through microwave and Internet channels. Thus the coastal population can be warned of a tsunami up to ten minutes before its arrival.

*Restoration from giant earthquakes and tsunami disasters, and city planning* — Engineering research was done into many practical construction methods that could possibly save lives. A water channel experiment showed that the acting force on a bridge correlates with tsunami speed. Another experiment showed that apparatus such as wave-dissipating blocks are not very useful if the block height is less than half that of the buildings to be protected. Plants such as mangrove show significant tsunami retarding effects; a 60 per cent reduction of force and 80 per cent of its velocity, if tsunami height is less than 1.5 times the height of the mangrove. It should be considered that there are limitations in the effectiveness of rigid construction or mangrove, when the city or town along the beach is designed to be tsunami resilient.

We also examined how well people in the affected area could rebuild from the disaster by using a construction ratio, which is the percentage of restored houses in a community. We proposed a building restoration curve as

**The balance between warning and risk bias**




Source: Fumihiko Imamura

a quantitative evaluation method for the restoration of a local community. The introduction of such quantitative evaluation for restoration will be helpful in other disasters as well.

Finally, we investigated the effect of lifelines such as power lines, gas, water supply and telephone, to propose a better method of restoration. We found that the restoration of the water supply and electricity was very fast, taking only about one month in the Phanga Nga province of Thailand. This was because the Government took the policy of restoring the system as it was before the disaster. There is a controversy as to whether restoration should be carried out to the original state as quickly as possible; or the lifelines redesigned to be more resilient against earthquake and tsunami, in which case it might take longer.

Image: Kenji Satake

Ban Nam Ken, Thailand: a boat stranded by the Indian Ocean tsunami

Through these investigations, we stress the importance of the predetermination of the city plan before a natural disaster occurs. For this purpose, capacity building of local communities for disaster management is truly important.

**Resolutions for the future**

In order to wrap up the project, an international symposium was held in Phuket, Thailand, over 22-24 January 2008. The symposium closed with the adoption of nine resolutions. The following three resolutions seemed most important for continuing our efforts into building more resilient societies in earthquake and tsunami-prone areas of south and southeast Asia, and elsewhere:

*Promotion of cooperative scientific research related to natural disaster mitigation*

- Recognizing the importance of international and interdisciplinary research toward natural disaster mitigation, particularly for giant earthquakes and tsunamis
- Resolve that all participants make every effort to promote such international and interdisciplinary research under the mutual and synergetic work among related researchers.

*Nurturing the next generation of researchers and community leaders in Asia*

- Recognizing that Asia is the severest area in the world in terms of natural hazards including, but not limited to earthquakes, tsunamis, volcanic eruptions, typhoons, floods etc.
- Noting that the number of researchers in this area is insufficient so that leading scientists, particularly in the universities and other research institutes, have an important role of nurturing researchers and local community leaders related to natural disasters and their mitigation
- Resolve to promote education for nurturing the next generation of researchers in universities and community leaders in local communities, particularly in Asia.

*Collaboration among researchers and practitioners for public awareness*

- Recognizing that education and training for public awareness on natural disasters for the public is important to reduce risks of disasters and rapid restoration from them
- Noting that these efforts are most effectively done through collaboration and synergetic works among researchers and practitioners, such as personnel in NGO/NPOs, officers of local and national governments and other local communities, through formal or informal classes at schools and at community gatherings and meetings
- Resolve to promote and to build concerted and sustained collaboration among researchers and practitioners.

# Understanding communities' needs for information and education

*Alison Cottrell and David King, Centre for Disaster Studies, James Cook University, Australia*

**The Centre for Disaster Studies at James Cook University researches the relationships between emergency service providers and the communities they serve. To more effectively engage community members in planning and mitigation for disasters, it is essential to have an understanding of the different ways that diverse communities and the people who live in them view a particular risk. We also need to understand the different ways in which various sections of the community might be affected or involved in readiness, response and recovery. Three case studies are used here to illustrate ways in which research has been applied to an engagement and empowerment of different sectors of the community.**

## Understanding communities

The Understanding Communities Project (part of the Bushfire Cooperative Research Centre) conducted household surveys in three different peri-urban communities to develop an understanding of community perspectives on bushfires/wildfires.

*Different communities, different issues* — In Australia, most communities have a fire service of some kind. In rural regions and some peri-urban regions, rural fire brigades provide this. Despite seeming to be obvious, it is necessary to remind agencies that each of the communities they serve has different needs, even with regard to hazards. Communities that were studied experienced different natural hazards. At Tamborine Mountain, intensive electrical storms were much more common than bushfires. In Thuringowa, cyclones and flooding were much more common than bushfires. At Plenty Gorge bushfires are the main natural hazard, there having been a fire in the area as recently as five years ago.

*Fire services' and householders' perceptions of issues* — Fire service agencies see bushfires as a critical issue, as it is their business. However, householders do not always see the issues the same way. Even in bushfire-prone areas like Plenty Gorge, other day-to-day issues such as household financial security, children's and personal safety, and traffic issues were all considered to be of more concern to householders than bushfires. The most detailed study of the similarities and differences between fire service providers and householders was conducted at Tamborine Mountain by interviewing fire service personnel, community groups, community meetings, community leaders and a household survey.

*Agreement between fire services and the Tamborine Mountain community* — Both fire service personnel and community members believed that experience of bushfires makes people better prepared. However, review of other research shows that the 'experience of fire' does not necessarily increase the 'awareness of risks', as it depends on factors such as how long ago or how awful the experience was, and how much loss was experienced. Media coverage of fire was described by fire services as unrelated to the local situation because 'fires like that don't happen here', and these views were also reported in the community meetings. There was a

**Differences in perceptions and expectations between fire services personnel and the community at Tamborine Mountain**

| Fire services perspective | Community perspective |
|---|---|
| Most people are unaware of the bushfire risk | Most people are aware of the bushfire risk but have other priorities that take precedence |
| Most people in the community rely on fire services to respond to a bushfire | At least half said they would not rely on help from fire services in a bushfire |
| The public expects things to be done for them | Individual householders see themselves as the most responsible for personal and home safety |
| Can advise residents but cannot tell residents they need to take action | Frustrated by lack of specific advice on what to do and no help provided |
| Controlled burns are not wanted by the public | Support for controlled burns as long as they are carefully done |

Source: Balcombe, L., Cottrell, A., and Newton, J, 2008 Awareness of Bushfire Risk – Tamborine Mountain Case Study, *Fire Note* Bushfire Cooperative Research Centre no. 20 pp1-4

Image: Alison Cottrell

Wildfire/bushfire-prone housing at Tamborine Mountain, Australia

general perception by fire services personnel, community representatives and household surveys that views about bushfire risk were quite varied in the area. Consequently, a 'one size fits all' approach to community information activities may not be appropriate. Management plans were seen as important by both fire services and the community, but everyone recognized that they were not effectively implemented.


Image: Centre for Disaster Studies

Stormwatchers 2008: an interactive children's game for cyclone education

Although individual householders felt themselves to be the people most responsible for personal and household safety in the event of a fire, expectations change when one occurs. There were also clear differences of expectations in terms of delivery of information to the public. Interestingly, although the fire services perceived public opposition to controlled burns, the survey and community meetings indicated that people supported controlled burns but had concerns that these should not get out of control and should be timed appropriately.

*Householders not prepared* — In all three locations, bushfire preparations were undertaken by less than half the householders surveyed. In addition, even where preparations had been undertaken they were very inadequate. Householders were not certain of what they needed to do or how much it would cost them to undertake preparations. In all three locations approximately half the respondents would rely on the fire service to respond to bushfire. This is highly problematic given that there can never be enough rural fire fighters.

*Implications* — A major issue for fire services is how to gain attention when other issues take priority for the community. There is also a need to approach preparedness issues in a variety of ways. At Tamborine Mountain, there appeared to be a substantial section of the community that was not at all prepared. Conversely, a substantial group of people believed they


Image: David Lowe (Cottrell, A., Lowe, D., & Spillman, M. 2008)

Community engagement: Weather Matters in Indigenous Communities Workshop and Evaluation Report

were responsible for their safety, but were nonetheless inadequately prepared. Different groups require different community education approaches, which adds complexity as they are not always discrete, easily identifiable groups. However, the active community involvement in the preparation of the *Tamborine Mountain Escarpment Management Plan* indicates that the community may be a resource for fire services, necessitating further education of the fire services themselves.

**Community education: Children's needs for Tropical Cyclone Education – Stormwatchers**

Effective disaster mitigation requires community education and awareness. Emergency managers have formerly seen communities as the adult population of a geographical location, but the most immediate subgroup of any community is its children. The Centre for Disaster Studies recognized children as a separate community group when analysing vulnerability to cyclones in the northern beaches suburbs of Cairns, in North Queensland during the mid 1990s. Internationally, the significance of children's involvement in disasters has been recognized by the United Nations as part of children's rights.[1] In many countries hazard education modules form part of formal school curricula. The importance of hazard education for children received further impetus after so many children died in the Indian Ocean tsunami, and was addressed in the Hyogo Declaration.[2]

Researchers have shared findings of projects aimed at children's experiences in disaster and the importance of educating children for hazard awareness.[3] After Tropical Cyclone Larry devastated small communities to the south of Cairns in North Queensland in March 2006, a group of schoolteachers and mothers gathered children's stories of the cyclone and their survival as a means of aiding the recovery of the children by encouraging communication and the sharing of experiences. Cyclone Larry crossed the Coral Sea in mid-March 2006, developing into a severe category five as it approached the coast south of Cairns, devastating the small towns of Innisfail and Babinda and surrounding small rural settlements.

There are distinct phases to each cyclone that engage the community. The precursor to many cyclones is the development of the monsoon trough and of tropical low-pressure systems, frequently bringing rain before the storm develops. People become aware and once the cyclone forms and is named, the watch intensifies. During this period of increasing tension people make preparations and clear up rubbish, but carry on life as normal. After Cyclone Larry the Centre for Disaster Studies carried out a household survey which addressed this pre-impact period in order to understand preparatory behaviour and the receipt of warning information.

The children's accounts began with the same period and both mirrored and participated in the tension, discussions, actions and preparations of the adults.[4] Both the household survey and the children's accounts recorded where and how people sheltered and protected themselves as well as aspects of the damage, although the children described the experience of the cyclone's passage particularly vividly. The eye of the cyclone was a stage in the process where many people left the safety of their houses, attempting some clear-up and even rescues of neighbours and animals, but it was also the point of wind reversal and a separate destructive experience. The final stages in the process of the storm were the initial clear-up, contact with others and then the long haul of recovery that ran into most of the rest of the year for most people and an ongoing slow recovery for some.

The feelings of both children and adults in this event shifted from the fearful or tense expectation as the cyclone came closer, through the horror, noise and awesome destruction of the event, with its accompanying emotion of excitement, into shock, sadness and anger after the storm had passed. Both adults and children reflected on their fortune in surviving as well as the trauma of their losses. They expressed philosophical acceptance and many drew attention to the community spirit, cooperation and support, and the efforts of the many groups of relief and recovery workers.

Cyclones bring significant amounts of the rain that falls in northern Australia's wet season. They are a regular and predictable part of the pattern of the seasons. They configure the experience of life in the north. All are destructive, all are local historical markers, and all can be prepared for through protective behaviour and mitigation actions. Some cyclones, such as Larry, are severely destructive events, and yet most people who live in the north of Australia can expect to go through such an experience every two or three decades. Most of the adults interviewed in Innisfail and the surrounding townships had experienced a previous cyclone and most had been through a severe storm. Most of the children whose stories were recorded can expect to go through this experience again in their lifetimes.

Education is then of crucial importance in maintaining the safety of all of the people who live in cyclone-prone areas. Although it is the primary responsibility of the adult members of the community to make preparations and practise sheltering behaviour that mitigates the impact of the cyclone, it is clear that the children are equally involved, not simply as passive receivers and potential victims, but as active participants involved with all of their families' activities and engaged with the preparations and recovery of friends and neighbours. Hazard education takes place in school lessons, serving to reinforce the broader community awareness advice. However, the lessons learned by children go further. School lessons are active, requiring activity and the involvement of children, whereas community awareness campaigns are primarily passive, placed before people but requiring no action unless heeded. Children are also in an active learning phase of their lives, generally wanting to learn even if some pretend otherwise. The hazard education they learn as children, however partial or fragmented it may be, stays with them for life. Even more significantly, children share their school learning and projects with their families, acting as reinforcers of the more passive community safety and mitigation messages. All members of the community share the hazard experience and consequent natural disaster. All of the community, adults and children, participate in each of the stages of a cyclone impact. All are likely to be traumatised to some extent, so that the more education prepares people, especially children, the better prepared the community will be in future events, thereby enhancing resilience and mitigation.

In response to this community need the Centre for Disaster Studies developed educational materials in the form of a CD-ROM game, *Stormwatchers*, aimed at primary school children.[5] As the initial game software became outdated over the following decade, the impact of Cyclone Larry prompted a redevelopment of the game as a 3D interactive package on the Internet, in order to maintain its effectiveness for new generations of children.[6]

**Involving the media in warnings and hazard education: Broadcasting to Bracs/Ribs**

In April 2007 a very successful workshop was held with presenters for an indigenous radio broadcasting network. This project built on earlier work by the Centre for Disaster Studies and the Australian Bureau of Meteorology (BoM) which identified that: "Radio announcers were not well trained to understand either the weather maps or the real meaning of the BoM weather reports. They download the BoM information and 'translate' it as best they can, but don't feel all that confident about it. The feeling was that a training session for radio operators to understand the information so they could 'translate' the reports into everyday language or even local languages would be very useful."[7]

The workshop included briefings by BoM staff on the meaning of various components of their weather reports, weather maps and weather warnings. A visit to the local BoM facilities at the Townsville RAAF Base was also undertaken. Participants were Broadcasting to Remote Aboriginal Communities Services and Remote Indigenous Broadcasting Services (Bracs/Ribs) presenters from the Torres Strait Islands; Darwin; Daly River area; the Tiwi Islands; Arnhem Land; Broome; Townsville; and Palm Island. The workshops provided the opportunity for radio presenters to better understand the weather reports, maps and websites to enable them to interpret the information and provide more meaningful weather reports for their local communities.

The presenters worked under the assumption that disasters can be substantially reduced if people are well informed and motivated towards a culture of disaster prevention and resilience, which in turn requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities;[8] and that warning messages should have local and individual meanings and should suggest appropriate responses.[9]

Participants found the workshop extremely useful, and were better able to understand the terms used by the BoM, and thus able to more easily negotiate meaning in the workshop setting. Participants were also comforted by the fact that they were not the only ones who couldn't understand the weather reports. Cultural issues about the naming of cyclones were also raised by participants. It is highly problematic for participants if a cyclone is given the same name as a recently deceased relative. Such workshops are equally applicable for training for other community radio operators.

# All natural hazards risk awareness in Australia: examples of community engagement

*Dr Ray Canterford, Jim Davidson, Jim Elliott, Dr Graham Mills, John Nairn and Alan Sharp, Australian Bureau of Meteorology*

**With the approach of the 2007/08 austral summer a predicted shift to La Niña brought the prospect of flooding rains for some regions of Australia, while others would almost certainly continue to endure the impact of severe drought. How these messages were received by the Australian community provides enduring examples of risk communication. Whether through the development and distribution of flood inundation maps or a seasonal outlook for expected fire behaviour, the community had the opportunity to engage and adopt risk mitigation strategies. While delivering these services, the Australian Bureau of Meteorology is constructing a new tsunami warning system that brings improved monitoring and science to a redefined understanding of risk. No matter which hazardous event threatens, prior investigations, statements and warnings will assist the community to establish its exposure to risk. Cultural and language barriers to understanding these messages have been addressed through an indigenous training programme in northern Australia.**

## Flood mapping

Flood maps are a very effective way to engage with the community to improve people's awareness of flood risk as well as to manage that risk during flood events. These maps show the extent, depth, velocity and hazard of flooding. Maps can be prepared offline for nominated (design) events or historical events, to improve flood awareness and to assist with a range of flood risk assessment, planning and regulation activities, as well as online to show the extent of flooding to date including predictions of likely future areas of inundation. Online mapping is particularly helpful in response operations to assist with planning evacuations in advance of the flood's arrival, but also in post-flood recovery planning by providing guidance on when inundated areas will become accessible.

Flood maps can be derived using a variety of techniques, including aerial photography of actual floods or the use of hydrologic and hydraulic modelling to predict flood levels and the extent of flooding. Satellite-based multi-sensor imagery is becoming more widely available, and improved digital terrain modelling is also assisting the task. A recent application of flood mapping utilising this growing remote sensing capability is the FloodMap project, which has developed a near real-time flood mapping tool to help reduce the vulnerability of communities at risk of flooding in remote parts of northern Australia.[1] Much of this area experiences regular flooding, and the harsh terrain and sheer distances involved mean that regional centres, remote homesteads and indigenous communities are significantly more vulnerable than communities in metropolitan and major regional centres. To meet this particular challenge, remote sensing imagery coupled with various geospatial data sets and other available data is being used to build a visual tool for displaying flood information that is directly accessible by these communities. The goals of the project include ensuring, or at least facilitating the incorporation of local needs (including local indigenous language requirements and traditional knowledge) into the presentation and timely communication of flood information through maps in a way that is understandable to those at risk. This requires a governance approach to the preparation of the maps and display tool that engages with the different communities at risk on their own terms. A series of workshops with indigenous and other local groups has been held to foster this type of input. The FloodMap service provided very helpful MODIS imagery during the flooding from tropical cyclone Emma around the Murchison area in Western Australia in March 2006.

## Seasonal Bushfire Assessment Workshops

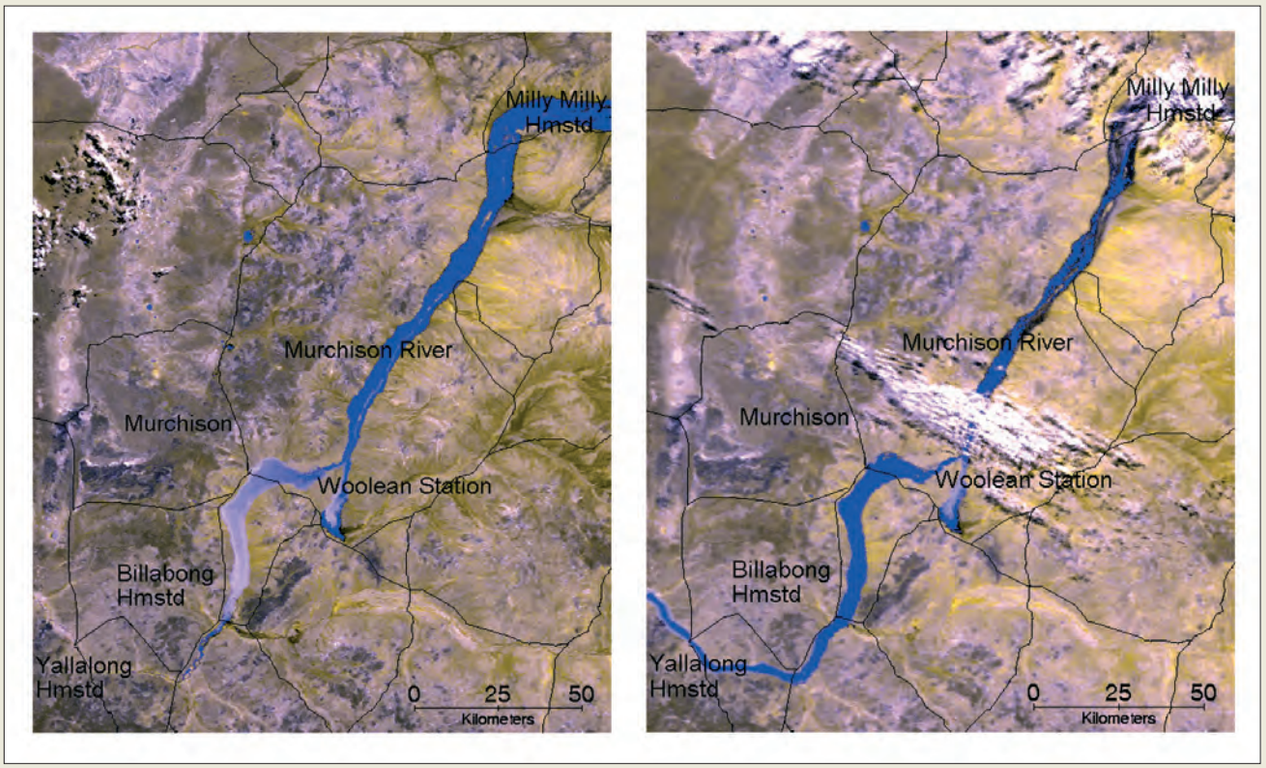
Weather forecasts in support of fire-fighting operations are a vital community service, but awareness of the degree of risk of wildfire activity in a forthcoming season can allow land managers to allocate resources and undertake mitigation measures before emergencies occur.

Seasonal Bushfire Assessment Workshops (SBAW), modelled on similar workshops that have been held in the United States since 2003, have been held in Australia since 2006. Because the fire seasons vary from northern to southern Australia, one workshop focusing on the tropical latitudes is held at the start of the dry season, and one focusing on southern parts in late winter. The goal of the workshops is to estimate the bushfire potential for the forthcoming season. Here, seasonal bushfire potential is defined (by the participants of the workshops) as:

The chance of a fire or number of fires occurring of such size, complexity or other impact which requires resources beyond the area in which it or they originate.

This is not simply a function of the weather or climate. Rather, the potential for a significant fire situation is the

**MODIS Image: Murchison River Flood, 8 March 2006 and 12 March 2006**




Near real-time satellite imagery available through the FloodMap service assisted with the management of flooding from tropical cyclone Emma in March 2006 around the Murchison area in Western Australia. These images show the movement of the floodwaters between 8 March (left) and 12 March (right)

Source: Land Information Authority Western Australia (Landgate)

sum of factors that includes fuels, ignition triggers, timing and duration of fire seasons, significant weather triggers and resources available in an area.

A cross-disciplinary approach is required to evaluate this potential, entailing inter-agency cooperation. To this end, severe-weather meteorologists from the Bureau of Meteorology Regional Forecast Centres, climatologists from its National Climate Centre, and fuel and fire management specialists from the various state fire and land management agencies meet to produce a consensus outlook of bushfire potential for the forthcoming fire season. Thus antecedent conditions that affect fuel state, the seasonal climate outlook, and socioeconomic factors that affect resource availability are all included in making the assessments. As well as the most likely scenario, best case and worst case scenarios are also presented as part of the risk assessment. The outlooks are presented as a map showing areas of above normal, normal, and below normal bushfire potential.

### Tsunami risk mitigation and community warnings

As a direct result of the tsunami generated off the coast of Indonesia on 26 December 2004, the Australian Government reassessed its ability to minimize the loss of life and economic impact on the Australian community. At the time of the tragic 2004 Indian Ocean tsunami, the Australian Tsunami Alert Service (ATAS) was in service, informally operated jointly with Geoscience Australia, Emergency Management Australia and the Bureau of Meteorology. It was readily apparent that the system was not intended to provide a comprehensive warning service and that public awareness was inadequate. The Australian Tsunami Warning System (ATWS) project has been developed to provide a 'comprehensive tsunami warning system for Australia that is capable of delivering timely tsunami warnings to the Australian population in an effective way'.

To provide a comprehensive tsunami warning system for Australia, an end-to-end system was required that incorporated enhanced seismic, sea level and tsunami information in the Indian Ocean and Southwest Pacific regions. Deep ocean modelling and inundation studies have established areas in which the community is at high risk. Even though these events are rare the ATWS has placed a high premium on community awareness campaigns. The first step has been education of emergency management agencies that service coastal communities, resulting in regionally relevant 'action statements' for inclusion in alerts and warnings. These community response guides are now included in public education material. A recent event that impacted the east coast of Australia on 2 April 2007 resulted in a degree of public panic, with some evacuations, traffic jams, school closures etc. Consequently, Australia has concentrated recent tsunami modelling development on warning stratifications. Stratified warning categories of 'no threat', 'potential threat', 'marine warning' and 'land

**Storm tide hazard guide**


Cairns emergency zones

Source: © State of Queensland

inundation warning' provide better advice on the level of risk, which is easier to communicate to the community. The category of no threat is particularly important, as it eliminates 90 per cent of public concern that results from international and national media reports of weak and/or distant seismic events. The Bureau of Meteorology is utilising public focus groups and media advice to ensure clear and fast messages are delivered to the public. A science programme and updated instrumentation now support these stratified warnings. Australia's second deep ocean tsunami buoy is located just off an earthquake fault line to provide maximum warning lead time. This is one of several different types of detection instrumentation.

Interactions with emergency agencies are a key component throughout the warning process. Australia has pursued strong international ties to ensure that other countries in the Southwest Pacific and Indian Ocean have the capacity to put in place similar systems and public campaigns.

### Indigenous broadcaster training

In remote parts of Australia, particularly in the tropics, there are many indigenous communities that are isolated from the mainstream media. The Broadcasting for Remote Aboriginal Communities Scheme (BRACS), was introduced in the late 1980s, providing resources that would allow indigenous communities to broadcast locally produced radio and television as well as managing content received from the mainstream networks. BRACS stations often provide a community's only significant portal to the world.

One important task these stations perform is broadcasting the news and local weather, including official warnings for hazardous conditions. Presenters are drawn from the local communities and receive limited training in the basics of broadcast techniques. While this is sufficient for the provision of an adequate broadcast service, it can be lacking in some of the finer points of broadcasting – importantly, the process of providing information on hazards to the community, which relies on the broadcaster's understanding of the hazard, the scope of the risk, and the relevance to the community.

These remote communities are vulnerable to events like tropical cyclones and severe thunderstorms. When official weather warnings are issued, these presenters need to pass the message to the community so they can take appropriate action. This includes translation of the warning into the local indigenous dialects. Since the presenters are from the community, they will generally know the needs and capabilities of the community. What may be lacking is knowledge of community vulnerabilities, and understanding of the warning they are broadcasting.

To address this knowledge shortfall, a workshop was held in 2007 to determine training requirements. The following requirements were identified:

- Brief layman's summary of meteorological phenomena and their causes
- Summary of severe weather phenomena and threat to the community, along with the provision of public education materials (posters, brochures, disaster mitigation checklists etc.)
- Explanation of common terms used in forecasts and warnings
- Hands-on exercises using synoptic charts, radar and satellite imagery, and forecasts associated with past significant events.

Also recognised was the need for the Bureau of Meteorology to avoid the use of overly technical or obscure language in its products. A product accurate in the pure grammatical sense of its construction and word use may be unintelligible to many users, particularly those for whom English is a second language.

### Queensland storm surges under climate change

The Queensland east coast is impacted most years by tropical cyclones that typically cause severe winds, storm surge and extreme wave conditions over a wide area. To better assess the likely impacts, the Queensland Climate Change and Community Vulnerability to Tropical Cyclones project updated and extended previous estimates of the storm tide inundation risk in Queensland. The project scope included the effects of extreme wave conditions in selected areas, and estimates of potential enhanced greenhouse climate impacts within the full context of the naturally complex climatic variability of tropical cyclones.

Image: Australian Bureau of Meteorology


An Australian tsunami detection buoy deployed in conjunction with the USA National Oceanic and Atmospheric Administration

The recognized benefits are improved real-time forecasting and warning capabilities for the Bureau of Meteorology, together with updated storm tide statistical estimates for long-term land use planning, emergency response strategies for disaster mitigation, and near-shore extreme wave statistics for coastal zone protection and management.

Compared with earlier studies, the project results indicated a reduction of estimated storm tide levels for many parts of the Queensland coast. This is consistent with the expectations of undertaking numerical modelling to a higher resolution and accuracy than achieved previously. However, the more detailed estimates for zones along the southern Queensland coast, which include allowance for wave setup, suggested that previously nominal allowances for this component may have been widely underestimated, thus increasing the potential impact on coastal erosion and the likelihood of inundation of some near-shore communities.

The longer-term safety of coastal communities has been enhanced by virtue of the fact that the potential impacts of climate change sea level rise have been quantified, thereby allowing low-lying coastal communities to plan accordingly. Three greenhouse scenarios were considered:

- Scenario A — the combined effect of a ten per cent increase in maximum intensity and a pole-ward shift in tracks of 1.3 degrees
- Scenario B — Ten per cent increase in tropical cyclone frequency
- Scenario C — Mean sea level rise of 300 mm.

The enhanced greenhouse scenarios are predicted to increase present climate storm tide levels by about 0.5 metres on average (approximately a 19 per cent increase), with a standard deviation of 0.13 metres.

Queensland's efforts in developing forecasting and planning tools for tropical cyclone impacts have been nationally recognized. The project has won a number of prestigious prizes including a Queensland Engineering Excellence Award, and both Queensland and Australian Safer Communities Awards. The innovative work has also been presented at several international conferences. The numerical and statistical modelling methodologies used in this project are consistent with world best practice methods used overseas in the United States by the Federal Emergency Management Authority (FEMA).

The study provided the first state-wide basis for evaluating the relative risks from storm tide inundation, and serves as a baseline for more detailed studies which are being progressively undertaken by local government authorities. Associated benefits include the mapping of storm tide hazard zones to be used for emergency response. These maps necessarily conform to the *National Storm Tide Mapping Model for Emergency Response* and are produced to a standard colour scale that exactly aligns with the graphical warning product issued by the Bureau of Meteorology. Copies of the project reports can be downloaded from the Internet, as can storm surge and wave frequency analyses for selected locations along the Queensland east coast.[2]

# Safety at sea — building resilience and capacities of small-scale fishers in South Asia

*Yugraj Singh Yadava, Director, Bay of Bengal Programme Inter-Governmental Organisation*

**The Bay of Bengal is a semi-enclosed tropical ocean basin and forms the north-eastern part of the Indian Ocean. It is surrounded by India and Sri Lanka to the west, Bangladesh and the Indian State of West Bengal to the north, and Myanmar, the southern part of Thailand and the Andaman and Nicobar Islands of India to the east. The bay is a tropical ecosystem in a monsoon belt, highly influenced by monsoonal winds and receiving large volumes of fresh water from both river discharge and rainfall. It experiences south-west monsoon during June-September and north-east monsoon during November-February. This is a region which experiences regular depressions to super cyclone, making the coastal areas of the countries surrounding it highly vulnerable to risks and calamities.**

The bay also covers some of the most productive waters in the world, and supports a large population of small-scale fishermen: some 6-8 million directly and an additional 35-40 million engaged in ancillary activities related to fisheries. The contribution of coastal fisheries from the bay to nutrition and economic well being in the region is substantial. Marine fisheries are a lifeline in the coastal areas of the South Asian countries, such as Bangladesh, India, Maldives and Sri Lanka.

The Bay of Bengal is exploited by 11 major countries: Myanmar, India, Malaysia, Thailand, Bangladesh, Indonesia, Sri Lanka, Japan (main islands), Taiwan, Korea (South) and Australia, as well as some smaller countries. During the period from 1950 to 2005, fish landing in this region increased from 0.91 million tonnes in 1950 to 5.16 million tonnes in 2005, recording a cumulative annual growth rate of 3.18 per cent. In recent years, capture fisheries in the region have expe-

Image: Yugraj Yadava

Fishing boats (Orus) idling on a beach in a village in Negombo, Sri Lanka


Image: Yugraj Yadava

An FRP traditional boat (Oru), Negombo, Sri Lanka

Image: Yugraj Yadava

A wooden boat returning from a fishing trip, Teknaf, Bangladesh

rienced a slowing growth rate, leading to fishers moving offshore in search of catch.

Increasing human population and reduced productivity of coastal fisheries through unsustainable fishing practices, habitat degradation, post-harvest losses, etc. threaten the livelihood of millions of small-scale fishers in the Bay. Given that coastal resources, particularly near-shore resources, are exploited close to, if not beyond sustainable levels, improving the management of fisheries and the safety and health of fishers is of immediate concern.

**Safety at sea of small-scale fishers**

Fishing has been recognized as the most dangerous occupation with more than 24,000 deaths per year. These figures originate from those countries where a sound database exists on fishing related fatalities and accidents. If figures were included from those countries where no surveillance and monitoring, or an inadequate mechanism for this, is in place, the annual figures of deaths at sea would be much higher. The large number of fishing-related mortalities, especially in the developing countries, is attributed to weaknesses in the institutional and regulatory environment, a declining resource base and the poor socioeconomic condition of the fishers.

A Regional Workshop on 'Sea Safety for Artisanal and Small-scale Fishermen' was organized by the former Bay of Bengal Programme[1] of the Food and Agriculture Organization (FAO) of the United Nations in Chennai, India from 8-12 October 2001. This workshop discussed various issues impacting the safety of small-scale fishers at sea. The most significant output of this regional initiative was the 'Chennai Declaration on Sea safety', which resolved to effectively meet the challenges through holistic fisheries management, adherence to mandatory requirements, installation of regulatory mechanisms, community involvement and education and training. The full text of the Chennai Declaration is included in this article.

The Chennai Declaration recommended that the issues of sea safety be addressed on an urgent basis. Keeping this in mind, several initiatives have been made in the BOBP-IGO member-countries in South Asia (Bangladesh, India, Maldives, Sri Lanka). Based on critical analyses of the factors that affect the safety of small-scale fishers, it can be summarized that the most important factors contributing to increased accidents and fatalities at sea are: open access to fisheries and excessive fishing effort; increased competition among different categories of fishers; reduced profitability;


Image: Yugraj Yadava

A multi-day fishing boat (gill-netter), Beruwala, Sri Lanka

economies in fishing vessel maintenance equipment and manpower; fatigue, recklessness; fisheries management measures that do not take sufficient account of the human element or take fishers' safety into consideration, and diversified fishing operations unaccompanied by training, traditional experience and skills. A summary of factors affecting sea safety of small-scale fishers in the BOBP-IGO countries is given in a separate table.

Image: Yugraj Yadava

Wooden trawlers back from a fishing trip, Roypuram Fishing Harbour, Chennai, India

**The global initiative on safety at sea**

Building on the Chennai Declaration and the Third International Conference on Fishing Industry Safety and Health (IFISH-3) held at Chennai from 1-4 February 2006, the FAO has designed a global Safety at Sea Programme, aimed at improving the livelihood of small-scale fishing communities by decreasing the number of accidents at sea and the effects of such accidents. The programme is funded by the Swedish International Development Agency (Sida) and addresses the issues of safety at sea for small-scale fishers in two sub-regions: West Africa and South Asia. The programme commenced in May 2007 and is expected to be completed by December 2008. In South Asia, the programme is being implemented by the BOBP-IGO in close coordination with FAO and other concerned agencies.

The intended outputs of the Project in South Asia are:

- An enhanced awareness of sea safety within the fishing community operating in the small-scale sector
- An improved system of reporting and analysis of incidents at sea causing loss of life or serious accidents to fishers and fishing craft

**Summary of factors affecting sea safety for artisanal and small-scale fishermen in the BOBP-IGO countries**

| Bangladesh | India | Maldives | Sri Lanka |
|---|---|---|---|
| • Open access management regime leading to overexploitation reducing overall profitability of operations, affects investment in safety related equipment or safety orientation activities<br>• Need to coordinate and harmonize the regulatory environment<br>• Need to upgrade mechanical installations to replace the use of tube well engines<br>• Upgrading of communication equipment on artisanal vessels<br>• Risks associated with the economic structure of the industry<br>• General need to upgrade fishermen safety training and awareness<br>• Issues of concern:<br>  • Weak enforcement of all safety and operator competency standards<br>  • Fishing gear conflicts<br>  • Cyclone related risks<br>  • Piracy<br>  • No reporting mechanism exists. | • A need to harmonize resource management framework between the respective states with a view to reducing conflicts amongst adjacent resource users<br>• A need to develop and strengthen the enforcement of the requirement to carry a minimum level of safety related equipment on all vessels<br>• Development of low cost safety equipment for use on small scale vessels<br>• Need to promote the expanded use of communication equipment at sea, together with training in its proper use<br>• Increased dialogue between Sri Lanka and India, with a view to reducing unacceptable levels of risk and detainment of fishers<br>• Continuing assessment of resource management instruments to determine their impact on the socio-economic structure of coastal communities and associated levels of safety<br>• Potential for the development of informal community based search and rescue activities in an auxiliary coastguard model<br>• Attention to development and enforcement of safety related competency standards<br>• Attention to communication and community participation in disaster prevention<br>• Data collection mechanism established but needs streamlining to make it effective. | • Few inherent risks in the artisanal sector<br>• Fishing environment not particularly hostile and good forecasting systems prevail<br>• Traditional boat building evolved to suit the sea conditions<br>• Appropriate standards for safety equipment introduced recently<br>• High percentages of boats carry either VHF or radios and GPS<br>• Administrative structures for regulation and enforcement in place. All agencies well familiar with sea safety issues but are under-resourced<br>• Coordinated efforts to expand fisheries training and increase safety awareness<br>• Few fatalities in the fisheries sector. Reporting fairly well-developed<br>• Issues of concern:<br>  • New fleet growing rapidly with no regulations for design approval, construction and outfit standards, or operator certification standards<br>  • Unregulated use of propane to fuel fishing lights<br>  • Use and onboard fuelling of small gasoline engines to drive spray pumps<br>  • Improper use of SCUBA gear. | • Pro-active policy environment, supported by widely experienced professional and technical capability<br>• Sea safety is recognized as a serious policy issue<br>• Community based resource management models are being piloted and evaluated<br>• Monitoring in regulation of fishing effort and activity appears to be weak<br>• No standards for fishing vessel operator training or competency certification<br>• SAR capability most effective at the community level<br>• Environmental forecasting capability sound and effectively distributed. Risks and improper use of fishing vessels associated with the civil conflict in the northern and eastern part of the country<br>• Increased conflicts between traditional and introduced vessels<br>• Issues of concern:<br>  • Need to develop design/safety standards for multiday vessels<br>  • Need to improve the engineering and navigational skills of the operators of the multiday boats<br>  • Need to improve the level of communication equipment, operator training, operator radio discipline, and assignment of an emergency radio channel for fishermen<br>  • Need to channel safety training and awareness through community organizations<br>  • Need to address issues of surveillance mechanism on fatalities/accidents at sea. |

Source: BOBP, 2001: Sea Safety of Artisanal and Small-scale Fisheries (Unpublished report submitted by FAO/BOBP Consultant, Mr Roger James Pearson)

- Rules and regulations for design, construction and equipment of fishing vessels in the small-scale fisheries sector adapted and amended from the FAO/IMO/ILO draft voluntary guidelines, presented in a form that is easily understood by the small-scale boat building industry
- Integration of Safety at Sea as an important element of fishery management.

Besides the above, the programme is also addressing the issues of design, construction and equipment of small fishing vessels, which will be suitably adapted to enable fishing vessels to meet safety standards. The reporting and analysis of accidents at sea, assistance in the planning of distress response and vessel/shore communication systems, and the initiation of a dialogue with member governments to integrate sea safety measures are also part of a holistic fishery management programme that is being addressed to build the capacities and resilience of small-scale fishers in the region.

The fisheries sector has substantial social and economic importance in the South Asian countries. Improving the safety and health of fishers can better their quality of life and also contribute to the well being of the family and future generations. The Chennai Declaration recognized that the problem of safety at sea is not insurmountable, and it now appears that governments and other stakeholders are more appreciative of the sea safety requirements of the fishers, and are gradually moving toward an improved and holistic regime of fisheries management, which also takes into account the safety needs of small-scale fishers.

**The Chennai Declaration on Sea Safety for Artisanal and Small-Scale Fishermen**

*Conscious* that fishing is the world's most dangerous occupation with more than 24,000 deaths per year attributable to weaknesses in the institutional and regulatory environment, a declining resource base, and poor socioeconomic conditions in the sector;

*Realizing* that sea safety regimes are weakest amongst the artisanal and small-scale fisheries sectors, particularly in developing countries;

*Realizing* that more than 80 per cent of the world's artisanal and small-scale fishers are concentrated in Asia, where many of the coastal target stocks are over or fully exploited;

*Recognizing* that the consequences of loss of life fall most heavily on the surviving families, for whom alternative sources of livelihood may not exist;

*Concerned* about the inadequacy of social and political will to address the issue of fatalities amongst artisanal and small-scale fishermen;

*Accepting* that the issue of safety for the artisanal and small-scale fisheries sectors is not fully recognized, or acknowledged, by fisheries policy objectives and further, that the focus is more on economic and resource management issues than the safety of artisanal and small-scale fishermen;

*Concerned* that current fisheries management regimes for coastal fisheries in the region may lead to increased levels of operational risk for artisanal and small-scale fishermen;

*Concerned* that safety measures, together with supporting regulations and standards relevant to the needs of artisanal and small-scale fisheries sectors, remain inadequately addressed by fisheries and maritime administrations in the region;

*Recognizing* that neither are the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, as amended by the 1993 Protocol, and the 1995 Convention for the Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel in force, nor are they applicable to fishing vessels under 24 metres in length;

*Recognizing* the limitations in institutional capacity of fisheries and maritime administrations in the region to undertake all responsibilities associated with their mandate;

*Realizing* that fishing operations are carried out in a hostile and hazardous environment from vessels often having weaknesses in their design, construction and equipment, thus being prone to failure;

*Accepting* that fishermen in both traditional and diversified fisheries are exposed to inherently high levels of risk and resulting accidents, for which there are few survival or rescue strategies;

*Emphasizing* the urgent need to address the multi-dimensional issue of sea safety for artisanal and small-scale fishermen on a regional basis and in a holistic manner and recognizing that the problem is not insurmountable;

Image: BOBP

**We, the representatives of Fisheries and Maritime Administrations, Coast Guard/Navy and Fishermen's Associations, nominated by the Governments of Bangladesh, India, Indonesia, Malaysia, the Maldives, Sri Lanka and Thailand, having participated in the BOBP/FAO Regional Workshop on Sea Safety for Artisanal and Small-scale Fishermen held in Chennai, India from 8th to 12th October 2001, now therefore:**

*Resolve* to address, as a matter of urgency, the issue of safety at sea for artisanal and small-scale fishermen;

*Recommend* that sea safety issues be comprehensively integrated into member country's fisheries policy and management frameworks. This would include associated commitments under the Code of Conduct for Responsible Fisheries and other regional, inter-regional or global instruments and initiatives;

*Recommend* measures, which would result in a harmonized and holistic fisheries management framework for the Bay of Bengal;

*Emphasize* the need to rationalize institutional mandates, legislation, regulation and enforcement at the national level, in order to enhance sea safety in artisanal and small-scale fisheries;

*Ensure* the incorporation of FAO/IMO/ILO Voluntary Guidelines for the Design, Construction and Equipment of Small Fishing Vessels and the FAO/IMO/ILO Document for Guidance on the Training and Certification of Fishing Vessel Personnel into regulatory frameworks, as appropriate;

*Recommend* that fisheries and maritime administrations enhance their knowledge of the operations and constraints of the artisanal and small-scale fisheries sectors in order to formulate effective guidelines, standards and regulations for the safety of fishing vessels, including the certification and training of crews;

*Recommend* the development and implementation of education, training and awareness programmes which satisfy regulatory requirements, while also building a culture of sea safety within artisanal and small-scale fishing communities;

*Recommend* that mandatory requirements for improving sea safety be supplemented by other strategies which involve the participation of the fisher communities, families, the media, and other stakeholders in order to promote the adoption of a wide range of safety measures;

*Recommend* that member countries undertake measures directed towards ensuring enhanced economic viability of artisanal and small-scale fishing enterprises as an essential element of the sea safety issue;

*Recommend* that administrations consider the provision of financial and other incentives to encourage and ensure the widespread use of safety equipment, together with training in the use of such equipment;

*Recommend* that a programme of applied research and development be initiated, focusing on the development of cost effective safety related equipment relevant to the needs of the artisanal and small-scale fisheries sectors;

*Strongly* recommend the formulation and implementation of a regional sea safety programme, employing a consultative and participatory approach, building upon institutionally derived data, together with the operational experience of artisanal and small-scale fisher communities;

*Recommend* that the issue of sea safety be addressed on an urgent basis. This could be achieved through a regional mechanism such as the Inter Governmental Organization proposed by the BOBP member-countries during the 24th meeting of the BOBP Advisory Committee at Phuket, Thailand. (The Phuket Resolution - October 1999);

*Agree* to seek the support of the donor community for the development of a sea safety programme, and also request FAO to seek such assistance on our behalf.

*Adapted on 12 October 2001*
*in Chennai, India*

# Working with communities to Get Ready and Get Thru

*John Hamilton, Director, Ministry of Civil Defence & Emergency Management, New Zealand*

**New Zealand is an island nation in the southwest Pacific with a reputation for beauty that has long impressed visitors to this country — volcanic peaks and snow-tipped mountain ranges, rolling bush-clad hills, river plains, sandy bays and long surf beaches. However, this stunning landscape is as rugged and dangerous as it is beautiful.**

The monumental forces that created it are an ever-present reminder to New Zealanders of the capability of nature. The constant movement of the Australian and Pacific tectonic plates, responsible for the elevation of mountain ranges, causes earthquakes and potential tsunamis. New Zealand's high density of active volcanoes also poses the threat of volcanic eruptions and lahars. Additionally, as New Zealand lies in the 'roaring forties' (temperate latitudes between 40 degrees South and 50 degrees South), the country is prone to severe storms and flooding.

**New Zealand hazardscape**

Flooding is the most common natural hazard in New Zealand, although earthquakes, tsunamis and volcanic eruptions are potentially the most damaging and disruptive. Accidental release of a hazardous substance, introduced organisms and diseases may also affect New Zealand's environment, health and economy; and terrorism could become a threat to public safety and national security.

New Zealand has a population of 4.23 million with almost 86 per cent of the population living in urban areas. Technological hazards and increasing reliance on key infrastructure all compound New Zealand's exposure and vulnerability to damage, death and injury, and social and economic disruption.

New Zealanders have been at risk from a broad range of hazards in the past. The 1854 measles and 1918


Image: David Plews, Whakatane

New Zealand records thousands of earthquakes each year with about 150 that are strong enough to be felt. The key message to the public is that 'it could happen at any time and without warning'. Photo shows the 1987 Edgecumbe earthquake where 5,000 people had to be evacuated

influenza epidemics collectively accounted for more than 12,600 deaths. The 1886 Mount Tarawera eruption and the 1931 Hawke's Bay earthquake were the most significant natural events of this period, with 153 and 256 deaths respectively.

Since the mid-1900s relatively few people have died from natural hazards, with most hazard deaths attributed to transport accidents — the 1953 Tangiwai train derailment with 151 deaths, the sinking of the Wahine in 1968 with 51 deaths, and the Mount Erebus crash in Antarctica in 1979 with 257 deaths.

In more recent years there have been a number of flood, earthquake, volcanic, and severe weather events in New Zealand, which have caused evacuations of people, disruption to services and damage to property, but few deaths.

Recent international events, particularly the 2004 Boxing Day tsunami, have had a significant impact in heightening awareness of the likelihood and impact of disasters.

The National Civil Defence Emergency Management (CDEM) strategy for New Zealand identifies four main goals:

- Increase community awareness, understanding, and participation in civil defence emergency management
- Reduce the risks from hazards to New Zealand
- Enhance New Zealand's capability to manage emergencies
- Enhance New Zealand's capability to recover from disasters.

The fundamental principle underlying the strategy is that while disasters cannot be prevented, it is important that those who live in New Zealand understand the causes and risks, and know the steps to take to ensure they remain safe. Worldwide experience has shown that where people are aware of the risks around them and plan their response, injuries, damage and subsequent trauma are significantly reduced.

Since its establishment in 1999, the fundamental driver of the New Zealand Ministry of Civil Defence & Emergency Management has been to work with its stakeholders to increase the capability of communities and individuals to prepare for, respond to and recover from disasters. It does this by working closely with the CDEM Groups (a consortia of local and regional authorities), central government, emergency services and lifeline utilities involved in civil defence emergency management.

The ministry's objective is to make New Zealand and its communities resilient by understanding and managing their hazards. The overarching strategy for achieving resilience is through a risk management approach based on the '4 Rs' — Reduction, Readiness, Response and Recovery.

This approach starts with recognizing the hazards we face and the vulnerability of our communities and infrastructure to those hazards. By addressing what these hazards could do to us, the focus is on measures for reducing the risks and for managing the impacts when they occur.

**Get Ready Get Thru**

In 2006 the ministry launched its 'Get Ready Get Thru' programme, a long-term national public education programme aimed at increasing individual and community preparedness for disasters.

Image: Northland Regional Council

New Zealand's 18,000km of coastline is constantly changing, shaped by frequent high swells and occasional storm surges.
Photo taken during the 2007 coastal storm in Northland at the top of the North Island

Spectacular image of the 1995 Mt Ruapehu eruption. The same volcano created a stir in April 2007 when the collapse of the crater-lake caused a lahar

Quantitative and qualitative research undertaken prior to the programme launch indicates that despite an apparent high level of awareness of the nature of disasters that may affect New Zealanders, many individuals and communities are not as prepared as they need to be to deal with, and recover from these disasters when they happen.

The challenge for the ministry and the various agencies involved in CDEM is to shift New Zealanders from apathetic awareness to total preparedness, resilience, self-responsibility and community responsibility. Achievement is not defined by complete and permanent success, but by significant progress towards moving people along the continuum of being aware of our hazards and taking action to be prepared.

The key strategy behind the national public education programme is to empower individuals and communities by providing clear information on what they need to do to look after themselves and their loved ones in the event of a disaster. The consistent key underlying message is this: 'The CDEM agencies and emergency services will be doing their job to respond and support people in a disaster, but help can't get to everyone as quickly as they may need it. It is your responsibility to look after your loved ones, and to plan to cope for at least three days until help can get to you'.

The television, print and radio campaign sets out to illustrate how having an emergency survival plan and the necessary emergency items helps people get through a disaster. Qualitative research undertaken in the development stages gave us a better understanding of the barriers to action, and identified what the motivators were to get people to take action. We also needed to address misconceptions about how quickly help could get to everyone in need and that individuals had a personal responsibility to take action to be prepared. The key insight from the research was that we needed to make the message personally relevant and build understanding and awareness through the positive outcome of a disaster: 'My loved ones survived and are safe because we took some simple steps to get ready'.

Since the launch of the campaign, annual benchmark research has been undertaken to monitor its effectiveness and identify issues that need to be addressed in the ongoing development of the programme. Early indicators are that the key messages are getting through with heightened levels of awareness of the need to take action to be prepared. The ministry also works collaboratively with the CDEM Groups around the country to reinforce the national public education programme, and support regional activities aimed at raising awareness and preparedness at a community level.

While we still have a long way to go to ensure everyone takes action to be prepared, we are hugely encouraged by the impact that the programme is having, and have made an ongoing commitment to work with

Image: Lloyd Homer GNS

the CDEM sector to keep building on the momentum that has been achieved.

**What's the Plan Stan?**

In addition to the mass media Get Ready Get Thru campaign, the ministry has invested in the development of a schools' programme aimed at building a solid foundation of awareness and preparedness.

The *What's the Plan Stan?* schools' resource addresses the need for a resource for teachers and students to learn about our hazards and what to do. This programme allows us to build that foundation of knowledge effectively, and have a generation of kids coming through the system that are aware and better prepared. The strategy also allows us to get the message into homes through kids at school.

From the outset, the project involved both teachers and civil defence staff around the country in planning and development. We worked closely with them to identify their needs and develop a resource that was targeted specifically for teachers and kids.

*What's the Plan Stan?* features Stan the dog and five children who model what to do before, during and after six types of emergency events: earthquakes, tsunamis, volcanoes, storms, floods and non-natural disasters. It can be used to incorporate civil defence emergency contexts and activity-based learning across all areas of the New Zealand national curriculum for students aged 8-12 years. The resource consists of several different components, each of which can be used independently or in conjunction with each other:


Image: MCDEM

The user-friendly resource aims to help kids learn about hazards and what to do to be better prepared for disasters

- A teacher's handbook containing unit plans, activities, simulations and information for school emergency planning
- A CD-ROM for teachers and students, including stories, interactive games, maps of regional disasters, research material, tips for teachers, and electronic versions of the handbook resources
- A storybook and accompanying audio CD that can be used for younger audiences
- A poster promoting *What's the Plan Stan?*
- A website with information, interactive activities and templates.[1]

The resource allows for self-paced learning where students can work through the material as a group or individually. It is enquiry based, encouraging students to ask questions and find the answers in an interesting and friendly manner; and it is also accessible to parents as a family learning activity.

The resource was sent free of charge to all primary and intermediate schools in 2006. To further encourage use of the resource, the ministry ran a series of workshops for teachers and principals around New Zealand to provide an opportunity for users to familiarize themselves with *What's the Plan Stan?*, identify ways it could be implemented into teaching programmes and meet local civil defence staff in their community who could assist with emergency preparedness.

Within a year of providing the resource to schools we surveyed teachers to get feedback and identify areas for improvement. The results were hugely encouraging, with 95 per cent saying they found the resource very useful or useful and 88 per cent saying they had either taught or were planning to teach a unit plan from the resource.

The resource is not static and will keep evolving. In its second year we upgraded the CD-ROM and added new material, based on feedback from the teachers' survey. The focus in 2008 is on developing a Te Reo version for schools that teach in the language of New Zealand's indigenous Maori people. Next year we will continue to upgrade the handbook and the CD-ROM in line with changes to the New Zealand schools curriculum.[2]

*For further information about the NZ programme contact chandrika.kumaran@dia.govt.nz*

# Building inherent resilience

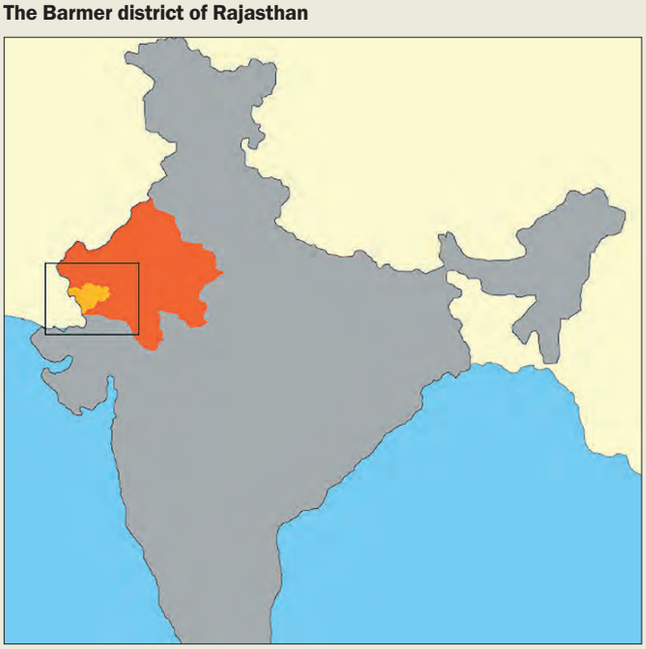
*Manu Gupta, Sustainable Environment and Ecological Development Society, India*

**The continued high loss of life due to disasters in areas where disaster reduction practices have been introduced questions the efficacy of current practice. The paradigm shift towards community-based disaster management (CBDM) practice, though rightly intentioned, has to be examined in the light of practical experiences. Without questioning its purpose, that is, to build community resilience, it is worth attempting to find an alternative approach to CBDM. At the core of the proposed alternative approach is the need to recognize and build on a community's own coping skills and practices that are rooted in traditional relationships with its immediate natural environment.**

CBDM is now an accepted and widely practiced strategy in disaster vulnerable regions. Essentially, it puts community at the forefront of local disaster management efforts. External agencies then become facilitators of the process. In developing countries such as in South Asia, where disasters are recurrent and heavy in impact, such strategies help communities prepare better to respond to disaster situations.

In recent decades there has been a marked increase in losses due to natural disasters. Changes in societal living patterns, technological advancement and increasing pressure on the natural environment have made human existence increasingly unsustainable, often leading to disasters. At the same time, there is an increasing amount of investment in disaster reduction interventions. Have these interventions really been effective? Have they really been successful in reducing the impact of disasters among vulnerable communities? Each large-scale disaster exposes the inadequacies of interventions so far, and at the same time questions their basic methodology and approach.

**The Barmer district of Rajasthan**



The Barmer district experienced unprecedented floods in 2006

Source: Safer World Communications

### Effectiveness of CBDM

When words are put into action, there is often a wide gap in the way CBDM is understood on the ground. An overview of CBDM strategies implemented around the world clearly suggests that while communities at risk are put at the centre, the solutions are often imposed from outside.

Moreover, as pointed out during a recent national meeting of community representatives on disaster risk reduction in India,[1] communities become vulnerable because:

- An overemphasis on technology masks social, political and economic issues that underline vulnerabilities
- Many development policies and programmes create or increase vulnerability
- Reconstruction and development policies sometimes increase vulnerability which leaves disaster struck communities worse off
- Community knowledge and solutions are getting lost due to non-recognition.

Every individual is endowed with an inherent capacity to overcome any extreme adversity in his life. The inherent capacity, if properly recognized, honed and sustained, can lead to fewer lives lost due to natural disasters.

Several methods used in CBDM — that is, Participatory Rapid Appraisal from group discussions, such as disaster mapping — are aimed at identifying root causes of vulnerability; but solutions do not always appreciate the existing coping practices of the communities. Traditional systems are often discarded, as they are considered 'obsolete' and therefore cannot be replicated in the contemporary context.

It is important to define here the scope of the community's own coping capacity. While most communities are

Image: SEEDS

Over 800,000 of Barmer's population were affected by the floods

able to absorb stresses at a smaller scale or in recurrent forms, they may not be in a position to absorb larger shocks. Here lies a paradox. While communities are able to deal with stresses, they cannot deal with sudden large shocks. At the same time, if they are not allowed to deal with small-scale or recurrent stresses, their vulnerability to large shocks increases. In spite of experiences proving so, CBDM strategies continue to increase/make no difference to vulnerability rather than increase resilience.

The community's own capacity being central to building resilience, the critical challenges are:

- How to recognize and build upon traditional knowledge?
- How can communities overcome their helplessness to face sudden catastrophic disasters?
- How can communities build resilience incorporating the needs of both present and future generations?
- What is the role of external agencies in helping communities become resilient?

An analysis of ongoing approaches for disaster reduction either as part of development programming or as disaster response, presents the following conclusions:

- The key to successful CBDM is strengthening resilience by way of recognizing and strengthening communities' traditional coping mechanisms, rooted in their culture and environments
- The role of external agencies is to create enabling environments that strengthen communities' understanding and application of their natural environments and find technological solutions that help remove impedance to understanding and application.

**Recognizing communities' traditional coping capacities**

The most recent experience for the author was a post-flood shelter recovery programme in Rajasthan State, located in western India. The community in the Barmer District of Rajasthan experienced unprecedented floods in 2006. These people reside in an arid area of the continent. Almost entirely a desert district, Barmer is one of the sparsest regions of the country with regard to density of population. It has only 853 inhabited villages with barely 70 people spread over every square kilometre.[2] People in Barmer face sweltering heat of up to 45 degrees centigrade in the height of summer, dropping to a minimum of nine degrees centigrade in the chill of winter. The 2006 floods in the region were an unprecedented phenomenon, putting the community's own knowledge and traditional practices to the test. In one day alone, the district received 577mm of rainfall, 300mm more than the annual average rainfall of 277mm.

*Shocks and stresses in Barmer* — The region is marked by dire poverty. Arid land with extremes of temperature does not provide the right ingredients for a good agricultural yield.

Under the unfriendly and unfavourable conditions, life is a struggle. Though the land is unyielding, agriculture is the mainstay of the district and the state. Close to 80 per cent of the workforce depends on the land for income and livelihood. Following close on the heels of agriculture is animal husbandry. Incomes from livestock account for up to 50 per cent of a rural household's revenue. In the aftermath of the 2006 floods, it would seem that the people lost more than they possessed.

Over 800,000 of Barmer's population of two million were affected by the floods with hundreds of people still missing. It was officially reported that 103 people died, while 95 per cent of the villagers were made homeless and had to move to higher ground with no clothes, food, utensils or bedding. Forty seven thousand cattle died in the floods and 5,200 houses were damaged. Houses in the affected villages of Barmer district were primarily made of a mixture of soil, cow dung and some wooden constituents that are locally available in the area. These are circular structures called 'Dhanis'. The damage in these villages was widespread as most of the houses made up of such material were washed away.

In Bandhada village, the local people had not experienced such rain in their lifetime. There were 85 such damaged houses in Bandhada village, which has a population of about 1,200. Apart from 'kuccha' houses, the school building was also damaged due to incessant rain. Even 15 days after the flood, the water did not recede in some areas, as the soil strata are made up of gypsum and bentonite. Thus, seepage of water was much reduced. Furthermore, as there are no natural drainage channels like rivers or 'Nala' in this area, water was present in many places. Evaporation is the only natural way by which this level of water can be reduced.

*Shelter recovery programme* — The shelter recovery programme was taken up by the Sustainable Environment and Ecological Development Society (SEEDS) India with support from Christian Aid, a UK-based charity, and the European Commission's Humanitarian Office. As part of the programme, 300 houses were reconstructed within eight months of the disaster.

Three hundred beneficiaries were chosen from over 400 potential recipients across a group of 24 villages, which was then downsized to 15 villages. The main targets were families that were socially marginalized and ostracized, persons who were physically handicapped and/or remotely located. Community participation was at the core of the shelter recovery programme. Villages

Image: SEEDS

The traditional Dhanis of Barmer district were primarily made of a mixture of soil, cow dung and locally available wooden constituents

included in the mission were assisted in forming Village Development Committees (VDCs), which were the link between the implementing agency and the beneficiaries. Recipients of shelter were identified through consensus in committee meetings that were attended by all residents of a village.

The houses were specially modelled to comply with the socio-cultural and environmental peculiarities of the district and the villages involved. The houses are built in a circular fashion on a foundation of 3.5 feet, and made of earthen blocks. The model was on the same lines as traditional Dhanis. The circular model is well adapted to the weather. The shape of the structure keeps the high-speed sandy winds from thrusting against the house, which could be a concern in a model that consists of corners and points of obstruction for the sweep of wind. Strengthening the structure further is the use of earthen blocks as opposed to the normal practice of bricks and cement. These earthquake-resistant interlocking blocks are made of the regular dose of cement, sand and an added ingredient of sand-loam soil, which is sticky in texture and has a cooling effect.

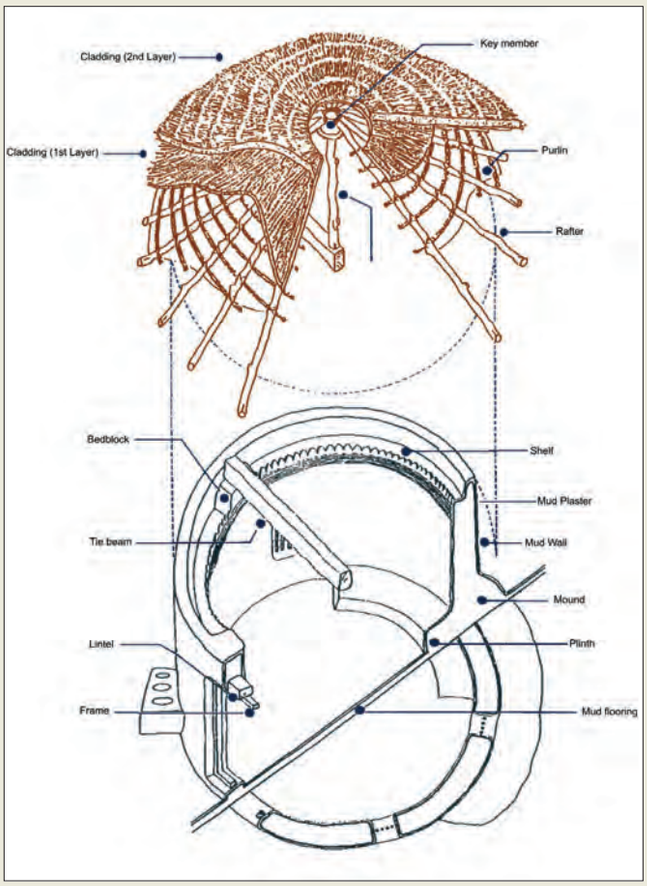
Completing the construction of the house was left to the beneficiaries and their families. This involved roofing the house, which only required the families' effort, time and a little money. The money is needed to pay the carpenter who does the woodwork, which forms the base to lay the three layers of the roof. Material for the roofing is easily available locally, and is known as 'Shaniya' or 'Kheep'. The final step is the roping of the roof once all the layers are in place. Ropes are made by the villagers themselves using straw. The conically shaped roof converges at the top to form a thick stump (known as 'Chotti') bound tightly with ropes, which diverts rainwater from seeping into the house.

Traditionally, communities in desert areas have evolved rounded housing units. To a contemporary architect, this may not be the best example of the internal organization of space. However, the design works wonderfully well from several environmental perspectives. The rounded design of housing units in Kutch (Bhungas) evolved because communities found this to be a perfect example of seismically sound design. In the Thar desert areas of Barmer district in Rajasthan, rounded units facilitated wind movement, thus preventing severe desert storms from hitting barriers and dropping dust.

Current practices are promoting regular stone masonry with galvanized iron roofs. Rather than adapting traditional means to modern needs, these practices set new paradigms, the impacts of which are not known. These practices may provide improved utilization of internal space. However, they cause increased insolation within houses, do not facilitate wind movements and as a result add up to increased environmental stress for communities. Over a period of time, such communities become more vulnerable.

Sudden shocks such as the August 2006 floods cause havoc. At the first level, traditional practices collapse; at the second level the new paradigms that are in vogue and have perpetrated vulnerability increase the intensity of damage.

**The design of an emergency shelter**




Source: Safer World Communications

Image: SEEDS

New houses were built on a similar model to traditional Dhanis, and made of earthen blocks

## Lessons learned

Following the floods of 2006, SEEDS intervened by restoring the shelters of the affected community. The challenge was deciding whether to go for an adaptation of their traditional shelter practices (which has limitations), or to apply contemporary approaches (which provided many external benefits, but allowed stresses to build up). SEEDS chose the former and the results have been very well received.

The results have revealed that:

- Communities have inherent resilience developed through adaptation to natural environments
- This resilience is put to the test in their day-to-day activities, and practices that promote resilience are often understood in their cultural and spiritual context
- The capacity of communities to absorb sudden catastrophic disasters is dependent on the level of their resilience to small-scale, recurrent disasters
- Failure of communities to correctly understand and respond to gradual stress build-up in their natural environments increases their vulnerability
- External post-disaster interventions that fail to recognize and strengthen the propensity to absorb small-scale disasters create new levels of vulnerability
- Post-disaster external interventions that seek to strengthen existing coping practices promote resilience
- Current interventions and related research activities to find ways to promote resilience by examining communities' coping practices are inadequate
- Coping practices do not become integrated by external intervention. Rather, problems are imposed on communities from outside
- A form of education is needed that restores communities' traditional bonds with their natural environments. This would imply revisiting traditional knowledge on coping practices and finding ways in which they can be applied in current scenarios
- The model of resilience in vulnerable communities needs to put education and awareness of community knowledge and practice ahead of any other.

## Allow small shocks, prevent stress build-up, build resilience

The emerging model approach may be summarized as follows:

We should recognize communities' coping practices. In a sense, allow small shocks to take place that can help build their capacity.

New solutions should strengthen resilience, through research and development. These solutions, if aimed at long-term development, would prevent stress build up and allow communities to be able to rely on their locally available resources for lowering their risks.

We should promote education that allows communities to mirror their own past, their interconnectedness to all things living and not living, discovering their own infinite potential and thus enable them to practice measures, strengthened through external intervention, which will promote their own resilience.

The alternative approach to CBDM practice proposed herein needs further debate and testing. Its true value would lie in its efficacy in varying social and natural environments.

# New forms of private-public risk transfer: making societies more resilient

*Reto Schnarwiler, Head, Business Development Governments, Swiss Re*

**The rising impact of natural catastrophes is driving up the cost of disaster relief and reconstruction for the public sector. New forms of private-public partnership can make societies more resilient by absorbing the financial impact of large catastrophes. Such partnerships allow governments, semi-governmental agencies, aid organizations and non-governmental organizations (NGOs) to manage disaster expenses more efficiently by funding them before — instead of after — a catastrophe occurs. One recent example of this approach is the GlobeCat securitization structured by Swiss Re.**

### GlobeCat: a new transaction model

In December 2007, Swiss Re used new financial instruments to transfer Central American earthquake risks to the capital markets, using a very innovative trigger mechanism. The GlobeCat securitization provides a payout based on the size of population exposed to a specified earthquake. The transaction provides a new model for governments and relief organizations to access pre-event financing, in order to fund the growing impact of natural disasters in developing countries.

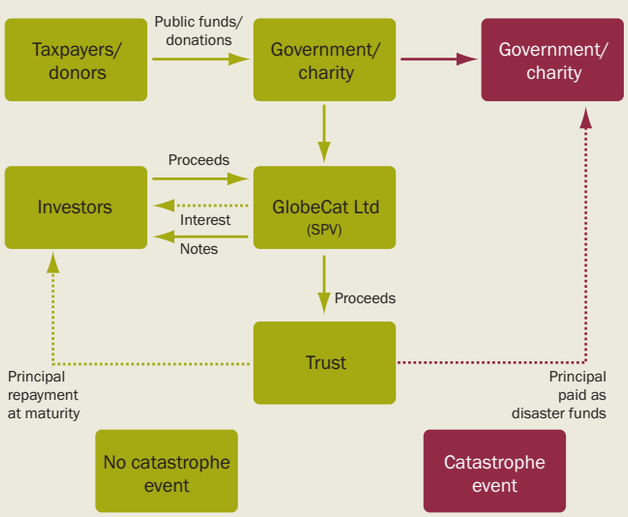
The GlobeCat transaction is an example of how governments and NGOs can efficiently secure funding through capital market securitizations. It uses an innovative trigger to determine coverage based on an index of the population exposed to specified levels of ground-shaking intensity, as measured by the Modified Mercalli Intensity scale.

Parametric triggers based on independent factors such as affected population, crop levels, wind speeds or earthquake intensity are ideal for public sector entities, which typically carry broad relief and infrastructure rebuilding expenses that are not linked to a particular damaged property. As they avoid the need for damage assessment, such triggers allow for the swift payment of funds. Due to their independent — and typically scientific — nature, they are also preferred by investors.

The goal of the GlobeCat transaction is to create a platform and model by which charitable foundations, governmental relief organizations and corporations can leverage donations, government funds or international aid in order to reduce the burden of future natural disasters. Such a programme will help public sector organizations become more proactive in planning and anticipating relief needs in areas of the world affected by severe catastrophes. If a triggering event happens, the funds will be quickly available for relief efforts rather than being raised after the event.

GlobeCat has shown that this concept is viable, and that the leverage of own funds to coverage can be as high as 45 times. For example, USD1 million of donations or government funds can be used to secure contingent disaster relief funds of USD45 million. Structures such as GlobeCat provide swift access to relief funding, and offer a means to increase contingent funding for catastrophic events by using public funds and donations to purchase coverage on the capital markets.

**How the GlobeCat platform works**




Source: Swiss Re

### Natural catastrophes: a rising burden for society

The impact of natural catastrophes on societies and economies has increased considerably over the last two decades and is likely to grow further as a result of two complementary trends. Firstly, climate change is expected to increase the scale and frequency of major weather-related events. Secondly, the economic severity of natural catastrophes is growing due to a rise in both population and economic activity in areas with a high risk exposure. In addition, the nature of the risk is changing, for a variety of reasons. Buildings have become more expensive to build and repair, and higher interdependencies in the production process have

increased the likelihood of business interruptions following a flood or a storm.

In 2005, economic losses from natural catastrophes hit a record high, with direct financial losses of about USD230 billion. This represents 0.5 per cent of total worldwide gross domestic product (GDP).[1] Despite a record insurance payout of more than USD83 billion worldwide, uninsured direct losses of USD150 billion had to be carried by individuals, companies and — last but not least — the public sector.

In 2007, a total of 335 natural catastrophes led to overall economic losses of USD64 billion across the globe, of which USD40 billion were uninsured.[2] Europe was hit particularly hard, with winter storm Kyrill causing an insured loss of USD6.1 billion — making it the third most expensive winter storm on record — while the UK was hit twice by extreme rains and flooding resulting in a total insured loss of USD4.8 billion. In terms of fatalities, however, Asia suffered the greatest impact, with 4,140 persons dead or missing in Bangladesh following Cyclone Sidr in November. In the Korean peninsula, heavy rainfalls and resulting flooding left 610 dead or missing.

**Financial impact on governments**

Natural disasters have a significant financial impact on private individuals, business and insurers. However, events such as strong flooding, severe storms or heat waves also place a huge burden on the public sector, which not only shoulders the cost of relief efforts, but is also responsible for rebuilding public infrastructure. This is intensified by the fact that public entities consciously decide to retain risk by not insuring their infrastructure. Depending on the level of insurance penetration, governments may also be expected to support private rebuilding efforts. The overall impact on the public sector varies greatly. In smaller and developing countries with less financial resources, a catastrophic event can result in higher public deficits and debt.

The burden of natural catastrophes on the national economy varies greatly by region. Although developed countries typically account for the majority of economic losses, the burden in terms of GDP is dramatically higher in developing countries and emerging markets. For example, in Turkey an earthquake in 1999 caused an economic loss of 11 per cent of GDP, while a 1986 earthquake in El Salvador cost as much as 37 per cent of GDP. In Jamaica, the possible loss from a hurricane scenario with a return period of 250 years has been estimated to exceed 200 per cent of GDP.[3] In the absence of widespread insurance coverage, economic losses of this magnitude can only be addressed with significant public sector funding by governments or relief organizations.

**Shifting from post-event to pre-event financing**

Traditionally, the public sector has adopted a post-event approach to disaster funding. This includes increasing taxes, reallocating funds from other budget items, accessing domestic and international credit, and borrowing from multilateral finance institutions. Many developing countries also rely on assistance from international aid.

Pursuing a post-disaster financing strategy has several disadvantages. Diverting funds from key development projects to pay for emergency relief and recovery efforts entails significant opportunity costs. It may also be costly to raise new domestic debt in an expensive post-event capital market, which can significantly raise the cost of servicing the country's debt. Finally, raising taxes following a disaster may further weaken an already impaired economy and provide a disincentive to new private investments that are important for a speedy and sustainable recovery.

Clearly, there is significant value in shifting the traditional 'disaster relief' approach — raising scarce funds after the event hits — to an approach that accumulates funds and funding sources before a disaster occurs. The financial and insurance markets can play a key role in preparing for the impact of extreme natural events and can also help to spread risks. Pre-event risk financing instruments include setting up financial reserves, contingent debt agreements, insurance and alternative risk transfer solutions.

**A new generation of financial risk transfer solutions**

Risk avoidance and mitigation strategies must be the first priority in managing natural disasters, in order to reduce the extent of any loss and thus the required funding. However, no organization or country can fully insulate itself against extreme events. Transferring catastrophic risk has to be a key element in the financial strategy of every disaster-prone country or region in order to enable and sustain growth — just as corporations and individuals pass on peak risks to insurers in order to reduce financial volatility and avoid potential ruin from events that exceed their resources.

This is where the insurance industry can offer its expertise in developing innovative solutions. A new generation of sovereign insurance (or 'macro-insurance') instruments can make it easier for local and national governments to cope with disasters. In parallel, innovative 'micro-solutions' can protect previously uninsured individuals and small enterprises from the catastrophic financial consequences of weather-related risks. Such products can help governments and individuals in a number of ways, by:

- Ensuring that funds are in place for recovery and rebuilding efforts as well as to compensate victims of catastrophic events, particularly in developing countries or in rural areas of developed countries with no insurance access
- Protecting their budgets and reducing financial volatility, with potentially positive implications on debt levels, sovereign ratings and foreign exchange fluctuations
- Reducing income volatility for individuals in developing countries, thus providing greater financial security in the face of changing economic circumstances, reducing distress and conflict, and providing access to credit for farmers with little income diversification (by allowing them to borrow against insurance as collateral).

**Innovative solutions already in place**

One way of securing access to disaster funds is through reinsurance solutions and insurance-linked securities. In recent years, several innovative private sector schemes have provided models for both the public sector and NGOs:

- In May 2006, Swiss Re structured, placed and reinsured parametric earthquake coverage for FONDEN, the Mexican Government's natural catastrophe fund. The transaction combined securitization and reinsurance instruments
- In September 2007, Swiss Re launched the Climate Adaptation Development Programme, which

Image: Vivamos Mejor

As part of a 'Vivamos Mejor' project supported by Swiss Re, a community in the Atitlán region of Guatemala develops risk mitigation measures against natural catastrophes

provides financial protection against drought conditions for up to 400,000 people in Africa

- In Mexico, the state-owned reinsurance company Agroasemex insured small cattle ranchers against droughts and other climatic events that would reduce the animal feedstock on their pasture. Swiss Re supported the transaction as an international reinsurer
- In Canada, Swiss Re insured the state of Alberta against wildfire. The insurance scheme helps the Forest Protection Division of Alberta finance the cost of fighting wildfire and restoring damaged forest.

**Developing countries affected most**

The effective reduction and financing of catastrophic risks requires a combined response by both private and public sector players. As complexity and costs rise, single organizations can no longer meet the challenge alone. This is particularly true for developing countries, which, besides having fewer funds, also bear the brunt of global warming. Public-private partnerships can help governments absorb catastrophes — and thus also provide individuals and businesses with greater financial security.

As a first step, governments and the private sector must work together to raise awareness of risks and their possible solutions through risk transfer schemes. This is critical as many perils have rather low probabilities — i.e. long return periods — and are thus frequently ignored. Major earthquakes are an example. Risk awareness also includes showing possible solutions for risk prevention, as well as for risk transfer and financing.

**Partnership in risk transfer and financing**

For insurance to work effectively, governments must ensure a framework that allows market mechanisms to work unhindered. Government intervention in a functioning insurance market should be limited, since it can trigger unexpected side effects such as moral hazard and may lead to further interventions rather than addressing the root causes. For example, public and semi-private insurance schemes that keep rates artificially low may encourage homeowners to stay in highly exposed areas, thus further increasing the burden of natural disasters for society and the public sector.

The public sector plays a key role in setting a legal framework that enables risks to be transferred to insurers, reinsurers and the capital markets. In addition to passing the necessary legislation, it must provide insurers with efficient access to its markets.

In some situations, governments and international organizations can help to expand the availability of risk transfer solutions for individuals and corporations. For example, they can encourage or enforce the creation of 'risk communities' through compulsory insurance in order to establish a critical mass and make an event insurable.

Governments may also act as reinsurers in order to supplement private insurance schemes. For example, governments — and NGOs — can encourage the development of an insurance market by initially subsidising insurance premiums. However, the public sector should limit its involvement in order to avoid establishing false incentives. Instead, it should focus its intervention on expanding the availability of insurance schemes — with the ultimate aim of establishing an efficient private-sector market.

Public-private risk transfer partnerships clearly have an important role to play in managing the increasing level of disaster expenses. They enable the public sector to fund disaster relief before — instead of after — a catastrophe occurs. As a result, governments will be able to deliver immediate relief to the victims of climate catastrophes without creating a significant sudden burden for public finances.

# A model for learnership training programmes in disaster management at higher education level: a South African case study

*A.J. Jordaan, University of the Free State; D. Pillay, Council for Scientific and Industrial Research, and J. Madiba, Department of Science and Technology, South Africa*

**Disaster preparedness essentially refers to a set of measures that seeks to minimize the adverse effects of hazards that result in loss of life and property, and it can be argued that it is the responsibility of every individual as much as it is the responsibility of governments and government agencies.**

There has been a concerted effort to move from disaster management practice to disaster risk reduction. It is primarily for this reason that the key role players in this domain identified capacity building as one of the more important strategies to mitigate disasters. Enabler 2 of the South African disaster management framework specifically addresses disaster risk management priorities in education, training, public awareness and research. This enabler describes mechanisms for the development of education and training programmes for disaster risk management and associated professions, and the incorporation of relevant aspects of disaster risk management in primary and secondary school curricula.

An affected community will need all the strengths and resources available that can reduce the level of risk, or the effects of the disaster. Therefore a community will need skilled personnel with appropriate leadership and management attributes to ensure the safety and security of the people. Many organizations have taken the initiative to ensure that training and development interventions are given priority, and we see greater involvement and investment from government.


Image: DiMTEC

Mr J. Madiba from DST hands the first cheque of ZAR2.3 million to acting rector of UFS, Prof. Verschoor

**Funding model and key role players**

The University of the Free State (UFS), in partnership with the Department of Science and Technology (DST) and the Council for Scientific and Industrial Research (CSIR), has designed and successfully implemented a graduate learnership in disaster risk management. This learnership programme gives full-time as well as part-time Masters students the opportunity to combine theoretical work and practical experience as preparation for the workplace.

CSIR, whose role is manifold, serves as the implementing agency for the DST. However, the role of CSIR is complemented by other key players such as the University of the Free State, Department of Provincial and Local Government (DPLG), Department of Water Affairs and Forestry (DWAF) and others such as Municipalities and Metros. The efficient and effective execution of the programme depends a great deal on the support and co-operation of these institutions.

The bulk of the funding is provided by the DST and in 2007 DPLG and DWF also began contributing. As a result of the success of the programme, DST provided a further USD650,000 for the 2008 and 2009 academic intakes.

**Recruitment process**

A rigorous recruitment process is conducted to ensure that high calibre, committed students are enlisted for the training. As a result of advertisements in the national media more than 800 applications were received for the 2008 intake from which only ten students were selected. The CSIR put in place a very comprehensive induction programme which included appropriate training interventions such as technical and scientific report writing, presentation skills, creativity

courses etc. In addition to in-house guidance and support the CSIR works very closely with the UFS to ensure timely and efficient execution of the programme.

**Student placement**

One of the important requirements of the programme is to ensure that the students receive on-the-job training. Here, the DPLG, through its National Disaster Management Centre (NDMC), DWAF and the Tshwane Municipality excelled in taking the lead for accommodating students, who have settled well in the work environment. Students are placed on a rotational basis between the different departments so that they can be exposed to a diversity of experience. The host institutions also have the benefit of evaluating students for future permanent employment.

Students were involved in a very comprehensive and substantive learning programme at their host institutions. They were exposed to day-to-day disaster risk reduction as well as disaster response activities. This put an additional workload on their supervisors at the host institutions; something that was gladly accepted by these professionals since they recognized the benefit of supplementing theoretical training with practical experience.

**Programme management**

The day-to-day management of the programme is done by an appointed manager from the implementing agency who reports to a steering committee. The steering committee is responsible for strategic management and consists of representatives from the UFS, DST, CSIR, DWAF and the NDMC. The steering committee meets on a regular basis and has the following tasks:

- To oversee and guide the project
- To review progress on the project and ensure regular reporting to monitors appointed by DST to review progress
- To approve and certify correctly the Minutes of previous steering committee meetings
- To consider and confirm, where and when applicable, the inclusion of an additional steering committee member

Image: DiMTEC

The first graduates from the programme with the steering committee

- To make recommendations regarding the future of the project
- If necessary, appoint separate committees to the project on an 'ad hoc' basis
- To do whatever else may be necessary to give full and proper effect to and to achieve the objectives of the project.

**Distance learning and contact sessions**

Distance learning can be quite a challenge. However, the University has ensured a fair amount of contact between students and lecturers. Thus far there have been several contact sessions organized by the university which are complementary to the distance learning programme. Students have to attend three contact sessions per year; one each during January (five days), May (eight days) and October (three days). These sessions are well organized with substantive content and students derive a great deal of benefit from them. As part of the evaluation of students it is expected that they will produce two assignments per structured module and write a final examination for each module.

In addition to the structured modules, students have to write a dissertation worth 120 credits before qualifying for the Masters degree in Disaster Management. Students are expected to base their dissertations on basic research, which usually focuses on research problems identified during their practical exposure in one of the host departments. An additional benefit for the host departments is that these research results became available for their own use.

**Student performance**

One of the most important lessons learned from the learnership programme is the importance of proper candidate selection. A high drop-out rate was experienced during the 2007 intake, with only three out of the original 14 selected students graduating in time for the Masters degree. A further four students opted for the Higher University Diploma.[1] The 2008 intake performed much better as a result of more rigorous selection criteria.

Probably the best testimony for the success of the programme is that all students are appointed to jobs before final completion of their studies.

**Current status and future planning**

The CSIR ceased its role as implementing agent for the programme from 2009 but still functions in a consultative capacity. The continuation of the programme, however, was resolved by the DST with the provision of a further USD650,000 and the appointment of the UFS as the new implementing agent. A person with a Masters degree in water management has been appointed as project manager to continue with the management of the programme in line with the guidelines set by the CSIR as the first implementing agency. In addition to this the following tasks were added:

- Provide academic mentorship to students
- Ensure the involvement of the outstanding national government departments in the programme[2]

- Ensure continuation of the programme beyond 2009 by securing funding from government departments and other institutions
- Ensure internationalization of the programme in two ways: by securing the inclusion of international students; and securing opportunities for students to obtain international experience in other African and least developed countries with serious disaster risk reduction challenges.

**Lessons learned and recommendations**

The real impact of the success of the programme can only be measured once the students deliver results in the communities or institutions they serve. It is only when their input as professionals has contributed toward the objective of disaster risk reduction that we can praise ourselves. Not everything in the project is perfect yet and a number of lessons were learned during the first few years. Others can learn from the experience gained from this innovative programme. Amongst the most prominent lessons are the following:

Individual cooperation and sharing in a common vision amongst participating institutions is paramount for success.

Flexibility in organizational structures and planning contributed to successful implementation of the programme especially during the initial stages.

Personal and continuous communication, transparent and joint decision making and personal involvement by the steering committee members ensured clear guidelines for the implementing agent, as well as the University responsible for the academic education of learners.

Thorough selection of prospective students according to specific guidelines is necessary to ensure an acceptable pass rate. The course requires exceptional self discipline and a high level of comprehension for inter-disciplinary thinking. Students have the opportunity to specialize in the course but the inter-disciplinary challenge for disaster risk reduction requires students to think and argue outside their field of speciality. One of the shortcomings of the current set of selection criteria is that these characteristics are not evaluated properly.

Image: DiMTEC

Students in the flood-affected area with personnel from Oxfam in Mozambique

Host departments/institutions should dedicate a specific person to mentor students during their stay at that specific institution. This is probably the biggest challenge for the future. Not all departments/institutions have the luxury of a dedicated mentor to look after the students under their jurisdiction. Although the University takes responsibility for the academic mentoring of students, practical exposure remains the responsibility of the host department/institution. The danger here is that students might 'idle' during their stay at a specific institution and use their academic responsibilities as an excuse not to gain much needed practical experience. Clear communication between the host department/institution and the programme manager at the University is therefore essential to monitor students.

The programme manager is key to its success. The CSIR as implementing agency has also managed the programme successfully to date. The University has been appointed as implementing agency for the 2008 and 2009 intakes with the responsibility to manage the total programme. The tasks of the programme manager are now extended to include that of academic mentor.[3] This required the appointment of a suitable qualified person with at least a masters degree who is solely dedicated to the programme. This is implemented from 2008 and the success of this arrangement has not been evaluated yet.

Finally, practical exposure of students to activities in host departments/institutions in South Africa alone might not be sufficient to educate them to the realities of Africa and developing countries. Well-developed disaster management institutional arrangements and policies in South Africa give its students a false representation of Africa. This deficiency became evident during class discussions and interaction with international students from other African countries. Young South African students struggle to grasp the real meaning of vulnerability, resilience and disaster risks faced by the poor in most African countries. The students themselves expressed their desire to obtain some hands-on experience with experts working in other developing countries. A programme of this nature should provide students with the opportunity to work as volunteers with NGOs and other organizations in various African or least developed countries in order to really understand vulnerability.

The Learnership programme serves as an effective model to build much needed capacity by recruiting and developing graduate students in preparation for technical and managerial roles. The recent appointments of the Learnership graduates by several institutions with a focus on disaster risk reduction bears testimony to the success of this model. Given the dire need in this sector this is something that should be pursued aggressively by other study programmes.

# Supporting community resilience — the approach of the International Federation of Red Cross and Red Crescent Societies

*Mohammed Omer Mukhier and Kenneth Westgate, International Federation of Red Cross and Red Crescent Societies*

**To many people, the International Federation of Red Cross and Red Crescent Societies (International Federation) is viewed as an organization focused strictly on humanitarian action in times of conflict and natural disaster. Others may have a wider view, noting the National Red Cross and Red Crescent Societies' involvement in first aid training, the donation of blood, running ambulance services and other health and care activities.**

Few would identify the organization as being at the forefront of the drive for disaster risk reduction despite the publication, nearly 25 years ago, of the landmark Swedish Red Cross report *Prevention Better Than Cure*. Disaster risk reduction is not necessarily seen as something that the National Red Cross and Red Crescent Societies do. Part of the problem is in the language — 'disaster risk reduction' is a relatively new term that appeared to confuse even further the profusion of already established terminology. But essentially, disaster risk reduction is not something that the International Federation is seen to be involved with.

Closer examination, however, reveals that not only has the organization been involved in the implementation of disaster risk reduction for years, but also that it has the kind of internal structure and established base that makes it a perfect vehicle for activity with a community focus as well as a long-term timeline. National Red Cross and Red Crescent Societies work through a system of branches, often growing out of the communities that they represent. Thus they have virtually permanent community contact, are often in close touch with the needs and aspirations of their communities and are able to tackle some of the issues highlighted by progressive disaster risk. In addition, National Red Cross and Red Crescent Societies are permanent, national institutions and most of them have been established for many decades.

### International Federation policy and the decisions of the statutory meetings

The key to unlocking the International Federation's involvement in disaster risk reduction can be found in global policy statements and in the decisions of statutory meetings. The guiding policy document *The*

Image: © Shehab Uddin/Drik/British Red Cross

Community Disaster Preparedness Committee members and volunteers in a meeting with the Red Cross and Red Crescent along with European Community representative of Babugonj Red Crescent in Barguna, Bangladesh, 2 June 2007

Image: © Yoshi Shimizu/International Federation

Arsi, Ethiopia. Alem Bekele, an Ethiopian Red Cross Society volunteer, tends Eucalyptus trees that have been planted in seven hectares of field by the Ethiopian Red Cross Society as a part of an income generating programme.

Image: © Nepal Red Cross Society

Children at a tube well constructed by the Nepal Red Cross Society

*Federation of the Future* sets out the International Federation's Global Agenda. Among the four goals it identifies are Goal 1: 'Reduce the number of deaths, injuries and impact from disasters' and Goal 3: 'Increase local community, civil society and Red Cross Red Crescent capacity to address the most urgent situations of vulnerability'. The priorities identified to meet the goals include 'Scaling up our actions with vulnerable communities in health promotion, disease prevention and disaster risk reduction'.

At the 28th International Conference of the Red Cross and Red Crescent held in December 2003, the theme was 'Protecting Human Dignity'. Among the resolutions adopted by the conference was the 'Agenda for Humanitarian Action', one of the final goals of which acknowledged 'the importance of disaster risk reduction' and agreed to 'undertake measures to minimize the impact of disasters on vulnerable populations'. The last International Conference held in November 2007 reinforced this need, associating disaster risk reduction very closely with meeting the requirements of climate change adaptation.

The support for disaster risk reduction has been echoed through the goals of regional conferences, while more than 160 of the International Federation's 186 members have identified disaster risk reduction activities in their plans and budgets for 2008/9. In 2002, the International Federation even devoted one entire edition of its annual flagship publication *World Disasters Report* to disaster risk reduction, concluding that:

- Disaster mitigation and preparedness must form part of the wider context of disaster risk reduction — relevant to all those working in hazardous regions, whether in relief, development, business, civil society or government
- Long-term partnerships based on good governance across many sectors and disciplines provide the best basis for tackling the threats posed by disasters
- Setting targets for risk reduction could provide a way to focus political will and adequate resources on the problem.

**The proof of the pudding**

There is no better way of demonstrating the importance of these policy and strategy statements than to look at the work of the National Red Cross and Red Crescent Societies on the ground. It is highly likely that in the global family that makes up the membership of the International Federation, there is activity being undertaken that relates to all five priorities of the Hyogo Framework for Action. Many of the member societies function in countries that have established Millennium Development Goals and are implementing substantial poverty reduction strategies. Success in


Image: © Knud Falk/Danish Red Cross

Community-based disaster preparedness programme, 2005

achieving the goals of these development actions includes ensuring that they are not seriously affected by risk factors among which must be included the risk of disasters destroying or severely disrupting development gains. On the other hand, mistakes can be made in the name of development, leading to the creation of new risk factors that may not have been identified in the initial assessment and may not have been foreseen. In the face of the new risks of the 21st century, especially those posed by climate change, there is a new urgency for disaster risk identification and subsequent reduction.

Of all the actions contributing to disaster risk reduction objectives, perhaps it is in the area of disaster preparedness that the National Societies find their most comfortable niche. Preparedness is closely linked to effective response, but it is also a way of developing community capacities and laying the foundations for addressing disaster risk more comprehensively. In Bangladesh, the Red Crescent together with the Government and the International Federation established a cyclone preparedness programme after five cyclones devastated the country during the 1990s. Each preparedness shelter can house 1,500 people while warning systems established alongside the shelters can alert millions of people. In Nepal, community-based disaster preparedness focuses on raising awareness of preparedness measures against flooding. Women play an important role in this programme which is centred around people rather than technology and features a revolving fund overseen by community committees.

Red Cross Red Crescent disaster risk reduction can go much further than preparedness, however. In Vietnam the Red Cross Society has been centrally involved in a mangrove planting programme to protect the fragile coastline. In Ethiopia, the Red Cross Society has been involved in an innovative cash-for-work programme as a means to address food insecurity. The cash was paid for programmes of road construction or environmental protection and benefited 62,000 people and their families. In El Salvador, the Red Cross Society has been working to reduce vulnerabilities to a range of hazards including earthquakes and floods. Although response capacity was also targeted, around 90 micro-disaster risk reduction projects were created to assist people in reducing their vulnerability. Throughout Central Asia the Red Cross and Red Crescent Societies have been working on a range of disaster risk reduction projects from dam-building and riverbank reinforcement to help prevent landslides, to preparedness and awareness-raising. As part of their comprehensive programme to support commu-

Image: © Yoshi Shimizu/International Federation

As a part of risk reduction activities for floods, the Red Cross of Viet Nam has planted and is maintaining over 11,000 hectares of mangrove trees along the seaward side of the sea dykes in eight provinces in the past three years. Here, a group of the Red Cross of Viet Nam volunteers from the Hai Phong branch making a routine check of the growth of the mangrove trees

nities facing frequent disaster, the Philippine National Red Cross has focused on community mitigation measures, which can involve physical structures, health related programmes or planning tools. Much of the work in disaster risk reduction across the National Red Cross and Red Crescent Societies is done by volunteers.

**Tying it all together**

The problem with disaster risk reduction among the membership of the International Federation is that it is difficult to measure and track, undertaken as it is by National Societies using resources from many different sources. Currently, for the first time, the International Federation is attempting an assessment of disaster risk reduction across the organization, looking to identify the scale and scope of the work being done and developing indicators against which to measure future results. This coincides with the launch of the Global alliance for disaster risk reduction, a means by which the federation will attempt to scale up its work, focusing on target countries. The programme will highlight the needs of communities and the reduction of their vulnerabilities.

More than this, however, the International Federation is keen to increasingly identify itself with the global disaster risk reduction agenda and to identify its own contribution to this agenda. Thus, the focus will shift to creating support for the building of community resilience, with the emphasis on core activities that National Red Cross and Red Crescent Societies traditionally do well. These include community-based disaster preparedness and early warning, awareness-raising and education, and advocacy with governments through the role that National Societies play as auxiliaries to government in disaster related issues. Additional to these core activities will be country and hazard-specific activities related to the individual country's needs. Bound together, this will become a Framework for community resilience which will identify the Red Cross Red Crescent brand in disaster risk reduction. In parallel, the International Federation has launched a five-year strategic framework for food security in Africa, emphasising the importance of this area for disaster risk reduction on that continent.

The overall objective will be to orientate the National Red Cross and Red Crescent Societies to support communities in achieving safety and resilience, in the face of disaster risk which threatens to be an increasing problem because of climate change, the growth in urban environments, environmental degradation and other risks as yet unidentified.

# Climate change and disaster related risks to human health in South Asia

*C. Sharma, M.K. Tiwari, S.C. Garg and Vikram Kumar, National Physical Laboratory, New Delhi, India*

**Human health is of great concern for any country as it has a strong bearing on national productivity and social well being. Developing countries are especially vulnerable to ill health due to the fact that their sizeable populations live under poverty and are deprived of quality health care facilities, which exacerbates the various impacts on human health.**

Natural disasters like floods, cyclones and droughts are known to affect human health as they create conducive conditions for the proliferation of several diseases such as cholera, malaria, dengue and heat stress. Bouma et al.[1] have reported that the number of persons affected by natural disasters worldwide is strongly associated with the El Niño Southern Oscillation (ENSO), with higher rates during the first El Niño year and that following, compared to the pre-Niño year. These associations are strongest for the South Asian region where more than 50 per cent of all disaster victims live. Climate change is likely to further enhance human health risks, by either creating favourable conditions in newer geographical areas for disease occurrences, or by further facilitating the conditions for disease proliferation.

The South Asian region, which is home to about 22 per cent of world population, is especially vulnerable due to the poor and inequitable availability of resources to a very large segment of its population. Countries in the region are struggling to develop national economies that can provide social well being to all residents, and available human resources are the key to this endeavour. Therefore, the risk to human health in the region has serious implications for the chances of achieving developmental goals. The generation of public awareness about the adverse impacts of climate change and disasters on human health is the key to empowering the population to cope with this vulnerability.

Modelled climate change scenarios for the region show exacerbation in various meteorological parameters such as temperature and precipitation. For example, the high resolution climate change scenario based on the HadRM2 regional climate model[2] for India under increasing atmospheric carbon dioxide concentrations, shows that mean surface temperatures are likely to increase everywhere in the region during the 21st century, with more pronounced warming on land areas and maximum increase over north India. Significantly, the warming is expected to increase in winter and the post-monsoon season compared to the summer season. These projected changes will have a major influence on disease prevalence and need appropriate adjustments in health care policies to minimize human health risks.

There are a large number of diseases which are influenced by natural disaster and climate change parameters. Some of these include diseases such as cholera, malaria, heat stress and pulmonary diseases, which are discussed below.

### Cholera

Cholera is a major enteric disease which is sensitive to climate change and variability. Rodo et al.[3] have reported the increased role of interannual climate variability on the temporal dynamics of cholera in Bangladesh. They also reported that warming over land in the Indian subcontinent might have noticeable effects on the temperature of water bodies that serve as an environmental habitat and a vehicle of bacterium transmission. Enhanced warming can also affect transmission, due to changing human behaviour increasing the likelihood of coming into contact with contaminated water sources. The combined effects of more extreme ENSO and climate change might also affect the sanitation conditions that are critical to cholera transmission. The endemicity of cholera in regions such as the estuaries of the Ganges and Bramaputra in Bangladesh has also been attributed to the presence of a marine reservoir of cholera pathogens, which persists for long periods with marine organisms in the mucilaginous sheath of blue-green algae and copepods.[4] In view of severe productivity losses due to cholera related human health risks, policies need to be implemented to ensure safe drinking water and sanitation, besides gearing up health care facilities in the region. Several low cost technologies such as ceramic filters are available to provide safe drinking water.

### Heat stress

Climate change is likely to increase the heat stress risk to human health due to high temperatures and humidity,


Image: C. Sharma

A stakeholders' meeting organized jointly by the National Physical Laboratory, New Delhi and Jadavpur University Kolkata

an occupational hazard for both outdoor and indoor workers. This could lead to death or chronic ill health from the after-effects of heatstroke.[5] Large areas in the South Asian region that experience high temperatures for a significant time in the summer seasons are highly vulnerable to heat stress, which affects poor people more as evidenced by the occurrence of heatstroke in metal workers in Bangladesh[6] and rickshaw pullers in South Asia.[7] In India, mortality due to heat waves shows an increasing trend. For example, in 1981 there were seven heat wave days with 63 deaths, which rose to 27 events and 1,658 deaths in 1998 and 70 events with 1,539 deaths in 2003.[8] Clearly, this shows the need for appropriate intervention such as augmenting forecasting measures, creating shelters and gearing up health care facilities to cope with this kind of human health risk.

**Malaria**

Malaria is a public health problem in 90 countries in the world, covering 40 per cent of the human population. South Asia is especially vulnerable to malaria risks. About 1.8 million malaria cases have been reported causing about 1,000 deaths annually in India. It is highly prevalent in the forest areas and tribal belts of the South Asian region. Malaria is one of the vector-borne diseases that is affected by a large number of factors related to human population, the parasite, vector bionomics and the environment; including temperature, precipitation, humidity and wind conditions of a region, which also have a role in determining transmission dynamics of the area. Additionally, it is expected to be most sensitive to long-term climate and environment change. Malaria has been on the increase due to a growth in urbanization and the migration of people searching for a better livelihood. For example, only sporadic cases of malaria were reported from states in north-east India before 1980. However, a widespread malaria outbreak occurred in Assam in 1995 and many deaths were reported from several primary health centres in the region. This increase in endemicity was traced to a large-scale migration of labour to the forests of Assam from areas with a higher prevalence of the disease.

Malaria is mostly endemic in the South and Southeast Asian countries. Attempts to eradicate malaria globally have been seriously hampered due to the fact that malaria vectors have become more resistant to insecticides, and the parasites that cause the disease have also become resistant to chloroquine and possibly other anti-malarial drugs. This is making prevention and treatment increasingly difficult and costly.

India has also spent a considerable amount of money on malaria control operations through its National Malaria Eradication Programme (NMEP), but due to the increasing resistance of mosquitoes to pesticides and of parasites to anti-malarial drugs, the effectiveness of malaria control attempts could not be fully successful. Therefore there is a need to develop new region-specific coping strategies to reduce human health vulnerability to malaria. For example, during 2000-2001 under the Roll Back Malaria initiative of the World Health Organization, a malaria situation analysis was undertaken in the West Aizawl district of Mizoram in India. This revealed that although there were negligible vacant positions in the anti-malaria department, an availability of 100 per cent of the required financial assistance from the Government of India, a vector fully susceptible to Dichloro-Diphenyl-Trichloroethane (DDT), coverage of indoor residual spray to the tune of 85 per cent and a more than 95 per cent literacy rate, there were still deaths due to malaria. This indicates that the intervention measures were inadequate in handling the situation, thus warranting investigation and development of region-specific intervention measures.

**Respiratory health**

Combustion of fossil fuel and biomass is the dominant source for energy worldwide, driving national economies and development. The combustion of these fuels results in the emission of gaseous species like carbon dioxide, carbon monoxide, oxides of nitrogen, sulphur dioxide and hydrocarbons, besides suspended particulate matter. It is well established that exposure to these pollutants can have a range of adverse health effects, especially if serious pollution episodes occur. Air pollution, both outdoor and indoor poses a great risk to human health. The impacts of ozone levels and benzene emissions, which have not been studied sufficiently in most of the developing countries where ambient concentrations of these species are generally increasing, would probably add more to the total loss in national productivity due to increased morbidity.

Extensive studies correlating indoor pollution and its impacts such as acute respiratory infections, chronic obstructive pulmonary diseases (e.g. chronic bronchitis), lung cancer, tuberculosis and prenatal effects are well documented. Long-term exposure to low levels of pollution may result in or aggravate chronic bronchitis, pulmonary emphysema, bronchial asthma, chronic cough, lung cancer and decreased resistance to infections. Excessive secretion of bronchial mucous is the hallmark of chronic air pollution effects. Dust allergens including pollen of size 1-90 µm in diameter can induce or trigger allergic reactions in susceptible people.

In view of the adverse effects of air pollution, some studies have been carried out in South Asian countries which provided inputs for evolving technologies, policies, laws and regulatory mechanisms to control the problem of poor air quality. While the developed countries have been able to improve their ambient air quality significantly, the developing countries are still facing a major challenge in tackling this problem in spite of several measures taken so far. This is because economic development and associated lifestyle changes in the region are resulting in an increasing rate of air pollutant emissions, which might need additional policy measures to prevent human health risks and boost overall national productivity.


Image: C. Sharma

Use of a ceramic water filter in an Indian kitchen

# Neighbourhood Disaster Volunteers: the crucial role of local residents

*Barbara Dätwyler Scheuer, Swiss Agency for Development and Cooperation*

**A critical lesson of major disasters – indeed, of worldwide experience – is that most earthquake victims are rescued by local residents, neighbours and family members, not by professionals of the official disaster response system. The reasons for this are apparent: the official response system requires some time to mobilize and professional rescue teams cannot be everywhere at once. Their information on the location of the injured person is often incomplete, getting access to local knowledge is a challenge and may take some time. In many cases, access is restricted. Thus, in the crucial 72-hour period following an earthquake during which the survival rate drops drastically with every passing hour, local residents play a major role. In the first 24 hours, over 80 per cent of rescues may be attributed to local residents.**

However, local residents are normally ill-prepared for disaster intervention and rescue work. Their effectiveness is seriously constrained by the lack of knowledge and skills, organization, and essential rescue equipment. Poorly prepared rescuers may even cause unnecessary injury to disaster victims and themselves. Furthermore, when professional teams do arrive on the scene, there is no clear basis for their collaboration with the spontaneous local volunteers.

This analysis of the potential and weaknesses of disaster volunteers underlies the concept of the Neighbourhood Disaster Volunteer approach (NDV), which was initiated in Kocaeli Province with Swiss Agency for Development and Cooperation (SDC) support in the aftermath of the 1999 Marmara earthquakes in Turkey. In particular, the approach recognizes that the effectiveness and sustainability of disaster volunteers depends on their organization into neighbourhood-based groups. The NDV approach embodies four working principles:

- Through appropriate training, organization and equipment, the immediate response capacity of NDVs can be significantly increased and maintained over the long term
- Thanks to their organizational structure, NDVs may be readily coordinated by the professional teams as soon as these professionals arrive; the capacities, equipment and local knowledge of the NDVs may significantly enhance the effectiveness of the official response system
- As local residents, neighbourhood volunteers can have a significant impact on the state of awareness and preparedness of the community at large by conducting schools programmes, identifying specific risks in the locality, providing leadership in damage mitigation and assisting with recovery measures and the return to normality after the disaster
- Finally, the tasks of training and supporting the neighbourhood disaster volunteers may be managed to a large extent by the volunteer network itself once it has evolved into a self-sustaining civil society organization.

Image: Neighbourhood Disaster Volunteer Foundation MAG

With the support of SDC, the Neighbourhood Disaster Volunteer approach prepares local residents for rescue work

Image: Neighbourhood Disaster Volunteer Foundation MAG

Appropriate training and equipment can increase the response capacity of Neighbourhood Disaster Volunteers

**Principles and challenges of the NDV approach**

The NDV approach is based on several working principles, in particular: volunteerism; neighbourhood-based organization; systematic capacity building; bottom-up organizational development; and partnership between government and civil society. Each presents specific challenges, which need to be addressed to establish an effective and sustainable network of disaster volunteers.

*Volunteerism* — An NDV network depends upon volunteerism: the willingness of people to contribute their time, energy and resources to training, organizational activities and community service. This willingness is motivated, mainly, by people's concern to protect themselves, their family and their neighbours from the impact of a natural hazard. Other private and/or social interests may also be involved, of course, but the basic motivation stems from people's conviction that, by joining together with their neighbours and acquiring appropriate skills, they can do something to reduce disaster risks.

*Neighbourhood-based organization* — The essential unit of the NDV network is the neighbourhood-based group, whereby 'neighbourhood' refers to a specific portion of a city, town or village with a recognized administrative and social identity. In general, it is an entity with which the residents readily identify. The basic reason for organizing NDV into neighbourhood-based groups relates to their greater effectiveness in disaster response, preparedness and recovery as compared with individual volunteer systems. Furthermore, neighbourhood-based organizations have distinct advantages regarding the recruitment of volunteers. As demonstrated by the Turkish NDV experience, the best way to mobilize new volunteers is through direct contacts with local leaders and their networks. Most volunteers confirm that their initial interest was awakened by participating friends or neighbours. Finally, the shared perspective of neighbours facilitates the evolution of NDV groups into broadly based and sustainable civil society organizations.

At the same time, implementation of the neighbourhood-based approach poses three important challenges. First, the approach must generate effective disaster response capacity in different neighbourhoods with a wide variety of physical characteristics, socioeconomic conditions, education levels, and past disaster experiences. Second, the groups need to be self-sustaining over a long period with a minimal amount of external support. This is not self-evident in view of the fact that community-based organizations normally exhibit a 'life cycle' — arising in response to a particular problem or interest and fading into inactivity once the problem is solved or, as often happens, no solution is found. Third, the stereotype that community-based initiatives are only locally effective and lacking wider impact must be overcome.

*Systematic capacity-building* — Capacity, as noted, is the inverse of vulnerability, and in this sense, capacity building is the central task of an NDV programme. Capacity building is understood here as processes whereby individuals and organizations acquire the ability to perform certain functions, solve problems, and set and achieve objectives. Training is evidently an important component of the process. However, beyond the transfer of information and skills, capacity building implies the creation of a fertile environment within which the 'seeds' of training can grow and become effective. Organizational development and the provision of appropriate instruments are essential aspects of the process.

The main challenge of an NDV programme is to mount a capacity building programme that is feasible in terms of the required time and resources, while being effective in its long-term impact on disaster management capacity.

*Bottom-up organizational development* — The NDV programme aims to establish a network of neighbourhood-based volunteer groups throughout the area of a prevailing hazard. The effort would not be justifiable or sustainable for a few groups in a limited area. Furthermore, the existence of a large number of local groups creates a potential for exchange, cooperation and joint activities which contributes simultaneously to the strength of each member group.

However, an extensive network requires an appropriate organizational structure. The challenge, in this regard, is to establish an appropriate organizational hierarchy which respects and reinforces the local 'ownership'

Image: Neighbourhood Disaster Volunteer Foundation MAG

Local residents play a crucial role in the first 72 hours after an earthquake

Image: Neighbourhood Disaster Volunteer Foundation MAG

A Neighbourhood Disaster Volunteer helps raise awareness and preparedness through a school programme

and relative independence of the member groups while bundling their strength to accomplish essential support and expansion functions.

*Partnership between civil society and government* — Although it is a relatively independent civil society organization, the NDV network depends for its practical effectiveness and legitimacy on linkage to the official disaster management system. The approach thus aims to build a strong working partnership between the NDV network, local authorities and the official disaster management agencies.

The main challenge regarding civil society-government partnership is to ensure that disaster authorities achieve adequate control of the volunteers' disaster related procedures and performance standards, and operational authority over the volunteers during disaster response, while, at the same time, respecting the independence and self-management needs of the NDV network.

The NDV approach to this challenge is based on well-defined training standards and regulations and a system of bylaws and agreements defining each level of the organizational structure. The central organization — which includes official participation — remains the final guarantor of the NDV principles and quality standards, ensuring their compatibility with official requirements.

**How effective is the NDV approach?**

*Origins and development* — The NDV programme began in late 2000 as a pilot project in two neighbourhoods of Kocaeli, Turkey. The initial focus was on the elaboration and testing of a training programme for disaster volunteers. In the following two years the NDV model was progressively developed, tested, improved and standardized as the programme expanded. The model defines four main stages of the NDV implementation process:

*Mobilization* — Neighbourhood selection and volunteer recruitment. The main activities are: establishing cooperation with officials, selection of the neighbourhoods and potential volunteers. Men and women between the ages of 18 and 55 who are residents of the neighbourhood and intending to remain so for some time can take part in the next stage. Women are particulary welcome to participate.

*Basic training* — Activities include setting up training facilities and equipment, organization of trainers and conducting training sessions. The Standard Basic Training Program is 36 hours and comprises disaster awareness, disaster psychology, basic fire fighting, basic first aid, basic search and rescue, with many practical exercises as well as theory.

*Organization and equipment* — Formation of neighbourhood groups and their local committees; distribution and management of equipment and facilities; internal communication procedures; official recognition and operational linkage to the civil defence system. After the basic training and formation of the teams, neighbourhoods receive both personal and team equipment which will help them to apply the first response. The equipment is meticulously maintained by the volunteers according to a carefully prepared periodic maintenance programme.

*Follow-up support* — Ongoing support activities include: conducting refresher, replacement and advanced training; social events, drills and exercises, maintaining equipment, organizing community activities, disaster awareness training and other events to keep motivation high and build team spirit. All these activities are conducted in close cooperation and coordination with local officials and other volunteer organizations.

NDV has evolved into an extensive taskforce for disaster preparedness and response numbering 68 neighbourhood groups and over 3,000 active volunteers, with standardized training, locally maintained equipment, clear organization and close working relationships with the official emergency response centres in three provinces: Kocaeli, Yalova and Istanbul, in the Marmara region. The network is presently growing at the rate of over 500 volunteers per year and expanding to other regions in Turkey.

**Organizational structure**

The NDV network is structured at three organizational levels: neighbourhood, provincial and central.

At the neighbourhood level, each group of 35-50 volunteers is headed by a Neighbourhood Disaster Committee (NDC), consisting of the official neigh-

Image: Neighbourhood Disaster Volunteer Foundation MAG

Neighbourhood Disaster Volunteers receive basic training, including setting up training facilities and equipment


Image: Neighbourhood Disaster Volunteer Foundation MAG

A Neighbourhood Disaster Volunteer response centre

bourhood head, who is official chairman of the NDC, and three other members (and their alternates), who are elected by the volunteers from their ranks. Elected committee members assume responsibility for three main functions: volunteer coordination, logistics and the assessment of risks and damages. NDVs become involved in awareness building campaigns, school programmes and other public service activities, while seeking to mobilize local support for their mission. Today women account for 42-45% among the volunteers. Women have a strong commitment and encourage their familiy members to participate in NDV groups as well.

NDVs are linked in several ways to the official disaster management system. First, the neighbourhood headperson implies government involvement in the network through his/her position as Chairman of the NDV Committee. Second, individual volunteers are linked to the official system through their eligibility for registration as civil defence volunteers. While the NDVs respond directly in the event of disaster in their neighbourhood, they operate under the coordination of the civil defence authorities as soon as the professionals are present.

At the provincial level, NDV associations have grown out of the need of neighbourhood volunteers to secure the status and independence of their local groups, interact with other neighbourhood groups and act jointly in matters of common interest. Registration is needed for practical matters such as obtaining telephone connections, and for more complex processes such as fundraising. The provincial or intermediate level of organization is indispensable to facilitate the provision of support to a growing number of active NDV groups. As the associations become stronger, they are expected to assume an increasing share of central support functions such as: organization of refresher and advanced training; mobilization of new volunteer groups; monitoring of equipment; organization of joint exercises and social activities; public relations activities; and channelling district and provincial resources to the neighbourhood groups.

Finally, a central support organization is needed to:

- Define and uphold NDV quality standards while safeguarding the identity and effectiveness of the NDV network
- Mobilize and allocate resources required by the NDV network
- Provide necessary follow-up support to neighbourhood NDV groups while strengthening the capacity of provincial associations to assume an increasing share of support activities
- Plan and coordinate inter-provincial NDV activities and further expansion of the network
- Ensure a framework for cooperation among the NDV network, civil defence authorities, and other stakeholders.

**Current status**

By mid-2008, about 3000 NDVs in 68 neighbourhoods of four Turkish provinces have completed the basic training programme, signed a volunteer cooperation protocol, received NDV ID Cards and are active participants in the official disaster management system.

The NDV model has gained national and international recognition. It has been recommended for implementation in Istanbul Province within the Istanbul Seismic Mitigation and Earthquake Preparedness Project, which is being implemented by the province with World Bank financing. At the same time, the European Union is using NDV as best practice in its Volunteers and Democracy in Emergency Management Program.

Image: Neighbourhood Disaster Volunteer Foundation MAG

Neighbourhood Disaster Volunteers play a crucial role in saving lives

Replication of the NDV approach has already commenced in other countries. Preparations are underway to launch similar projects in the Medina of Fes, Morocco and Amman, Jordan.

**Testimony from Neighbourhood Disaster Volunteer team members**

As is known, it is impossible to assign professional search and rescue teams simultaneously in case of disasters affecting mass geographic regions and populations. It is essential to take preparedness measures to perform efficient search and rescue operations in the first 72 hours of the disaster, the 'golden hours'. We as a civil defence institution provide and support theoretical and practical training of members of voluntary organizations to make them prepared in the face of disasters.
*Can Avci — Head of Civil Defence Brigade of Istanbul*

We experienced the 1999 earthquake. We had no training on search and rescue operations and how to help the injured before the earthquake. We fell into a desperate mood as we could not help others. We now develop our knowledge and skills thanks to training we receive in the Neighbourhood Disaster Volunteer Project. We have now self-confidence and I am so happy to be a part of this voluntary initiative.
*Celal Kara — Neighbourhood Disaster Volunteer*

The NDV group has also contributed to our friendship. We now know each other better. We discuss what we should and can do in order to prepare ourselves for disasters and reduce the risk in our own neighbourhood. We produce plenty of ideas and the group helps us to focus on those that we can use.
*Banu Tarim — Neighbourhood Disaster Volunteer*

# Flood disaster recovery in China

*Li Maosong, Song Jiqing, Bai Wenbo, Wu Yongfeng, Liu Buchun, Wang Chunyan and Wang Xiufen, Laboratory of Agro-Natural Disaster Reduction, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Key Laboratory of Agro-Environment & Climate Change, Ministry of Agriculture*

**Flooding is the second largest meteorological disaster in China. Floods have a detrimental effect on people's lives, cause economic loss and destroy the environment. Furthermore, the secondary effects and indirect costs of flood disasters have caused long-term effects in local societies, regardless of their level of development. Taking action to prevent floods and to reduce their impact is essential.**

China is located in the world-famous monsoon area, and resultantly frequently suffers flooding. From the 1960s, China has experienced almost annual flood disasters, especially in the years 1963, 1975, 1991, 1998, 2003 and 2007. During the rainy season from May to August, the flood disasters mainly concerned the Yangtze, Huaihe and Pearl Rivers, which distribute for the main rice production regions of China.

The statistics show that the rice paddies affected by flood disaster in the main rice production regions of China was about 244,000 hectares on a yearly average in the 1960s. From the 1970s to the 1990s the affected area expanded steadily. In the 1990s, it soared to 1,070,000 hectares, and between 2000 and 2007 it reached as much as 648,000 hectares on average.

Rice is an indispensable staple food, especially in the large areas of Asia, Latin America and Africa, which are characterized by semitropical climates with alternating rainy and dry seasons.[1] The current demand for rice exceeds its production. This situation will worsen given the world's increasing population and the decline in arable land. Production in regions where rice cultivation is subjected to stresses, such as the seasonal flooding that occurs during the rice-growing season, particularly in the lowlands of South, Southeast and East Asia. Furthermore, this flood disaster-affected condition of rice paddies will be even more severe in the future, as trends in the frequency and intensity of floods events are closely related to changes in the patterns of precipitation and river discharge, and thereby also to other long-term changes in the global warming. All these trends are expected to continue, with the exception of the reduced seasonal variation, which is not expected to be the case in southern China. It is a matter of urgency to take measures for flood disaster recovery in China.

**Flooding in Luxian county, China**

The flood disaster in Luxian county, China 2007 (upper) and the countermeasure against it, to apply with fertilizer on ratooning rice (lower)

Source: IEDA, CAAS, China/Bai Wenbo

### Ratooning rice alleviates economic losses after catastrophic flooding in Luxian county

Catastrophic flooding occurred from 8-10 July 2007 in Luxian county, in the Sichuan province of China. The county was substantially affected, with the submergence of farmlands covering more than 35,073 hectares and an inundation time of 60-92 hours. The rice was in its blooming stage, and about 78 per cent of the rice paddies were severely affected. According to the results of previous studies, rice, with an inordinate metabolic physiology, cannot normally assimilate and respire in submerged conditions. At the same time, rice changes from reproductive growth to vegetative growth, a process that is accompanied by dedifferentiation.[2] The propagule phenomenon, which refers to the generation of new individual leaves and ears from internodes, occurred after the water had fully receded for four days — that is to say, rice has the ability to regenerate.

If effective measures are not taken after a flood disaster, this results in wilting rice and rebirth rice growing together in uncut-stem rice paddies. The rice grew in an undesirable condition and the plant carbohydrates were largely consumed, which resulted in serious growth damage. Submergence affected the bourgeoning, growth and yield of the rebirth rice, while the original rice was almost unharvestable, which would result in potential large-scale yield losses.

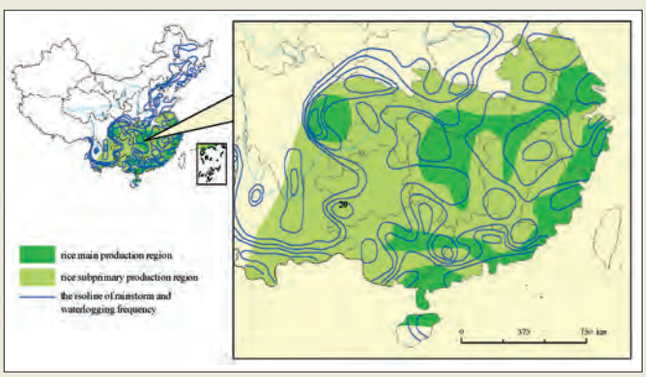
Based on previous studies and experimental results, countermeasures against flood disaster were based on

**The growing vigour of a rice paddy with uncut-stems after the flood disaster**

**16 July** **20 July** **20 August**

Source: IEDA, CAAS, China/Bai Wenbo

**The frequency distribution of annual rainstorm and waterlogging in rice main production region in southern China from 1961 to 2006**




Source: IEDA, CAAS, China/Wu Yongfeng

the damage to the rice paddies, as determined by the effect on the plant growth and development period, inundation time, growth vigour, and so on:

- When rice is in the initial pregnation stage or just before this growth period, the rice paddy should be reserved after the flood recession
- When the rice paddies were submerged for more than ten hours in the pregnation and tasseling stages, the effects of flooding on rice production and viability could be judged by the following characteristics:
  - Three days after the recession of flooding, although the plant root grew normally, there was no dew on the leaf apex in the rice paddy. This results demonstrates that the above-ground parts of the rice had suffered serious injure and that ratooning rice was needed. Moreover, the hydrophanous ears had developed a brown colour and some of them were rotting. It was therefore, essential to cut the rice stem
  - If 80 per cent of rice leaves in reciprocal two, three and four-node positions were sharply elongated five days after the recession of flooding, then the plant growth centres had transferred and the rice ears were damaged. Therefore, under these conditions, substitution with ratooning rice should be adopted immediately.
- As for rice plants that had reached the milking period, five to seven days after the recession of the flood, If 20 per cent of the rice continued to burgeon, then the rice paddy needed be harvested earlier, followed by quick cutting of the rice stem. However, if fewer than 20 per cent of the rice plants continued to burgeon, ratooning rice should again be immediately adopted
- If the rice paddy suffered serious flood stress, with plant leaves slumped and damaged by chlorosis and necrosis, the rice ultimately wilted in the sunlight. This indicated that the rice was almost completely dead and that the axillary bud could not normally elongate. In this case, it was urgent to replant other crops.

The method of ratooning rice was introduced to mitigate flood disaster, which exploited the potential of rice regeneration. Ratooning could adequately use light and temperature resources, save both time and labour, and alleviate the loss of food. The main technical determinants for optimal use of ratooning rice to minimize the damaging effects of flooding were to accurately judge, cut the rice stems early, maintain the cutting-stem heights as 20 cm, enhance fertilization (the application of urea between 2,430 and 3,105 kg $ha^{-1}$), and prevent and control plant diseases and insect pests.

According to statistical results provided by the bureau of agriculture and forestry in Sichuan province on 1 November 2007, the total farmland for ratooning rice paddies were 18.2 hectares in the towns of Jiaming and Fuji in Luxian county and the average yield was 4,950 kg $ha^{-1}$. Based on its market price of 1.70 RMB $kg^{-1}$, minus the input costs of fertilizers, pesticides and labour, farmers are expected to earn a net income of 6,915 RMB $ha^{-1}$.

The findings of ratooning rice have important ramifications for the world, especially to Asia, which faces the task of feeding a fast-growing population with increasing agricultural acreage being sacrificed for urbanisation.

# Relief to risk reduction — a paradigm shift

*Sanjeev K. Bhanja and Ramesh Babu, EFICOR*

**Flood is a recurrent phenomenon in northern parts of Bihar in India. The Dalit community, especially the Ram, Paswans and Musahars, bear the brunt of flooding and its resultant hazards. Women, adolescent girls and children are the worst sufferers. The flooding and its aftermath badly affect their living standards. Victims take shelter on embankments and railway tracks, often under the open sky. Some take shelter on the rooftops of school buildings or neighbours, if space is available.**

Scarcity of food and drinking water compels people to consume minimal amounts. People often drink contaminated floodwater thereby risking diarrhoea and other water-borne diseases. Agricultural crops are damaged and livestock is washed away. The floodwater destroys road connectivity and communication between hamlets and villages, thus cutting the community off from the nearby towns. Schools remains closed for about three months during the flood season, which runs from July/August to September/October. The post-flood season sees heavy migration due to lack of wage opportunities in the agricultural sector, which is the major source of livelihood for these communities. Poor governance and improper service provision by the government compounds the vulnerability of the flood-affected community in Bihar.

Bihar is one of the most populous states in India and is prone to various disasters. It has a population of about 120 million and is one of the poorest states in India, with about 42 per cent of the population living below the poverty line. It is a land-locked central Indian state that lies in the Gangetic basin, accounting for 16.5 per cent of the flood-prone area and 22.1 per cent of the flood-affected population of India.

Image: EFICOR, DRR Project, Madhubani, Bihar

A flood shelter built on raised gound in Gandhrayan village

A brief recent history of flooding in Bihar follows: during the last decade the state was inundated at least four times with the 2004 and 2007 floods being the worst. The rivers that regularly inundate the plains are the Kosi, Bagmati, Budhigandak and the Ganga and its tributaries.

In 1999, 800,000 people were displaced due to floods. During the 2001 flood 22 districts, 183 blocks, 1,653 panchayats and 5,477 villages were affected. It affected 81.28 lakh people and took 203 lives. The floods in 2004 affected over 9,333 villages spread over 20 districts in the state, claiming 683 human lives and killing 2,354 livestock; and damaging about 717,000 houses in an area of 4.986 million hectares. A population of over 21 million was affected and crops covering an area of 1.34 million hectares destroyed.

In early July 2007, Bihar faced its worst floods in 50 years due to heavy rains in the catchment areas in Nepal, causing breaches in embankments along many parts of the Kosi, Bagmati, and Budhigandak rivers and tributaries, inundating the surrounding areas. The flooding affected more than 9,333 villages spread over 28 districts in the state, according to government reports. The flooding claimed more than 900 human lives,[1] killed about 4,000 livestock and damaged 600,000 houses in an area of 4.986 million hectares. A population of over 21 million was affected and crops covering an area of 4.34 million hectares destroyed. Railway bridges and tracks were completely washed out in several places.

Civil society organizations, non-governmental organizations (NGOs, both international and national), bilateral agencies and government have always responded to flood emergencies in Bihar with relief assistance; as has the Evangelical Fellowship of India Commission On Relief (EFICOR), a national level NGO with expertise in relief and disaster management. However, resource generation for relief depends on the nature of coverage by national and international media, particularly electronic. Coverage of the 2007 south Asia flood by international and national media shaped the mindset of international government donors towards intervention.

In response to the flood emergency in Bihar in 2004, EFICOR intervened with relief assistance in Madhubani, Muzafarpur, Madhepura, Begusarai and Samastipur districts, catering to the food, temporary shelter and sanitation needs of 21,000 families at a cost of USD500,000. The story was repeated during the 2007 flood with fewer families (16,000) supplied at a cost of USD300,000.

Image: EFICOR, DRR Project, Madhubani, Bihar

A high raised tube well which provides safe drinking water

Image: EFICOR, DRR Project, Madhubani, Bihar

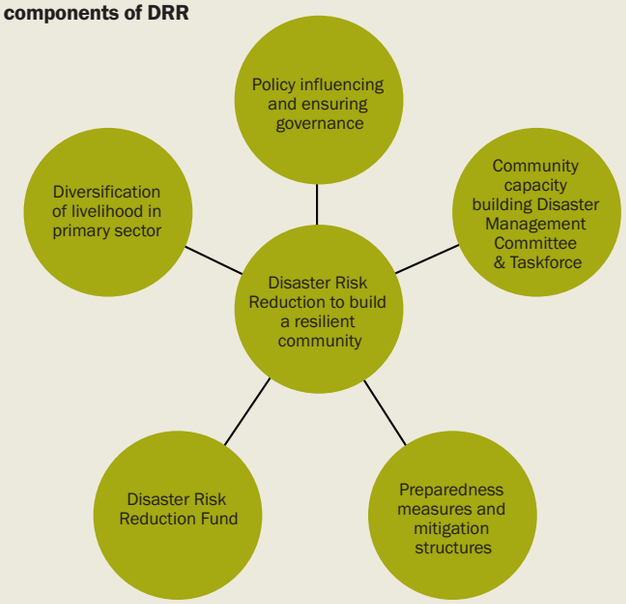
A farmer carries sugar cane (an early crop) bundle

Relief intervention in 2004 worked as a catalyst to build rapport with flood-affected communities in Bihar, allowing EFICOR to think about long-term intervention in terms of rehabilitation.

A planning tool process called Participatory Assessment of Disaster Risk (PADR) was initiated in November 2004 to understand the community perspective on disaster management, which enveloped hazard assessment, risk associated with hazards, vulnerability assessment and community coping capacity. The PADR process gave EFICOR a chance to replicate the lessons gleaned through the Disaster Mitigation and Preparedness Program (DMPP) implemented in the flood affected Khammam district of Andhra Pradesh, with the support of Tearfund UK in 2003.

Subsequently, a food for work (FFW) programme ensued for a period of three months with the support of the Canadian Food Grain Bank (CFGB). The programme was implemented in 20 villages of Madhubani district, and briskly embedded some of the findings of PADR; the laying out of evacuation routes, community infrastructure and connectivity, for example. FFW intervention addressed household food insecurity for a period of three months, reinstated community infrastructure such as roads and ponds, rebuilt damaged individual houses with raised platforms and laid out evacuation routes as designed by the community. Moreover, the involvement of the community in the process worked as a safety valve to ventilate the psycho-social trauma that arose out of flood hazard, thereby restoring their sense of confidence.

**The community mobilization process includes several components of DRR**




Source: EFICOR, DRR Project, Madhubani, Bihar

The FFW intervention produced a conducive atmosphere for long-term intervention in community-based disaster management, with a focus on risk reduction that involves community preparedness, mitigation and response. Considering resource availability and programme feasibility options, 20 villages of the Andhrathari, Madhepur and Khutona blocks of Madhubani district were chosen as the operational area, with the support of DFID through Tearfund UK and Tear Australia.

The following components of disaster risk reduction (DRR) were nestled into the community mobilization process.

A Disaster Risk Reduction Fund (DRRF), as enshrined in the disaster management act 2005, was introduced into the community discussion process as part of preparedness measures against the floods. The community, despite initial inhibitions, unanimously decided in favour of it, and decided to contribute INR5-10 per family per month, (the figure varies from village to village). In a span of three months the DRRF was set up in all the villages. As of March 2008 the total amount of INR125,000 had been deposited. The fund came to the aid of the community during the 2007 flood by propping up its foodstuffs purchasing power during the emergency. For instance, the people of Gandhrain and Bhadwar villages in Andhrathari block managed to purchase food grain that sustained them for about seven days during the emergency. Relief assistance (both from government

Image: EFICOR, DRR Project, Madhubani, Bihar

Bhadwar, a flood affected village

Image: EFICOR, DRR Project, Madhubani, Bihar

DMC members at Bhadwar village

Image: EFICOR, DRR Project, Madhubani, Bihar

DMC collecting DRR funds in Bhadwar village

and NGO sources) generally reaches the affected community after a week. Amidst the flood emergency backdrop, DRRF has been proven to work as a cushion for flood victims.

A Disaster Management Committee (DMC) has been formed in all 20 villages that have members from the vulnerable community. Each DMC comprises 10-12 members including one to three women. The DMC, on being capacitated, becomes the custodian of DRR knowledge, particularly from an applied point of view. It propagates knowledge of early warning and safety measures, directs taskforce rescue operations, monitors relief operations and takes up local level advocacy measures like compensation packages, damage assessment and embankment safety measures with the administration.

While disseminating knowledge to the community, the DMC in facilitation with the project team adds value to indigenous knowledge and community coping mechanisms, such as drying up cow dung paste for fuel during the flood season and the preparation of earthen hearths, locally made earthen and bamboo containers on a raised platform for grain storage etc. The DMC also monitors the smooth functioning of the various task forces during the emergency, such as warning, rescue, first Aid, shelter and relief. However, the project team also facilitates the capacity building exercises of the taskforces on a regular basis in the normal season.

During the 2007 flood the task force in coordination with DMC evacuated 135 families in Bhadwar village. Seven people from Bhadwar and Sivarampur villages were saved from drowning in the Kamla Balan river. The Government of India has recommended that DMCs should be part of the Panchayati Raj Institutions (PRI) to take part in disaster management planning and implementation. Consequently, the EFICOR project team has advocated that the existing DMCs should be part of the respective Panchayat committees.

An alternative cropping pattern was introduced to diversify livelihoods. A local paddy variety called Aghani has been piloted, which is sown in March and harvested in June before the advent of the flood season. Farmers in north Bihar traditionally opt for a high yielding paddy variety that will not withstand heavy flood. If successful this attempt to revive the local variety will ensure food grain security for farmers despite flooding. The project has also been piloting a wheat variety that in the recent harvest gave a hike in the yield rate of about 50 per cent per acre. However, creating wider acceptance among the farming community in the area remains a challenge.

The project, in sync with the participatory planning process, has set up mitigation structures like evacuation routes, tube wells on high-raised platforms to save them from being contaminated during floods, culverts for floodwater drainage, rescue kits, engine-driven fibre boats and multi-purpose flood shelters. In the recent 2007 Bihar flood, the multi-purpose shelter at Gandharin village sheltered about 80 families for about seven days.

The DRR intervention, albeit a recent initiative, has given EFICOR an edge on macro level advocacy by facilitating access to policy-making bodies like the National Disaster Management Authority (NDMA) of the Government of India. DRR lessons are presented to the NDMA through an NGO taskforce, preparing flood guidelines to be implemented by the state government. The project's experience suggests that well planned DRR initiatives, with community capacity-building backed up by common minimum governance measures, can establish a resilient community with minimum loss of life and livelihood. May this endeavour be a stepping stone towards a dignified life for the flood affected community in Bihar and the rest of India.[2]

# From grassroots to global: people-centred disaster risk reduction

*Margaret Arnold, Bruno Haghebaert and Ben Wisner, ProVention Consortium*

**The disaster risk reduction (DRR) agenda continues to build momentum, spurred by tragic catastrophes, active lobbying, and global attention garnered by the issue of climate change. The past couple of years have witnessed important developments related to global policy and support for DRR, including the creation or revision of DRR policies in several bilateral donor agencies and international financial institutions (IFIs), the establishment of the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), structural changes to strengthen the United Nations International Strategy for Disaster Reduction (UN/ISDR) system, and the adoption of the Bali Action Plan at COP-13. A critical challenge remains to translate these global commitments into changes on the ground.**

There is a growing perception that although progress has been made within the macro-level public policy domain; the current system is not as yet bringing about the required change at the sub-national and local level. While all agree that time is needed for these global efforts to filter down, the lesson of waiting decades for 'trickle-down economics' to alleviate poverty should teach us that waiting is not enough. The effectiveness of these DRR investments and efforts at the higher spatial levels will ultimately need to be measured by noticeable changes in terms of lives saved, people protected, losses avoided and livelihoods secured in a local context. Since the early nineties, the global number of disaster fatalities has gradually decreased mainly due to enhanced disaster preparedness and early warning in a number of high-risk countries such as Bangladesh and drought-prone African states. However, over the last decade the total number of people affected and the economic losses as a result of disasters continue to increase.[1] These impacts fall overwhelmingly on the poor.

Some observers highlight that the lack of progress in terms of vulnerability reduction is partly due to the limited resources allocated and policy attention paid to more people-centered DRR approaches. They identify three substantial flaws in current DRR strategies.

One flaw is a strong focus on system and institution building with no clear evidence yet that this is being translated into the improvement of safety and protection levels of at-risk communities. While the creation of frameworks, platforms and networks may provide more conceptual cohesion and facilitate knowledge exchange among different constituencies there is a risk that the systems and frameworks become a goal unto themselves. Reference to and compliance with frameworks are no guarantee for effective DRR. Legal frameworks, if not enforced, do not necessarily lead to better protection. Risk assessments, if not followed by concrete risk reduction measures, have limited effectiveness. Awareness raising campaigns, if not translated into behavioral change, may only have marginal effects on people's safety. The current input oriented approach that assesses compliance with frameworks should be shifted towards a more output or results oriented assessment of the effectiveness of all the current system building efforts.

While governmental and intergovernmental actors undoubtedly play an important role in vulnerability and risk reduction, the challenges ahead compounded by a changing climate will require the involvement of all segments of society on an equal footing. A multi-stakeholder and even multi-role approach to DRR is absolutely required to address disaster risks in an efficient, integrated and sustainable manner. From grassroots to policymakers, each player has an essential role in managing risk. And while traditionally-conceived roles are a good starting point, expanded and overlapping roles are needed to accelerate DRR. For example, the role of the media in communicating risk issues to the general public is critical. But they can support accelerated DRR if they were also to serve as watchdogs and advocates. Academics could also support these efforts by being more than neutral observers of risk. Many non-governmental organizations (NGOs) are expanding their traditional role of supporting awareness raising and advocacy; undertaking excellent research, and field testing innovative development and DRR strategies. Donors play a key role in resource development and capacity building, but could do more to assert the primacy of human rights and pressure national governments to live up to their commitments. National governments can create the enabling conditions for DRR through the development of legislative frameworks, plans and budgets. Yet without national governments promoting popular participation in these processes, the national role is not complete. Local authorities also need to promote population participation in their decisions. Finally, in many countries, the private sector is going beyond its conventional role of protecting its work force — adopting schools for seismic retrofit, controlling mosquito breeding in the communities surrounding factories, and so on. Thus, institutions and groups should be encouraged to re-think and expand their roles for effective implementation of DRR, particularly in

Image: Maya Schaerer, IFRC/ProVention

An indigenous women's group builds earthquake-resilient homes, Guatemala, March 2008

countries where the commitment of governmental actors is limited, their resources and capacities are insufficient, or they are struggling with conflict or economic crisis.

A third flaw is focusing too strongly on physical measures aimed at protecting buildings, infrastructure and critical facilities with limited attention to 'people-centered' social vulnerability and livelihood issues. Participatory disaster risk assessments at the local level show that vulnerability can vary substantially within communities and that context specific solutions need to be sought. These assessments also show that people, despite their vulnerability, often also possess remarkable skills, capacities and local knowledge on which local DRR initiatives need to build. Thus a multi- and inter-disciplinary approach is essential, in which technical and physical interventions are merged with social and culturally sensitive approaches.

Civil society has a unique contribution to make towards developing these people-centered approaches and building safer, more resilient communities for a number of reasons:

- Local people and locally-based organizations are the main immediate and proximate actors in disaster reduction, response and recovery
- Grassroots organizations have an established presence in affected areas, relevant experience and expertise based on an understanding of the local context
- They often have the working relationships with and access to poor people that are essential to ensure that the needs and priorities of the most vulnerable and marginalized are taken into account
- Grassroots organizations have an ability to mobilize communities and harness indigenous knowledge and resources (including access to a strong volunteer base).

However, there are also significant limitations and challenges to working with civil society groups related to such issues as diversity and fragmentation of the sector, the relative small size of local actors, low absorption capacities, limited financial resources, weak management structures, accountability and representation issues.

Image: Yoshi Shimizu/IFRC

Backyard gardens improve food security for Aids-affected households in Zimbabwe

A more people-centred approach to DRR should therefore not be seen as the sole responsibility of civil society but as a collective responsibility of all actors in the DRR system. ProVention has over the last years substantially increased its involvement and support for local risk reduction work. It is developing a Community Disaster Resilience Fund, which is being piloted in India and aims to provide small grants directly to at risk communities. The Consortium also has strong links with GROOTS, a global network of grassroots women's organizations. It is an active member of the Global Network of Civil Society Organizations for DRR and is collaborating with the development of the Global Alliance for DRR.

The 2008 ProVention Forum, which was held in Panamá on 8-10 April, looked at different ways to promote people-centred DRR approaches. The Forum's climate and DRR session discussed how local perspectives can be integrated more effectively in global and national policy making on disaster and climate risk. A session on grassroots and indigenous women looked at ways to build upon women's skills and indigenous knowledge when developing DRR strategies. The communicating risk session explored ways to use participatory video to directly engage communities in awareness raising and risk assessment. The upscaling grassroots efforts session discussed issues of scale and sustainability of civil society DRR initiatives. The youth session looked at different ways to engage young people in the DRR debate. The risk financing session discussed the role of Public Private Partnerships in bringing together different sets of stakeholders to address resource and economic gaps affecting risk reduction decision-making. Finally, the urban risk charrette included field visits to informal settlements in Panama City and discussions with at-risk communities. For more information on the ProVention Annual Forum, see the forum web page.[2]

Giving local people a voice in the global DRR processes, however, needs to go beyond inviting grassroots representatives to global meetings or developing good practice CBDRM case studies. For the current DRR system to make a real difference on the ground, a stronger representation of civil society representatives in key decision making bodies, an important shift in the current resource flows and significant investments in DRR capacity building at the local level will be required.

# Toe the line for behavioural change: a capacity development system for disaster risk management

*Dr Rakesh Dubey, Disaster Management Institute, Bhopal;*
*Dr Christina Kamlage, InWEnt — Capacity Building International, Berlin; Dr Jürgen Bischoff, Director, ASEM;*
*Florian Bemmerlein-Lux, ifanos concept & planning, Nuremberg and Dr Sandhya Chatterji, ifanos concept India*

**On 23-24 April 2008, a key planning workshop on 'Capacity Building for (industrial) Disaster Risk Management' (iDRM) was held in the city of Bhopal, the site of a terrible accident in 1984 at the Union Carbide pesticide plant – a deadly event that released approximately 40 metric tonnes of methyl isocynate (MIC) into the atmosphere.**

This incident sparked serious debate both in India and abroad on the issues of chemical safety, and helped focus attention on protecting people and the environment from 'high consequence/low frequency events' by providing regulatory provisions to industries as well as civil administrations. General consciousness about the topic of risk rose. India enacted the 1986 Environment (Protection) Act, which contained several regulations aimed at preventing any future chemical accidents.[1]

However, although India has created rules and regulations regarding chemical safety, there is still a lack of proper monitoring and implementation guidelines. Apart from adapting and detailing rules and norms, what will matter in the long run is behavioural change in the corporate sector, among the regulating authorities and first responders, and in political and civil society. A tragedy like the Bhopal accident only provides momentum. It acts as a trigger to jumpstart change. As long as disaster preparedness is not integrated into everyday traditions for 'doing/not doing' things, a repeat of the catastrophe remains a possible scenario. The willingness and conviction to develop new perspectives in prevention and preparedness have to go hand in hand with changes in technical and management capacities.

Image: F. Bemmerlein-Lux

Acceptance: awareness campaign together with a community-based organization

The last few years have been marked by a paradigm shift in perceptions and discourse, and a corresponding but slow change towards action.

**Being proactive — a paradigm shift**

The move from a reactive and relief-centred approach to a more holistic and integrated approach will mean nothing less than a sea change in how people think. It places emphasis on the proactive phase of disaster risk management. The primary goal becomes conserving developmental gains and minimizing the loss of life, livelihood and property.

Capacity development is the basis for a proactive strategy that starts with building awareness about risks and prevention; disseminating knowledge about threats, potential dangers and their mitigation, and fostering appropriate skills and expertise of key persons in education, health, science, administration, the corporate sector and civil society to plan, implement, respond to and deal with disasters. Capacity development is a contribution that has a long-term effect, and it has become one aspect of policy concepts. India's 'National Disaster Management Guidelines — Chemical Disasters' from April 2007 state that 'there is a need to strengthen the existing training institutions and set up additional training institutes in fire, risk assessment, certification, safety audit and emergency planning.'

Translated into more practical terms, this policy setting has consequences for the core elements of capacity development: building awareness, strengthening cooperation and integration among actors/institutions, building up knowledge and skills to perform, reinforcing the technical

**The challenges of a capacity development system for disaster risk management in India**

| Challenges | Needs and requirements |
|---|---|
| 1: Diversity of potential disasters:<br>The diversity of ecosystems and economic activities requires prevention/mitigation and preparedness for a large variety of potential threats. | Relevant areas: floods, cyclones, tsunamis, erosion and drought, earthquakes, landslides and avalanches, forest fires, chemical production/industrial safety, mines, nuclear assets, biological areas, environmental degradation, cyber-security<br>• Reach the different sectors according to their priority in the regions through decentralized capacity development activities<br>• Provide technical and managerial skills to implement, plan, design rules, teach, etc.<br>• Create awareness about threats, dangers, prevention<br>• Spread knowledge about how to prevent and mitigate. |
| 2: Large-scale problem:<br>In order to be effective/have an impact, a very large number of people from different cultures, backgrounds, institutions and organizations have to be reached. | • Cascade system of decentralised training providers with their own networks of affiliated training institutions/ facilities drawn from government departments and the private sector<br>• Enforcement and monitoring of disaster related regulations at national, regional and local levels. |
| 3: Diversity of areas and subject matter responsibilities. | Disaster Risk Management is a cross-sector task involving target groups/organizations from: emergency and preparedness planning, administration and regulatory bodies, the geosciences, chemistry and physics, engineering, land use planning, architecture, industrial management, medicine and public health, security, education and training, insurance, etc.<br>• A common communication and information platform<br>• Central and localized coordination, workshops and events<br>• Coordination rules and paths, including notified reporting systems. |
| 4: Diversity of target groups and their requirements:<br>Not all targeted groups need the same capacity development and awareness. | • Adequate definition of target organization and groups<br>• Customer-tailored types and contents of measures organized in programmes of different levels (awareness campaigns: basic, intermediate and advanced programmes) especially at the school level<br>• The offer of the capacity development measures, which depends on the vulnerability of the area (what type of adaptation is necessary to what disaster). |
| 5: Differentiated needs of awareness raising: A large number of vulnerable people with a low level of awareness; preparedness with a diverse cultural and economic background. | • Adapted awareness programmes for raising consciousness about disasters (Awareness-cum-Tools approach)<br>• Specialized local training providers with adapted information, communication and behavioural change methods. |
| 6: Lack of practical testing, learning and coordination processes: Mock drills for practical testing, feedback for improvement and motivation of stakeholder coordination. | • Increasing the frequency of mock drills in disaster prone areas for industrial as well as natural Disaster Risk Management; proper documentation and dissemination to all target groups for learning purposes<br>• Standardization of mock drills for different risk scenarios<br>• Raising public awareness and the use of mass media linked with Corporate Social Responsibility to build partnerships with the private sector. |
| 7: Multiple but weakly-coordinated activities in the area of capacity development: Many different agencies exist, but approaches are uncoordinated; initiative from government, private sector and civil society in terms of rules, regulations, training and preparatory activities. | • Standardization of capacity development programmes; streamlining programmes into a comprehensive offer<br>• Involving all training providers (including educational institutions, management institutions, and human resource development activities of line departments) into one framework system of capacity development. |
| 8: Major differences in qualification of training providers: The quality and the comprehensiveness of existing training and educational programmes can be improved and streamlined considerably. | • Need for recognized (accredited) specialists/masters at each level<br>• Train-the-Trainers programme<br>• Accreditation system at different levels for training providers. |
| 9: Unclear, undefined, underdeveloped or lacking responsibilities. | • Improvement of regulations/requirements of persons responsible for Disaster Risk Management in all the different sectors/institutions<br>• Focus on enforcement of regulations<br>• Certification system within the capacity development programmes. |
| 10: Lacking or weak integration in existing curricula of education and/or training: Train the key persons for all risk sectors and develop concepts of transfer and integration with appropriate resource and demonstration material. | • Integration of Disaster Risk Management into curricula of relevant subjects (i.e. engineering, architecture, land-use planning, basic education). |
| 11: Weak networking among training providers: Weak coordination, internal competition for funds and recognition, communication instruments such as web pages not up-to-date. | • Strong institutional networking of training providers, regulating authorities, administration, private and public sector institutions<br>• Communication and management platform of the capacity development system linked with Internet-based subject-matter information sites. |
| 12: Gaps and deficiencies in DRM infrastructure: Major problems exist at various levels in terms of equipment, regulatory frameworks, enforcement and practical alternatives of reactions for the affected people. | • Feedback system and sharing experiences to streamline and harmonize approaches and detect infrastructure problems<br>• Integrated 'Infrastructure Needs Assessments' in the capacity development process. |

and managerial capabilities of institutions and organizations, enhancing the regulative and integrative frameworks, and providing the institutional infrastructure.

Consider the Indian subcontinent, where there are about 1,700 Major Accident Hazard (MAH) units in place and a large number of small and medium enter-

prises. With both man-made and natural disasters (earthquakes, cyclones or floods), capacity development requires a major endeavour to reach the right people in the corporate sector, administration, and civil society who are able to cope with cultural diversity and needs. The situation requires a decentralized capacity development system that works under a central framework of standards and quality parameters.

A comprehensive capacity development system would assist the National Disaster Management Authority and the Indian Government when it comes to mainstreaming disaster management concerns. It would boost the development and planning process within each Indian state for 'promoting a culture of prevention and preparedness…by centre-staging disaster management as an overriding priority at all levels and at all times'. It would assist stakeholders in:

- The preparation and implementation of state (industrial) disaster management multi-sector and technology-driven strategies and plans to enable prevention, mitigation and preparedness
- The establishment of systems and procedures for coordination between administration, disaster management organizations, other stakeholder institutions, and civil society for ensuring efficient response and relief measures.

**The consequences for a national capacity development system**

To pass on the needed technical and managerial skills and knowledge, increase awareness and stimulate change in attitudes among people in industry, administration, professional organizations and civil society, you must first have a defined structure and mechanisms, as well as a strong management system. This is the only way to ensure you will reach a large number of people.

The system will be based on common capacity development standards that allow decentralized awareness building and training offers adapted to local conditions. It will focus on a 'cascade system' of training providers. National key trainers and nodal training institutions will have their own networks of affiliated training institutions drawn from government departments, industrial training institutions, universities and technical colleges for management, engineering, architecture and medical subjects, as well as non-governmental organizations (NGOs) that have been selected for their regional/international reputation. The following characteristics are defined:

*A National Coordination Centre (DRM-TMC)* — under the National Disaster Management Authority with various units at different institutes/organizations at various places in the country (based on capacity).

*Involvement of 'Nodal Training Providers'* — distributed all over the country and — where possible — working on a public-private partnership scheme.

*Train-the-Trainers programme* — for key trainers and resource persons at various levels.

*Awareness-raising programmes* — at national, state and local levels for the media, civil society and schools. The awareness programmes work with a sequence that increases in intensity. This can be expressed as a series:

- Presence of messages — about risks, first response, prevention measures etc.
- Sensitization — to explain the consequences of risks, and to make avoidance and preparedness interesting, acceptable and positive
- Orientation — to give direction and goals, and show ways to prevent disasters or how to react when a disaster occurs
- Motivation — to be willing to change and to promote change, and show the feasibility of prevention and implementation of measures

Image: Dr R. Dubey - DMI

Practice: decontamination of chemical disaster victims — demonstration by a response agency in a mock chemical disaster drill in India

Image: Dr R. Dubey - DMI

Implementation: field testing the knowledge and skills of fire fighters during a drill at an industrial site

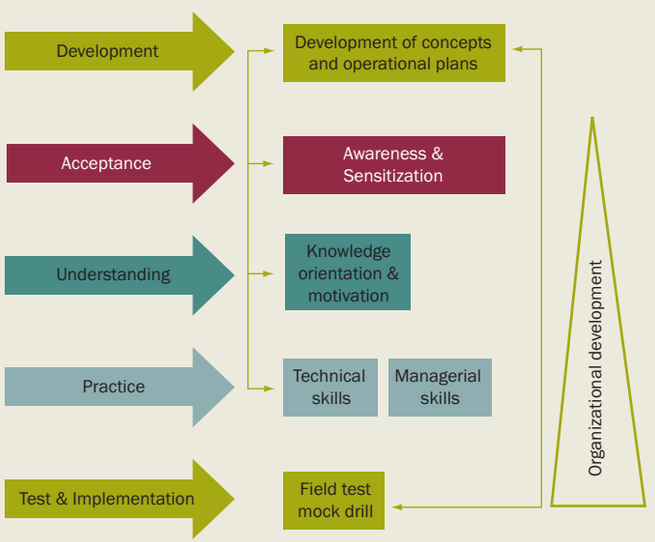
- Mobilization — to join in implementation and begin with your own activities
- Education — to include measures in the education process in schools, and pass on a standard tradition.

*Capacity development programmes* — to be placed at the basic, middle and advanced level for different subjects and different target groups (with a certification system). Each programme should be oriented along the series of steps shown in the included organization chart.

*Mechanisms and standards* — to guarantee recognition, adequate qualifications and integrated quality assurance of training providers and trainers with admission/acceptance and removal criteria.

*Mechanisms with commitments* — from the training providers to spread the capacity development efforts down the line (considering awareness building/teaching/training methods adapted to the absorption capacity of different target groups).

**Capacity development programmes — an organizational chart**




Source: F. Bemmerlein-Lux

Image: F. Bemmerlein-Lux

Development of strategies for disaster risk management for an industrial estate — planners at work

### Discussion among key participants: an important first step

The planning workshop in April 2008 brought together the Indian National Disaster Management Authority, industrial associations, officers in charge of disaster risk management of Major Accident Hazard industries, district collectors (the administrative heads of districts), chief inspectors of factories and boilers (the responsible authority for industrial Disaster Risk Management in each State), the responsible authority for industrial Disaster Risk Management in each State, State Industrial Development Corporations, State Pollution Control Boards, Central Labour Institute, emergency response centres, training providers for industrial managers, and the National Civil Defence College.

The phenomenon of intense, energetic discussions and long hours spent in a planning workshop — a process that can easily get bogged down in technicalities — can be summarized in the words of one participant: "All of us are at different points in the line of potential disasters. We are not contributing to the direct productivity of our industries, we are not increasing agricultural productivity, and we are not building nice houses — we are like Cassandra, and it is not the most pleasant thing to communicate with her. We had the chance here in Bhopal to talk to each other — and we talk about making changes in our system and industry more likely, in order to be better prepared. But we also talked about ourselves, to be taken more seriously."

These programmes are supported under Indo-German cooperation by InWEnt — Capacity Building International, and GTZ-ASEM — Advisory Service in Environmental Management.[2]

Image: F. Bemmerlein-Lux

Understanding: orientation and motivation of planners of an industrial estate

# The centrality of risk management in Concern Worldwide's programming

*Peter Crichton, Emergency Preparedness Coordinator and William Devas, Disaster Risk Reduction Advisor — Emergency Unit, Dublin*

**Concern Worldwide is an international humanitarian organization dedicated to working with people living in extreme poverty to achieve sustainable and major improvements in their lives. Over the last five years, Concern has developed a disaster risk reduction (DRR) policy, and delivered workshops in all of our country programmes to consider how we analyse and respond to risk and vulnerability facing communities.**

We believe that the adoption of a more consistent approach to the identification and management of risk should improve the quality, appropriateness, design and sustainability of programmes and improve the linkages and synergies within and between development and humanitarian interventions.

**Our operational context**

All of Concern's long-term programmes are in countries that fall in the bottom 40 of the Human Development Index or have substantial proportions of their population living in extreme poverty. Given the cyclical nature of disasters in many of the countries in which we work, there is an evident need to link our humanitarian responses to these often recurrent disasters with a broader approach that addresses underlying causes and vulnerabilities if we are to seriously address the causes and impact of poverty. Many of the countries in which we work are experiencing or recovering from conflict; have weak, under-resourced systems of governance; and suffer from inappropriate and unsustainable policies. In addition, many are located in areas that are prone to floods, droughts, tropical storms, earthquakes and landslides — hazards which are often exacerbated by, or are a direct result of, poor policies and practice. The HIV/Aids pandemic and the frequency of malaria have particularly high impacts on many communities with whom we work as their livelihoods are highly dependent on their own labour.

To this complex web of interacting hazards we must add the rapidly evolving risk of climate change and the

Image: Peter Crichton

Zambezi Flood Plain, near Mongo, Western Province, Zambia. Changes to the timing and intensity of the rains and changes to the seasonal flooding of the Zambezi plain is making maize more difficult to grow

Image: Peter Crichton

Nyamlel, South Sudan. Children play in front of an earth bund that protects agricultural land from seasonal floods

closely related threats of fuel and food price rises. These phenomena are already negatively impacting the countries in which we work and disproportionately affecting the poor. The prolonged drought experienced across southern Africa in the last seven or eight years is making maize production increasingly difficult, and the recent extensive flooding in Kenya and southern Somalia are consistent with what climate change models predict for these areas in the long term.

Generally speaking, the poor are most at risk as they tend to be economically, socially and physically marginalized. They have fewer resources to draw upon, have less influence over decisions affecting their lives, risk losing a disproportionate amount of their assets in small localized events, and may be forced to live and make their living from environmentally degraded areas that have a high degree of exposure to multiple hazards. It is generally accepted that development is unsustainable without a proper understanding of how and to what extent communities are vulnerable to disasters, and the establishment of interventions which minimize this vulnerability.

This pattern of recurrent, evolving and increasing hazards contributes to chronic hunger and food insecurity and wide scale environmental degradation, and puts the lives and livelihoods of the poorest under enormous and continual stress. For Concern to contribute to the global eradication of poverty it is essential that we work with the poor in helping them manage risk by increasing their resilience and capacity to anticipate, respond to and recover from shocks and stresses.

**Risk management**

Over the last few years, Concern has used a working definition of risk as being the frequency of exposure to a hazard or hazards, and the magnitude of their impact on people's assets and livelihoods. We recognize that impact is directly related to the degree of vulnerability of an individual or community and therefore that risk analysis requires a detailed understanding of hazards and vulnerability.

The reality of the countries where we work has encouraged us to adopt a broad view of hazards. In addition to the more orthodox hazards associated with weather, geology, and biological threats — diseases and pests that affect humans, crops and livestock — we recognize conflict, poor policies, poor governance, consequences of the global economy and the impacts of climate change as hazards that pose risks to the communities with whom we work.

Consequently, we have also taken a broad view of risk, incorporating the concept of 'extensive risk'[1] which is characterized by large numbers of highly localised events affecting relatively few people and economic assets; but whose cumulative impact over years of cyclical recurrence can corrode the assets of the poor to a greater extent than better publicised major disasters which may result in widespread death and destruction.

The magnitude of impact that any hazard or set of hazards will have on individual or community assets and livelihoods is directly related to the vulnerability of those individuals. Vulnerability describes why individuals and communities are not able to anticipate, cope with, respond to, or recover from hazards and their impacts.

An example of the nature of extensive risk may be seen in Nyamlel, in south Sudan, where a risk analysis process

Image: William Devas

Plaine Mapou, La Gonave, Haiti. A risk analysis recently completed on the island of La Gonave, Haiti showed that addressing environmental degradation is a priority for the community

identified a small group of farmers at risk of losing a significant proportion of their crops every second or third year because of localized, low intensity floods caused by rain water runoff from sloping land. These farmers were participating in an agricultural diversity programme but, because of the regular eroding of their asset base, were not benefiting from the programme in a sustainable fashion that could lead to the establishment of more livelihood options. The vulnerability analysis identified that they could not manage this risk because they lacked appropriate tools to construct an earth bund to protect their fields — something which was easily addressed by the programme — an intervention that had an immediate impact.

In essence, risk management is very simple — it requires that we address the scale, frequency, intensity or impact of a hazard, or people's vulnerability to a hazard, or both. In practice, it requires a careful contextual understanding of the nature, cause and interactions of the many types of hazards, and identifying why communities are unable — or only partially able — to manage the risks that face them as a result of these.

The complexity and nature of hazards facing poor communities are such that it may not always be possible to introduce measures to reduce their frequency, magnitude or scale, particularly in the short term. For example, when looking at the risks facing those in displaced camps in northern Uganda, the underlying hazard facing the community was conflict. While it was not realistic for Concern or our partners to resolve this, risk analysis suggested areas where we could help the displaced reduce their vulnerabilities to some of the consequential risks associated with the conflict. These included issues around firewood collection, the siting of water points, the location of latrines, and protecting particularly vulnerable groups such as households headed by children.

**Risk analysis — an approach to holistic contextual analysis and quality programming**

In addition to responding to humanitarian crises, Concern focuses on four programme sectors through which we seek to realize our mission of contributing to the elimination of poverty: health, HIV/Aids, education and livelihoods. These areas of activity are informed by a number of cross cutting issues including gender and equality. One of the challenges that we have is to ensure that these activities are complementary and collectively contributing to the elimination of poverty.

Contextual analysis and understanding are fundamental to quality programming and risk and vulnerability analysis must be at the heart of the highest level of analysis that we make when seeking to determine where and how we should work.

The starting point for risk management should not be post-disaster, but rather the consistent early application of risk analysis to further our contextual understanding. Risk analysis aims to identify the nature, characteristics, interaction and causes of existing and expected future hazards that threaten poor people's lives and livelihoods, the impact of these hazards, and to establish who is vulnerable to these and why.

Risk analysis should include an analysis of micro and macro issues, and the linkages between them, as this will highlight the underlying causes of poverty such as inappropriate policies, poor governance and the denial of rights. Responding to risks of this nature requires long-term advocacy programmes that are necessarily

Image: Peter Crichton

Lautem, East Timor. Locals maintain their livelihoods by protecting irrigation canals

complemented with programmes to reduce vulnerability, so as to make appreciable differences to poor people's lives in the shorter term.

In Zambia, the longer-term advocacy programme to strengthen the capacity of the health services to deliver anti-retroviral to those who are HIV positive is complemented by subsidising the cost of diesel mills in villages — a measure which reduces the increased workload on women resulting from the reduction of available labour in the community because of sickness, death and nursing responsibilities.

Risk analysis, by its nature, is not restricted to one programme sector, and therefore helps draw together the most important issues for a community, facilitating the easier integration of programme sectors, cross cutting issues and potential areas for advocacy at the outset of programme identification and design. It informs geographical and sectoral programme choices, considers the affects of poverty as well as the root causes, identifies trends, contributes to the anticipation of future risk, and helps prioritize programme choices by grouping and ranking hazards into a hierarchy. It helps suggest how best to protect our programmes from these hazards, so as to ensure their greater sustainability.

A preliminary risk analysis in the central highlands of Angola illustrated a number of these points. The Concern programme was intending to focus on an agricultural diversity programme, education, HIV/Aids awareness, and support to the government's decentralization process. However, risk analysis identified malaria as a principal hazard as it not only threatened the health of the poor, but could also have undermined the sustainability of the proposed programme activities. The peak malaria season coincided with the peak agricultural labour requirements (in an area that had lost most of the draught animals and was thus highly dependent on human labour) and would result in lower programme participation rates. The schools programme would be jeopardized because the incidence of malaria would lead to poor attendance, as children would either have been sick or needed to provide substitute labour for sick adults, and the cost of medical care would mean the diversion of limited money resources from school expenses. In response, Concern determined that helping communities to address malaria — through expanding the roles of existing partners or encouraging specialist malaria focused organizations to work in the area — would have to be an essential complementary activity to the programmes already identified.

Our mandate directs us to work in a group of extremely poor countries, many of which are regressing economically, almost all of which are threatened by recurrent hazards, and all of which have large — and in many cases increasing — numbers of people living in absolute poverty.

Given the predictable nature of hazards in almost all of our target countries, and their impact on the poorest people living in them, the key issue for us is to translate this appreciation of the centrality of risk management into good, documented practice. To pursue this we have identified seven countries in Africa, Asia and the Caribbean where, over the next three years, we will focus on geographical areas where the risk management approach — using risk analysis as a primary driver of programme design — is adopted. It is intended to document and disseminate lessons learnt and examples of good practice from this initiative.

# Education for Sustainable Development as a platform for disaster preparedness

*Sheldon Shaeffer and Derek Elias, UNESCO*

**The United Nations Educational, Scientific and Cultural Organization (UNESCO), as the UN specialized agency for education, has been designated as the lead agency for the UN Decade of Education for Sustainable Development (DESD) 2005-2014, which includes education for natural disaster preparedness as a thematic priority.**

Sustainable development is undermined by the occurrence or threat of disasters. The Director General of UNESCO, Mr Koïchiro Matsuura, has highlighted the significant role of education in improving the capacity of individuals and communities to reduce the risk of disasters, saying: "Anticipating, educating and informing are the keys to reducing the deadly effect of such natural disasters."

Furthermore, UNESCO has identified disaster preparedness as a core environmental issue in the DESD. Education for Sustainable Development (ESD) is an appropriate framework for disaster preparedness in three important ways:

- It is interdisciplinary and holistic. Therefore, important consideration is given to the impacts on, and relationship between society, the environment, economy and culture
- It promotes critical thinking and problem solving that are essential to the empowerment of stakeholder groups threatened or affected by disasters
- It seeks to be locally relevant, acknowledging that languages and cultures say and understand things differently, and addresses both local and global issues.

Image: Derek Elias, January 2005, Ko Surin, Thailand

A Moken man from Mergui Archipelago, Myanmar, relating the story of the tsunami

**Phase 1: natural disaster preparedness and ESD**

In the wake of the 2004 tsunami, numerous assessments began gathering information on its impact on communities and the environment. The focus of activity in Thailand and other countries directly after the disaster was naturally on relief. However, the implementation of many activities was undertaken only with short-term needs in mind while problems of longer-term social, environmental and economic unsustainability were already becoming evident. The Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters identifies education, coupled with sustainable management and planning, as the only effective long-term solution to prepare for, and alleviate, future tsunamis and other natural disasters.

However, much of the existing educational material is either too dry and academic, and/or targets a limited audience. This project focuses on vulnerable populations and the key sectors that suffered as a result of disasters. It includes, but is not limited to, education, agriculture, tourism, environment, fisheries, communication and the private sector.

Significantly, the disaster has served to highlight the importance of local and traditional knowledge in the region. There are accounts in Thailand, for example, of 'sea gypsy' communities that escaped the tsunami based on such knowledge. These and other traditional approaches should be seriously considered and utilized in future education initiatives for disaster preparedness.

**Thailand country highlights**

*Towards sustainable development for the Moken-Andaman Pilot Project* — The sea of South-East Asia is home to unique groups of people, often euphemistically called 'sea gypsies'. They have travelled the region for centuries, living on boats and in temporary settlements along the

Image: Derek Elias, January 2005, Ko Surin, Thailand

Rebuilding Moken village, Ko Surin, Thailand

coasts of southern Thailand, the Philippines, Indonesia, Malaysia and to the far north in the Mergui Archipelago of present-day Myanmar. In Thailand, almost 10,000 sea nomads remain dispersed over the coastal area and numerous islands of the Andaman Sea. These people belong to three distinct communities: the Moken, Moklen and Urak Lawoi, each with its own set of cultural traditions and language.

Since 1998, the Andaman Pilot Project, led by Chulalongkorn University's Social Research Institute, which is supported by UNESCO and, most recently by the National Oceanic and Atmospheric Administration (NOAA), has focused on action and research to achieve sustainable development on these islands as well as cultural heritage conservation among indigenous groups. With generous funding from NOAA, the project was able to build upon this work and contribute to the development of a model for equitable governance for sustained conservation of natural and cultural diversity in the marine protected areas of the Andaman Sea.

For nearly ten years, the Andaman Pilot Project facilitated research on the indigenous sea gypsy communities that inhabit two of Thailand's national marine parks in the Andaman Sea: the Moken of the Surin Islands National Marine Park and the Urak Lawoi of Tarutao National Marine Park in the Adang Archipelago. The pilot project focused on collecting socioeconomic data about the Moken and Urak Lawoi and working with stakeholders to foster an enhanced understanding of the communities' indigenous ways of life, build community capacity, identify economic options that promote cultural survival as well as natural conservation and encourage a cooperative approach to the protection of the natural and cultural heritage of the Surin Islands and the Adang Archipelago.

*The indigenous knowledge that saved the sea gypsies* — While the other sea gypsy groups, the Moklen and the Urak Lawoi, have integrated into Thai society and acquired a modern lifestyle on land, the Moken remain semi-nomadic. They live on boats out at sea during the dry season, coming ashore only during the monsoon season. The total population amounts to approximately 3,000, with 200 living on Thailand's Surin Islands and the rest residing in Myanmar.

The Moken are very knowledgeable about their surrounding environment and natural resources. A nomadic lifestyle has made them excellent navigators with detailed knowledge of the winds, tides and lunar cycles. They are adept at hunting marine animals, including sea turtles, sea urchins, fish and giant clams. To aid hunting, a variety of different tools are employed, varying from hand lines to purpose-built spears, axes and hammers. The Moken are also highly knowledgeable about the terrestrial environment. They use at least 159 species of plants for food and medicine, building materials and fuel. This knowledge of the marine environment helped them recognize the receding tide of 26 December 2004 as a warning sign. When the seawater started to recede, the Moken knew that a 'La-Boon' (tsunami) was coming, so they took refuge on high ground.

The Thai Moken settled on the islands decades ago. Here, they built bamboo huts suspended on stilts several feet above water. Men fished, sold their catch to the mainland and used their earnings to buy rice. Children grew up in the water, where they learned to dive and swim with skill. During low tide, the women scoured the reefs for sea urchins, crabs, mussels and sea cucumbers. For years, the Moken led an isolated life until the Surin Islands were declared a national marine park in 1981. This has triggered a range of complex issues for the Moken that continue to entangle them today, especially the Moken children.

*Indigenous knowledge* — "Providing education to indigenous children is always complex. There is a risk that offering standardized formal education will alienate

Image: Derek Elias, January 2005, Ko Surin, Thailand

A Moken house boat from Myanmar at anchor in Ko Surin, Thailand

indigenous children from their own culture and affect the transmission of indigenous knowledge and cultural heritage from one generation to the other," says Sheldon Shaeffer, director of UNESCO's Regional Bureau for Education in Bangkok. "Many strategies have been developed to address this. Gaining initial literacy in one's mother tongue, then moving to literacy in the national language, is one such strategy. Most research shows that minority children in primary schools taught in their own language acquire knowledge and skills faster." Another strategy is the inclusion of ancestral stories in learning material — such as that about La-Boon. In northern Thailand, minorities have established their own educational programmes using ancient tribal stories as content for reading materials. UNESCO and Chulalongkorn University developed something similar for the Moken. A working system to preserve indigenous heritage, however, is generally hard to develop, especially for small groups like the Moken.

"The fact that the sea gypsies survived, while many others did not, points to certain lessons to be learned from traditional, indigenous knowledge," says Richard Engelhardt, UNESCO's regional advisor for culture in Asia and the Pacific. "Twenty years ago, beachfront construction was light and made of bamboo and thatch that, if it collapsed, would not kill the occupants. The use of such traditional construction 'rules' should be part and parcel of village rehabilitation work."

Unlike other Thai fishing villages affected by the tsunami, the sea gypsies prefer to remain in their traditional homes by the sea. On Ko Surin, where they also escaped without loss of life thanks to their knowledge of the sea, some 170 people had returned by mid-January to rebuild their homes from traditional bamboo and woven leaves.

Aid agencies have thrown themselves into the task of reconstruction. However, UNESCO's Bangkok Bureau observes with regret that, in the Surin Islands and elsewhere in Thailand, "a multitude of aid bodies are bringing in project money and 'staking their claim' to certain areas for providing reconstruction assistance that often does not consider practical matters of sustainability." In a newly reconstructed Moken coastal village in Thailand's Ko Surin National Park, new houses have been built in the forest too far from the water's edge, lined up on a grid, and both too low to the ground and too close together. The result is poor ventilation and sanitation, as well as obstructed views to the sea, even though clear visibility is essential both for monitoring sea conditions and for daily activities along the coast. The Moken would like to rebuild their village in the traditional sustainable manner at the earliest opportunity, if the park authorities will allow it.

UNESCO Bangkok developed a proposal in February 2005 to produce educational materials in health, disaster preparedness and tsunami education for different target groups, including schools, governments, municipalities and the private sector. Once finalized, these materials will be disseminated as part of the DESD.

A problem has arisen from a lack of consultation by local authorities. Another community saved from the tsunami by its knowledge of the sea, the Urak Lawoi, was unwilling to move from its village on Ko Sileh beach near Phuket, where only ten houses had been destroyed and a further 200 damaged. The villagers cited the importance of remaining close to their boats and equipment and the loss of income from fishing if they moved inland. Yet, the governor indicated in mid-January 2005 that 200 new houses would be allocated to the Urak Lawoi community, which was to be relocated to a nearby degraded mangrove forest some 300 metres back from the sea.

In 1995, Uluru-Kata Tjuta National Park and its management board won UNESCO's highest award, the Picasso Gold Medal. They were commended for distinc-

tive landscape and heritage preservation and for raising the standard of World Heritage site administration. In Thailand, there is an apparent openness to such a paradigm. The Department of National Parks, in partnership with Danida, the Danish aid agency, has created a programme for joint management of protected areas. This scheme consists of dialogue with all stakeholders, including indigenous villagers living within the national parks. Issues such as capacity-building for local people, livelihood concerns, land use and tenure will be a focus. According to Chatri Moonstan, Environmental Programme Coordinator at the Danida office in Bangkok, the four-year pilot project will encompass 11 national parks and the western forest complex. Included are some parks with indigenous populations: Ob Luang National Park in Chiang Mai province; Doi Phu Ka National Park in Nan; Talay Bun in Satun, and Hat Chao Mai in Trang, which is also home to sea gypsy communities.

Unfortunately, both the Surin Islands National Marine Park and the Moken are excluded from the project. Nonetheless, it is hoped that this programme will lead to a common policy applicable to all national parks. Given the inclusion of the Andaman Islands in Thailand's tentative dossier for inscription on the World Heritage List, now would seem the time for UNESCO to mobilize support for the inscription of Ko Surin as a mixed site of both natural and cultural heritage.

**Phase 2: education for natural disaster preparedness in the context of ESD**

In direct response to the 2004 Indian Ocean tsunami, in April 2005 UNESCO Bangkok's programme for ESD, established within the Asia-Pacific Programme on Educational Innovation for Development (APEID), initiated a project entitled 'Education for Natural Disaster Preparedness in Asia-Pacific in the context of Education for Sustainable Development'. Funded by the Japanese Funds-in-Trust of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Government of Japan, as well as public donations by the citizens of Switzerland and contributed to UNESCO Bangkok by the Swiss National Commission for UNESCO, the project focused on gathering, developing and disseminating information from key stakeholders in the Asia-Pacific countries most affected by the Indian Ocean tsunami.

The project provided details on the development of culturally appropriate and locally relevant educational materials for natural disaster preparedness which target key stakeholder groups and integrate ESD principles and strategies. It successfully developed and strengthened a regional network to implement and further ESD initiatives throughout the region by promoting education for natural disaster preparedness as well as ESD. This has underpinned an identified key area of the Hyogo Framework.

The impact of the project was evident from the extent to which disaster prevention, recognition and preparedness within the framework of ESD have become integrated into the policies and practices of targeted stakeholder groups. The project articulated the lessons learned by the four in-country project teams: the Maldives, Thailand, Indonesia and India, and two collaborating organizations (the Asia/Pacific Cultural Centre for UNESCO and the Bangladesh Red Crescent Society) in developing materials in collaboration with community groups in the Asia-Pacific region. It provides insights into effective techniques to develop locally relevant educational materials and highlights some of the challenges in that field. Ideally, the undertaking has helped set a strategic agenda in the Asia-Pacific region to ensure education for natural disaster preparedness is firmly entrenched in all educational contexts in the long term.

The launch of the World Disaster Reduction Campaign 2006-2007 led by United Nations/International Strategy for Disaster Reduction (UN/ISDR) has as its main theme 'Disaster Risk Reduction Begins at School'. UNESCO's Director-General Koïchiro Matsuura stated in his opening address: "Education and awareness-raising provide the foundations for a culture of prevention. If people in places threatened by natural disasters were conscious of the risks, and knew how to protect themselves, there would be fewer deaths, fewer wounded and less destruction when such disasters strike".

"Investing in school safety and education pays off in the long term," says Salvano Briceño, Director of UN/ISDR. "Many countries are already drawing the lessons of past disasters and taking measures to improve the level of safety of their schools. We encourage every government in the world to include disaster reduction in the curricula of school children."[1] These testaments clearly proclaim the need for Education for Natural Disaster Preparedness (ENDP) to be integrated into school curricula and for information to be accessible to every member of the community. The initiative aims to ensure that political commitment to these goals is applied until they are realized.

Under the mandate to promote the Hyogo Framework throughout the Asia-Pacific region, the UN/ISDR Regional Programme for Asia and the Pacific co-organized a regional workshop with UNICEF and UNESCO Bangkok in October 2007 on 'School Education and Disaster Risk Reduction'. The regional workshop is the benchmark activity giving opportunity for real dialogue on ENDP between practitioners, curriculum developers and policy makers from a larger number of countries throughout the region.

Following the workshop, eight national institutes in China, India, Indonesia, Japan, Philippines, Sri Lanka, Thailand and Vanuatu agreed to conduct a situational analysis of policies, programmes, curricula and school-based activities and materials in relation to the integration of ENDP or disaster risk reduction into school and teacher education curriculum and training. This project has specifically targeted these eight countries because of their geographic location, population and need for ENDP due to frequent occurrences of natural disasters, in addition to commendable work already undertaken for curriculum development and training under the theme of natural disaster preparedness. Regional outreach can be ensured through coordination with the New Delhi, Beijing, Jakarta and Apia offices of UNESCO.

What is fundamentally at stake in learning and innovation as promoted through ESD is that qualitative educational change must be locally relevant and specific. Issues of global concern today, such as disaster risk reduction and climate change, must be addressed and tackled strategically: education for all is the critical spark to ensure that the broadest and most inclusive response to emerging challenges is ignited.

# Peacetime Strategies for Disaster Risk Mitigation

*Hassan Ahmad, Alicia Wong and S.R. Shiever, Mercy Relief, Singapore*

**Natural disasters are inevitable, and they often occur with little or no notice and require an immediate and effective response in order to prevent further damage or loss of life. Cyclones, earthquakes, tsunamis and typhoons are all forces of nature. Environment abuse has led to the increase of natural disasters. The process of environmental degradation and damage can only be delayed. With the decline in global climate due to environmental and human factors, disaster and risk mitigation has taken on an unprecedented importance.**

Environmentally focused solutions have limitations and require total global cooperation. There must be resources, education and training before they can be put into place. More importantly, the community and the affected peoples must be able to see the relevance of the proposed solutions. Why should fishermen plant mangroves that will stop them from accessing the sea for the daily catch that would feed their families? International experts are brought in with scientific and technical knowledge that has little relevance and connection to the local community. Very often, the proposed solutions are too narrowly focused on the single problem at hand and do not take into consideration the challenges faced by the affected peoples in their daily lives; or offer any alternatives when an environmental solution takes away the only means of livelihood the community has.

In the introduction chapter of the *World Disasters Report 2005*, Markku Niskala, the Secretary-General of the International Federation of Red Cross and Red Crescent Societies (IFRC) said:

"Three things need to happen. First, we must understand what enables people to cope with, recover from and adapt to the risks they face. Second, we must build


Image: Ernest Goh

Meulaboh: history helps — Personnel from Mercy Relief (MR) and the Tentera Negara Indonesia (TNI) delivering supplies to Meulaboh in a Singapore Armed Forces' (SAF) Chinook just days after the tsunami. From left: Iwan Subrata (MR's Medanese partner); Hassan Ahmad (MR's Chief Executive) and Dr Iskandar Idris, (MR's medical volunteer) with other volunteers in the background

our responses on the community's own priorities, knowledge and resources. Third, we must scale up community responses by creating new coalitions with governments and advocating changes in policy and practice at all levels.

"If we focus only on needs and vulnerabilities, we remain locked in the logic of repetitive responses that fail to nurture the capacities for resilience contained deep within every community. We have talked about building capacity and resilience for decades. It is now time to turn rhetoric into reality: to dispel the myth of the helpless victim and the infallible humanitarian, and to put disaster-affected people and their abilities at the centre of our work."

What happens before and after a disaster is all related to disaster risk reduction. The main concern is human life and human suffering. It is time to bring the humanitarian players together; to build an alliance for effective action locally, nationally, regionally and internationally.

**Objective and aims**

Mercy Relief's experiences in Myanmar, Sichuan and Aceh illustrate the importance of alliances and how the interoperability of different systems and institutional interactions are important elements in disaster risk reduction strategy.

**Case study: Cyclone Nargis — Myanmar, May 2008**

Although there were clear signals that there was inadequate capability to manage the disaster alone, the Myanmar authorities were hesitant to welcome foreign assistance. It was a situation where the international humanitarian community, including foreign military assets, had to wait by the sidelines and helplessly watch as the vulnerable survivors try to find food and help in the deteriorating ground conditions. Demands and pressure by the international community brought little positive shift. While aid-offering countries and bodies observed the Oslo Guidelines that humanitarian assistance must be provided with full respect for the sovereignty of the affected states (paragraph 21), the Myanmar authorities lacked confidence that the assistance offered would be purely humanitarian. As the clock ticked, the devastated Ayeyawaddy delta community turned desperate. Timeliness of aid is key to any acute crisis in order to prevent further damage or loss of lives.

Prior to Cyclone Nargis, Mercy Relief had minimal and short-term engagements in Myanmar implementing piecemeal development projects. Had there been a sustained commitment and cooperation previously, Mercy Relief would have had the necessary ground network and trust and confidence of the local authorities, to have been allowed continued and early entry to provide more timely and effective penetration.

When the first groups were eventually allowed in, they were from the immediate neighbours, followed by the Association of Southeast Asian Nations (ASEAN) members, then the other international agencies. However, each country went in with its resources and operated independently of each other. This resulted in serious duplicity of resources leading to wastages, and hence less efficient management of risk.

Whilst Mercy Relief awaited clearance from the Myanmar authorities to move into the badly affected delta areas, it dispatched the first two batches of relief

Image: Jaffar Mydin

Myanmar: caught in the politics of hope – Mercy Relief's volunteer pharmacist K. Thanaletchime administering medication during the daily mobile clinic runs in Twante, Myanmar

Sichuan: goodwill gets better - Having worked closely during the acute phase, the partners launched the reconstruction of two schools in Ziyang. From left: Shi Qian (Ziyang Foundation for Poverty Alleviation); Gerry D'Silva (Hong Leong Group Singapore); Chia Hui Yong and Hassan Ahmad (Mercy Relief), Jiang Shi Lin (Deputy Mayor, Zhiyang Prefecture)

supplies to the Ministry of Social Welfare, Relief and Resettlement and UNICEF in Myanmar. At the same time, Mercy Relief sourced for and built a network of partners on the ground, including the Adventist Development and Relief Agency (ADRA) and Singaporean businesspersons based in Myanmar, all of whom possessed reliable communication links with the local authorities and were already supporting the acute relief efforts in the delta region.

Mercy Relief only managed to deploy its personnel out of Yangon two weeks after the disaster, through the agreement made between the Foreign Offices of Singapore and Myanmar. ADRA is an excellent example – its engagements during peacetime, executing development work in the rural areas, gave it almost unlimited access to Ground Zero and even allowed it to act as a conduit for other foreign and local non-governmental organizations (NGOs) going into rural Myanmar. Working with ADRA allowed Mercy Relief's staff, volunteers, resources and equipment access to the delta region. Mercy Relief was able to latch on to these partners to effect disaster relief in the unique situation that Myanmar posed to all relief agencies.

**Case study: Wenchuan earthquake — China, May 2008**

The Wenchuan earthquake took place nine days after Cyclone Nargis landed on the Ayeyawaddy delta. Although China was geographically further from Singapore than Myanmar, Mercy Relief's response team to Sichuan was at Ground Zero on the fourth day after the quake, a week before its first relief team to Myanmar got out of Yangon. The reason: Mercy Relief had an existing and sound network and goodwill with the local Chinese authorities and NGOs, established through its staff who had implemented development projects in various parts of China. The sustained peacetime engagement and cooperation allowed Mercy Relief to effect timely assistance, with the assured warmth and confidence of the local authorities and partners.

**Case study: Indian Ocean tsunami — Aceh and North Sumatra, December 2004**

In the aftermath of the 2004 Indian Ocean tsunami, despite the challenging terrains of Aceh, Mercy Relief was able to secure early access into Meulaboh and Banda Aceh in the first week of the disaster. Medan (North Sumatra) was the main launching pad for international aid into Aceh, with rotary-wing aircrafts forming an air-bridge between Medan and the other parts of Aceh. The substantial history and goodwill shared by Mercy Relief and the North Sumatran Government (in particular the governor himself), through consistent engagements and joint projects on poverty reduction in and around Medan, gave the former priority and easy access to the air assets.. As such, Mercy Relief was not only able to provide timely and effective penetration into the remote affected areas in Aceh, but also helped pave the way for many other NGOs to set up their bases in Meulaboh. The timely intervention, together with other foreign NGOs and militaries, helped eliminated the risk of a secondary disaster such as an epidemic.

**Lessons learned**

Bureaucracy, while necessary, is machinery that moves too slowly and, more often than not, may prove a stum-


Image: Terence Teo

bling block in emergency response operations. Government-to-government relationships take time to develop. NGOs are generally small and do not have the resources of the governments, international NGOs or intergovernmental organizations. On the other hand, their smallness allows for greater mobility and adaptability, and their personnel are usually made up of specialized generalists. Therefore, the solution for NGOs in a disaster is alliances — alignment and cooperation with like-minded NGOs that share similar goals and vision. Continuous engagement during peacetime can only build goodwill, understanding, cooperation, and lead to easier access and greater efficiency when it comes to risk reduction before and after a disaster strikes.

NGOs generally have a long and intimate history with various communities in the country. They are close to and familiar with the challenges faced on the ground by the communities they serve, as well as the challenges faced by groups working on the ground. They have developed working networks within the community and are familiar with the system of governance in the host country.

Poverty increases vulnerability. Poorer communities are more vulnerable to natural disasters as they do not have the means to prepare themselves against them. Mud houses tend to crumble easily even with lower Richter quakes. The damage to the mud structures, if it does not cause death by impact, may suffocate the victims instead. Peacetime development work not only increases the capacity of the local communities, it also enables the implementing organization to build rapport and goodwill with the local communities, partners and authorities for future cooperation.

The experiences of Mercy Relief and ADRA in the case studies above highlighted the importance of existing good work and will which enabled early and timely response.

**Recommendations**

In a region where 70 per cent of the natural disasters take place, NGOs play a crucial role. It is even more pertinent that a civilian alliance dedicated to humanitarian assistance working with both government and military is built. Asian NGOs have the ability to open doors and cultivate relations. With the track record of disasters in Asia, developing working relationships in the region during peacetime has to take top priority in any risk reduction strategy. The small steps taken to develop working relationships will have a big impact on goals to minimize the risks pre- and post-disaster.

Based on the experiences in Myanmar, Sichuan and Indonesia, and as part of risk management when a disaster hits, social assets in the form of institutional interactions and alliances are equally if not more important than technological, physical and operational assets and capabilities. When a disaster hits, the people who need assistance and the providers of assistance are all involved. It is crucial that the dialogue and engagement starts before the disasters hit.

**Peacetime community capacity building**

Peacetime is when trust and confidence can and should be built, to ensure that when a disaster strikes there is greater chance of reducing the suffering and further loss of lives because timely and necessary assistance can be accessed and implemented based on the relationships built. Risk reduction is often seen in physical, technological, structural and environmental terms. Risk reduction strategy must also take into account capacity building, community development and poverty alleviation — all of which is about enabling people to help themselves, to build their own risk reduction methods. An example of an informal community building that worked and saved lives and only came to light after the tsunami is the people of Simeulue, an island off Sumatra.[1]

**Humanitarian disaster response**

The UN has the Office for Coordination of Humanitarian Affairs (OCHA) as its coordinating office for information. Perhaps there is a need for a working office to coordinate operations for coalitions of NGOs responding directly to disasters in Asia. Effective coordination will contribute to more effective and efficient deployment of resources. The ASEAN Regional Forum (ARF) has included humanitarian affairs in its mandate, with regular exercises.

Governments hitherto have underestimated or ignored the possible impact of NGOs in actual delivery of humanitarian aid in natural disasters. The IFRC's Code of Conduct for NGOs in Disaster Relief includes a section on recommendations to intergovernmental organizations.[2]

Mercy Relief is planning for a possible coalition of NGOs and corporate bodies in Asia, which share resources and network and have regular engagements and exercises. It would involve the heads of respective national disaster preparedness and response agencies. When the alliance of Asian NGOs crystallizes, the issue of civil-military coordination requires address.

# Tuvalu Red Cross: joining forces to tackle climate change in the Pacific

*Rebecca McNaught, International Federation of Red Cross and Red Crescent Societies & the Red Cross/Red Crescent Climate Centre*

**The scientific evidence on climate change is stronger than ever: the Intergovernmental Panel on Climate Change (IPCC) released its Fourth Assessment Report in early 2007, stating that climate change is now unequivocal. It confirms that extremes are on the rise and that the most vulnerable people, particularly in developing countries, face the brunt of impacts. This provides many challenges and opportunities for action in the Red Cross/Red Crescent Movement.[1]**

Climate change has very real local impacts and the time to act is now. It gives us a good reason to assess gaps and opportunities for disaster risk reduction, and avenues for partnership for greater efficiencies. Dialogue and cooperation between the climate change and disaster management sectors is necessary to enable practitioners to understand and address the nature of climate risk with communities.

This case study focuses on Tuvalu, a remote Pacific island nation often associated with the rising impact of climate change. Tuvalu Red Cross Society, aided by enthusiastic volunteers and strong partnerships with government and civil society, have been taking action through risk reduction and disaster preparedness to lessen the worst effects of global warming and other challenges facing the population.

**Tuvalu**

Tuvalu is made up of nine tiny islands in the southwest Pacific, stretching 1,000 km from north to south and with a total landmass of just 26 square kilometres. The capital Funafuti is situated on a coral atoll approximately seven kilometres long and 400 metres at its widest point, bordered by a turquoise lagoon on one side and open ocean on the other. It is home to 4,000 of the country's 11,000 people, vying for space with pigs, vegetable plots, roads, a runway and other infrastructure. Population density for the whole country is 378.9 people per square kilometre, higher than in Japan or India. Medical and government services are all concentrated on Funafuti, where there is also an outpost of the University of the South Pacific.

Tuvalu is strongly influenced by Polynesian culture. The original settlers came from Samoa and Tonga over 3,000 years ago. Youth and women's groups remain strong and active. Women's groups facilitate development work by carrying out skills training to increase household income. Young people lend a hand by fundraising for small projects for their island communities and by organizing social gatherings.

Many Tuvaluans rely on remittances sent home by seafarers or on earnings from seasonal work in New Zealand. For others in Tuvalu, fishing is a major source of income. Only 30 per cent of the population have a wage, mainly those working in the government sector. The rest survive largely on a subsistence lifestyle.

Like the rest of the world, Tuvalu is experiencing rising temperatures. Although temperature records only date back to 1977, a clear trend is emerging, with a marked increase in both winter and summer temperatures. Rainfall records, which date back further, show a decrease in overall rainfall.[2] Tuvalu's highest point is just 4.5 metres above sea level. A sea level gauge located on the wharf at Funafuti has recorded that there are increasingly higher peak sea level events, escalating the risk of inundation by sea surges.[3]

Apart from its vulnerability to rising sea levels, Tuvalu is also at risk of cyclones, tsunamis, house fires, drought, and flooding due to high tides and storm surges. The outer islands are very isolated, making communications difficult, if not impossible at times; the country's two cargo/passenger boats operate when they can to deliver essential supplies.

The Tuvalu Red Cross Society was established in 1981, just after the independence of Tuvalu itself, and has branches on each of the country's islands, with around 100 volunteers on Funafuti atoll alone. It is not yet a fully-fledged National Society, pending recognition and admission to the International Red Cross and Red Crescent Movement. In addition to activities related to climate change and disaster management, its programmes include HIV/AIDS, blood donor recruitment and life skills training.

**Addressing climate change**

In 2005, the Tuvalu Red Cross initiated a pilot project on climate change, in conjunction with the International Federation of Red Cross and Red Crescent Societies' Pacific delegation based in Suva. To start with, much groundwork had to be done to inform other like-minded groups of the unique role of the Red Cross, with a view to building future partnerships. The Tuvalu Red Cross now contributes to the climate change country team, as well as to the national disaster management working group. The Tuvalu Red Cross is a founding member of the Tuvalu Climate Action Network (TuCAN), a joint government-civil society body initiated by the World Wide Fund for

Image: Giora Dan, International Federation of Red Cross & Red Crescent Societies


Tataua Pese of the Tuvalu Red Cross explains how to use a satellite phone for emergency communications

Nature (WWF) that promotes cooperation in relation to the issue of climate change, by raising awareness and sharing skills and knowledge.

The Tuvalu Red Cross climate change and disaster management officer trained 17 volunteers to form an Emergency Response Team in Funafuti in March 2007. When a series of large waves struck a low-lying part of the Funafuti atoll early one morning in April 2007, flooding a number of houses, six families totalling over 100 people were evacuated with the assistance of the volunteer members of the Emergency Response Team. The National Disaster Management Office facilitated the distribution of evacuees into meeting halls — Tuvalu Red Cross took in a proportion of them at the Red Cross headquarters in Funafuti and distributed relief materials. To assist in future response efforts, a lockable 'response box' has since been built in the main office, containing high-visibility vests, portable radios, torches, assessment forms and other items needed for the rapid deployment of the Emergency Response Team.

**Reducing risks**

On World Environment Day in 2007, the Tuvalu Red Cross, in partnership with youth groups, Alofa Tuvalu, Island Care and the Environment Department, took part in activities such as cleaning up the shoreline and planting pandanus along the coast. They conducted similar activities in 2008, as well as a nationwide quiz among youth groups. Such activities combine well with messages promoting disaster preparedness and a cleaner, safer environment.

For the past two years, the Tuvalu Red Cross has had a regular slot on national radio through which it broadcasts messages on health, the environment, climate change and disaster preparedness. For example, during dry periods, the Red Cross reminds people to use water wisely, offers advice on boiling water and stresses the importance of

hand washing. The show has included competitions among schoolchildren and the general public to raise awareness of actions people can take to protect themselves from disaster risks.

To assist in addressing communication problems both during a disaster and at normal times, the New Zealand Red Cross has rolled out a communications strategy across the Pacific in conjunction with Pacific National Societies. The 'talking briefcase' contains a satellite phone, various types of charger, and instructions on how to operate it, all in a waterproof carry case. The Tuvalu Red Cross has been distributing the phones to the outer islands and training branch volunteers in their use. Positioning satellite phones on remote islands increases warning times and reduces response times for climate and non climate-related disasters.[4] The Tuvalu Red Cross has used its satellite phones to deal with emergencies and rented them out to the public to raise funds.

When distributing the equipment, the Tuvalu Red Cross also works with communities to map hazards, such as storms, and find out what coping mechanisms they have that can be built upon. It conducts integrated programmes with communities on disaster preparedness and first aid, in which information on climate change is incorporated since it is such a major concern for the country. The Society facilitates discussions on the effects of climate change on the community and what solutions they and others, including the government, can come up with to counter those effects.

Young people have also been actively involved in Red Cross programmes. School programmes run jointly by the Tuvalu Red Cross, the Tuvalu Meteorological Office and the National Disaster Management Office have targeted primary school pupils and are very popular. The programmes provide an overview of the role of each agency, tips on survival before, during and after a disaster, and information on climate and weather, and include drawing activities, a question and answer session, and first-aid training. Young people have also participated in a national poster design competition on climate change.

**Project impact**

The response capacity on the islands has improved and been put to the test during flooding events. Trained Red Cross volunteers are a valuable addition to the small resource base of the National Disaster Management Office.

There is a better understanding of the Red Cross role and principles among the general public and national stakeholders, which is an important first step in building future partnerships. Branches on the outer islands are being revived to enable better outreach, with 'on location' trained volunteers able to respond quickly in the event of an emergency.

The experiences of Tuvalu Red Cross have been documented in the Red Cross/Red Crescent Climate Guide to assist other national societies that are seeking guidance on how to get started on climate change.[5]

The Tuvalu Red Cross is now an active member of the National Disaster Committee and works in partnership with the National Disaster Management Office and the Tuvalu Meteorological Office, facilitating the sharing of expertise and the pooling of resources.

Eight satellite phones have been distributed to the outer islands and the isolated islet of Funafala to facilitate emergency communications.

People in Tuvalu have a better understanding of climate change and what steps can be taken to address it.

Youth groups know about and are involved in Red Cross activities. They have taken part in workshops on climate change and disaster risk reduction, prompting them to initiate related activities in their own communities.

In an international exchange, the Tuvalu Red Cross has been providing materials to a British Red Cross youth worker who has been highlighting the impacts of climate change in Tuvalu in United Kingdom schools; the materials are being used for the development of youth drama based on the flooding event that occurred.

**Lessons learned**

- Developing strategic and operational partnerships results in less duplication, greater sharing of knowledge, and better funding efficiency
- Creative communications, using media and drama offers exciting opportunities
- Conducting regular scheduled 'call-ins' to headquarters using satellite phones that have been distributed ensures users continue to get practice
- Climate change integrates naturally within regular programmes but also presents the opportunity to ask what can we do more of, differently or better?
- Hiring out equipment such as satellite phones in remote locations, with the right provisions in place, can be an effective fundraiser for the Red Cross
- Strong media interest can provide an opportunity to highlight the need for proactivity and risk reduction measures in dealing with the impacts of climate change
- Tapping into existing networks, such as youth groups, can be effective; young people can be powerful and creative agents of change
- Technical knowledge in government ministries can be complemented by the use of volunteers to spread information and serve as 'the legs and the voice' on the ground
- Addressing climate change can reinvigorate and empower young volunteers
- Incorporating simulation exercises and conducting regular refresher courses are important in volunteer training
- In a small country, volunteers can be shared between organizations to ensure that they are not underutilized
- Sharing experiences with other stakeholders means that a topic or a problem can be viewed from many angles.[6]

**Where to next?**

The Tuvalu Red Cross plans to expand its activities further to ensure that disaster risk reduction, preparedness and response reach even the furthest islet. These will build on existing partnerships and activities with their partners and include induction of more volunteers on outer islands, sharing community participation skills and linking communities to expertise and funding sources. Tuvalu will also continue to input into the regional capacity of the Pacific Red Cross Movement. From little things, big things grow![7]

*Adapted from an original IFRC report.*[8]

# Reporting IBC — a Turkish NGO's response to the Pakistan earthquake

*Ana Oprisan, International Operations Manager, International Blue Crescent*

**The International Blue Crescent (IBC)[1] is an emerging Turkish non-governmental organization (NGO), working since 1999 to improve the lives of the suffering people, especially the most disadvantaged, both in Turkey and in other countries, including Albania, Kosovo, India, Iran, Indonesia, Pakistan, Bangladesh, Syria and Sudan. As its mission states, IBC has been working to help in alleviating human suffering, hunger and illiteracy among all people, regardless of nationality, ethnicity, race, colour, social origin, religion, belief, language, political opinion, gender, age, sexual orientation or genetic and physical features.**

In April 2003, with the aim and intention of increasing its effectiveness internationally, IBC became a member of the International Council of Voluntary Agencies (ICVA), headquartered in Geneva; and at the 13th ICVA General Assembly in 2006, IBC was elected to its Board of Directors. In July 2006, it was given 'Special Consultative Status' by the Economic and Social Council of the United Nations (ECOSOC). IBC also has a member in the COPPEM Presidency Council. Headquartered in Palermo, COPPEM is the Standing Committee for the Euro-Mediterranean Partnership of Local and Regional Authorities.

Image: IBC Archive

Beneficiaries loading vans: during December 2006-January 2007, beneficiaries of IBC's Winter Relief Distribution Project received kitchen sets, blankets, water tanks, quilts and pillows

**The Pakistan earthquake and IBC's response**

On Saturday 8 October 2005, at 8:50 am, a 7.6 magnitude earthquake struck the India-Pakistan border with more than 140 aftershocks, causing extensive damage in Pakistan, India and Afghanistan. Reports indicated that more than 82,000 people were killed and more than 3.3 million people were left injured or homeless.

In the post-disaster response, the international NGOs added their inputs to the Federal Relief Commission's (FRC) joint collaboration with the military and the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), leading to an effective coordination of the relief process. Later on, the planning for rehabilitation and longer-term development was led by the Earthquake Reconstruction and Rehabilitation Authority (ERRA)2 and the core group of donors.

While generally challenges were encountered in managing the transition from military back to civilian administration, from UN coordinated support for relief to donor mobilization of long-term resources and from a humanitarian response to a development process, it can be said that the context of the emergency response in Pakistan was unique in the sense that it involved cooperative and competent national authorities.

**The IBC Pakistan mission**

IBC's mission in Pakistan started one week after the tragic event of the earthquake, the aim of the first interventions in the field being to respond to the primary needs of victims as winter approached in this high-altitude environment and the settlements of mainly Azad Jammu and Kashmir (AJK) were difficult to access.

Consequently, IBC has continued its post-disaster intervention through different rehabilitation and reconstruction projects. In parallel with its activities in the field, IBC has received long-term grant permission to work in Pakistan from the Ministry of Economic Affairs and Statistics, Economic Affairs Division (EAD). After the emergency phase, IBC continued to implement its projects in the framework of memoranda of understanding (MOUs) signed with ERRA.

The Pakistan mission's activities have been financially or technically supported at different stages and in different sectors by donors as Malteser International, the United Methodist Committee on Relief (UMCOR), the American Joint Distribution Committee (AJDC), UN-Habitat, Trocaire Ireland, and other private donations.

**IBC activities in the emergency relief phase**

IBC's immediate response after the earthquake in Pakistan consisted in the following activities:

- Distribution of food packages, October-November 2005 — provision of supplies for two weeks, for 600 families in Rawlakot/Ali Sojal Tehsil
- Distribution of non-food items (NFIs), November 2005-January 2006 — provision of shelter and basic survival NFIs to 200 families in the high-up villages in Bagh District (tents, CGI sheets, bedding sets, stoves, kitchen sets and shelter fixing tools).

The emergency relief phase was planned to last around six months after the October 2005 earthquake struck northern Pakistan. However, even one month after the disaster occurred, a number of activities were initiated to support the speedy recovery of the affected population, concurrently with ongoing humanitarian and life-saving operations.

On the other hand, the challenging environment of the earthquake-affected area of Kashmir proved that providing only immediate post-disaster relief activities would not be enough, as the region is negatively affected by weather conditions at different times of year (winter and Monsoon months) and the lack of infrastructure creates a permanent need for intervention. For example, IBC had to keep a bulldozer at its field camp in Salmia UC for a year, ready to clear the surrounding roads which were blocked regularly due to landslides or snow. This prolonged need for intervention led to an initiative to support some village committees to start a road clearance and construction project. Later on, this project proved a major support for rural housing reconstruction, in terms of facilitating access for transportation of construction materials and so on.

One year after the earthquake, during December 2006-January 2007, heavy snow affected hundreds of households in the area where IBC operated, cutting off access to major cities nearby and forcing people to demand immediate support from the teams deployed in the field. In this particular case, a Winter Relief Distribution Project was implemented with the prompt financial support of donors, addressing 956 vulnerable households. The beneficiaries received kitchen sets, blankets, water tanks, quilts and pillows.

Some months later, in April 2007, due to long rains causing major landslides in Salmia, a Landslides Victims Support project was required. During this emergency, 147 households received CGI sheets, shelter fixing tools and plastic sheets. The assessments and work done during the implementation of this one-time intervention led later on to inputs to a Policy Paper for the Landless, on the common contribution of UN Habitat, NGOs and ERRA.

The Sarbala Village Support Initiative is one example illustrating the need for prolonged emergency intervention mixed with speedy recovery activities. The first intervention in the village under the IBC/AJDC venture included the distribution of NFIs after the earthquake in 2005. Between March 2006 and January 2007, activities included road clearance provided after major landslides, erection of large-sized tents for the boys' and the girls' primary schools, distribution of winter jackets to the students of the primary schools,

Image: Florian Kopp

IBC worked to support children of all ages following the earthquake

distribution of educational, recreational (toys) and hygiene kits to 250 pre-school-age children, and installation of a playground in the village.

Given all the challenges in implementing post-disaster activities in AJK, the early recovery took a longer time. Now, the aim is to shift the focus from saving lives to restoring livelihoods, thus effectively preventing recurrence of disasters and harnessing conditions for human development.

**IBC's involvement in the rehabilitation and reconstruction phase**

The common efforts of ERRA, UN-Habitat and NGO partner organizations led to the elaboration and implementation of the 'Building Back Better' strategy for rural housing reconstruction. The basic principles of the approach included the fact that the reconstruction of houses will follow the principles of enablement; locally known construction technology will be promoted with

Image: IBC archive

Hands-on training was given through the construction of earthquake resistant model houses for the most vulnerable households

pragmatic improvements for seismic resistance; reconstruction will be promoted based on timeliness, practicality, basic seismic safety and local technology; future reliance of the community on technical assistance will be minimized by creating a self-sustainable talent pool in earthquake resistant construction; local uniqueness will be respected over monolithic implementation of standards, and reconstruction efforts will support environmentally friendly building techniques.

**Safe building training for rural housing reconstruction**

For the implementation of the owner-driven Rural Housing Reconstruction Strategy, IBC took over two Union Councils — Salmia and Sena Daman, both situated in Hattian Tehsil, Muzaffarabad District, AJK. The activities of these two projects were implemented by mobile teams (each team having one engineer, one mason, one carpenter, one male and one female social mobilizer) covering the area for community mobilization and formation of Village Reconstruction Committees.

The main focus of the projects was to train self-builders and local artisans in earthquake-safe construction techniques. All training modules were supported by visual material and using accessible language. Information materials with simple drawings and pictures were distributed and explained. All members of the mobile teams were trained before the start of the project by experts from UN-Habitat and the National Society for Earthquake Technology (NSET), Nepal.

Both projects included door-to-door assistance for self-builders, with IBC mobile teams monitoring and technically advising on earthquake resistant guidelines. IBC also assisted the monitoring visits of the army inspection (AI) teams in evaluating progress and supporting the beneficiaries receiving housing instalments from the Government.

The Safe Building Training and Technical Assistance for Rural Housing Reconstruction project in Salmia UC was implemented between May 2006 and June 2007, covering 16 main villages and 45 sub-villages. The four mobile teams working in the UC provided training to 297 masons, 411 carpenters, 22 steel fixers, 9,205 male self-builders and 388 female self-builders. The training sessions (both theoretical and practical) were held at IBC Rawal Gali field camp (also using multimedia) and at different venues in the sub-villages. Hands-on training was facilitated through work contribution of the trainees in building earthquake resistant model houses for 80 of the most vulnerable households (headed by widows, disabled people and senior citizens). As part of the technical support component of the project, tools sets were distributed to the self-builders, assistance was provided for the registration of the landless, village link roads were cleared and constructed, facilitating the transport of construction materials to the villages.

The Safe Building Training for Rural Housing Reconstruction programme in Sena Daman UC covered 19 main villages and was implemented between March and December 2007. Five mobile teams were active in community mobilization and lobby for use of earthquake-safe construction guidelines. During ten months of project implementation, IBC trained 2,353 masons, 798 carpenters, 3,866 steel fixers, 3,014 male self-builders and 707 female self-builders.

**Reconstruction in the health sector**

In the framework of rehabilitation and reconstruction policy in the health sector, IBC is involved in the physical reconstruction of eight basic health units (BHUs) in Muzaffarabad and Bagh districts (two BHUs in villages that were earlier targeted by IBC during the emergency phase), in AJK. The project was implemented with the financial support and in partnership of Malteser International, which is also going to provide the necessary furniture and equipment and also eventually support strengthening the referral system.

At each site, IBC is constructing earthquake resistant clinics (with structural and architectural designs based on detailed soil investigations and approved by the National Engineering Society of Pakistan (NESPAK), the technical consultant of ERRA), as well as two additional accommodation quarters for the lady health visitors (LHVs) and medical officers (MOs) to be stationed at these clinics.

**Reconstruction in education sector**

As in the health sector, the reconstruction of education facilities must follow the standards imposed by the regulating body, ERRA — all physical reconstruction projects have to pass the requirements of the technical body, NESPAK, before receiving a Non-Objection Certificate (NOC) for start of work. In the framework of the venture with AJDC in Sarbala — the 'adopted' village for reconstruction and rehabilitation — IBC is reconstructing three governmental school buildings: boys' and girls' primary schools and a girls' middle school. The schools will be provided with necessary furniture, ready to start the new educational year.

Following IBC's involvement in developing and introducing earthquake-safe and easy-to-build technologies, plans are being developed for IBC to take over the physical reconstruction of an additional 100 schools, to be sponsored by ERRA itself.

Image: IBC Archive

Theoretical training sessions were held at IBC Rawal Gali field camp and at different venues in the sub-villages

**Community development**

As a strategy for better effectiveness in implementation of its projects, for more comprehensive development of community ties and sustainability follow-up, IBC focused its interventions in selected areas, instead of spreading them over too many districts of the earthquake-affected area.

One of the villages targeted and addressed by IBC through all the post-disaster phases is Sarbala village — known to locals as 'the village in the sky' due to being situated on a mountaintop at a 7,500-foot elevation, at the border between Muzaffarabad and Bagh districts in AJK. The community of Sarbala, with a population of around 200 families, has been part of all IBC intervention stages.

Besides its share in the emergency phase, the rural housing reconstruction project that IBC has implemented in the same UC, the schools reconstruction and all other small initiatives in this particular village, IBC has built a community centre as a space for interaction and learning for Sarbala and surrounding villages. The multi-purpose building is providing a meeting space for the community, for common decision making and also for hosting the community's most important events; a space for initiation of vocational training and income generation for women (sewing and embroidery classes); a space for day-care, leisure and learning for pre-school children; modern skills learning for the youth (basic computer use skills supported by a small computer lab), and a facility for school support and learning, with the establishment of a small library (the first ever in the village or its surroundings).

**In summary**

Being impartial in its approach toward targeted beneficiaries and in relations with its various international donors, being non-political and non-religious but nevertheless coming from a majority Muslim country, IBC definitely has an advantage in working in parts of the world where these can be very sensitive issues. In addition, given the general well-received Turkish response by Pakistani society, IBC has managed to do its work in very challenging locations and conditions, encountering fewer difficulties than those reported at times by other agencies.

Summarizing the efforts put into Pakistan earthquake response, it can be said that IBC had a very interesting opportunity to be involved in original approaches and coordination (such as its participation in Clusters and Humanitarian Hubs, and the strategic approach of owner-driven reconstruction), to be working with both civilian and military entities involved in the relief and to act in extremely challenging environments. However, when quantifying and comparing the resources used, the timeframe of intervention and targets achieved, it can be observed that much more effort has been put into the Pakistan operation than in other emergencies, due to factors such as the extreme working environment, both geographically and climatically, lack of infrastructure and lack of qualified manpower.

From mountaintop village community meetings to strategic meetings at Islamabad level, from reaching earthquake victims by helicopter to providing aid on footpaths, using porters and mules, from rubble to building hope, the Pakistan response has been for IBC an amazing adventure and continuous learning process.

# The changing face of disaster management in South Africa

*Lance Williams, National Disaster Management Centre, South Africa; Pat Adams, President, DMISA*

**South Africa has made significant progress in complying with the Hyogo Framework for Action (HFA). There follows an account of some of the important milestones the nation has achieved in each of the HFA priority areas.**

HFA Priority 1 is to ensure that disaster risk reduction (DRR) is a national and local priority with a strong institutional base for implementation. Mainstreaming DRR is a crucial factor in the implementation of the HFA, supported by sound policy and legislation.

Disaster Management Act No. 57 (2002) recognizes the wide-ranging opportunities in South Africa to avoid and reduce disaster losses through the concerted energies and efforts of all spheres of government, civil society and the private sector. However, it also acknowledges the crucial need for uniformity in the approach taken by such a diversity of role players and partners.

The National Disaster Management Framework (NDMF), published in 2005, is the legal instrument specified by the Act to address such needs for consistency across multiple interest groups by providing a coherent, transparent and inclusive policy on disaster management. It recognizes a diversity of risks and disasters that occur in Southern Africa, and gives priority to developmental measures that reduce the vulnerability of disaster-prone areas, communities and households.

Image: Western Cape Disaster Management

November 2007 flooding in the Eden District

The NDMF comprises key performance areas that are informed by specified objectives, and each concludes with a list of guidelines that will be disseminated by the National Disaster Management Centre (NDMC) to support the implementation of the NDMF in all three spheres of government. The NDMC, Intergovernmental Committee on Disaster Management (ICDM), National Disaster Management Advisory Forum (NDMAF) and similar mechanisms at provincial and municipal levels have been established for systematic coordination of DRR.

The *South African Disaster Risk Management Handbook* series is being developed by the NDMC. Divided into ten critical outcomes for the development and implementation of disaster risk management, each presented as a separate handbook, it consists of a set of guidelines and support materials to help district and metropolitan municipalities and provinces to implement the Act and the NDMF, and to mainstream DRR into developmental plans and frameworks.

**Monitoring and assessment**

HFA priority 2 is to identify, assess and monitor disaster risks, and enhance early warning systems. Disaster risk assessments almost always require specialist input, and South Africa has many research institutions, government departments and private companies with expertise in assessing and managing different types of risk.

When working with technical specialists, the commissioning organ of state must define terms of reference that specify feedback, consultation, skills transfer and capacity building processes by the specialists commissioned. This is particularly important given the complex character of hazard and risk science for non-specialists, and the serious legal and other implications of disseminating incorrect or unverified disaster risk assessment findings that inform planning decisions.

In South Africa, disaster risks are more significantly shaped by social, economic and environmental conditions than by external threats. It is therefore critical that disaster risk assessments should be 'ground-truthed' (based on the actual situation 'on the ground'), with field consultations in areas and communities most at risk.

The NDMF provides for the establishment of a Technical Advisory Committee (TAC) comprising nationally recognized specialists in the hazards, vulnerabilities and disaster risks being assessed. In establishing standards and exercising quality control, the TAC will ensure that uniform methodology is used for assessments, that all disaster risk management planning and practice is based on scientifically sound risk assessments, and that those commissioning disaster risk assessments can access advice and technical support.

**Early warning systems**

Early warning systems relating to fire are maintained through the Advanced Fire Information System (AFIS) and the Fire Danger Index (FDI). Both use satellite technology combined with geographical information systems (GIS) and short messaging service (SMS) technology to monitor fire events and warn relevant role players.

The FDI is a web mapping application that combines data gathered from weather stations throughout South Africa. This is then organized and processed to provide an input to the FDI model that determines the weather conditions conducive to fire events. The final product is an ESRI ArcIMS map showing areas at high risk for that time. The FDI is updated twice daily and SMS is used to inform the relevant role players of the fire risk status for their areas.

AFIS is the first near-real-time operational satellite fire monitoring system in southern Africa. Satellite technology is employed to monitor live fires at up to 15-minute intervals and display these on a web mapping application. The Satellite Application Centre is in the process of customizing and further developing AFIS to enable not only the detection of fires but also the prediction and assessment of future fire events.

The NDMC has a mandate to gather, collate, analyse and disseminate relevant information about disaster events as specified by the Disaster Management Act. Communication of these events is managed through web applications, cellular technology and e-mail. The Situation Reporting application enables role players to capture events and their associated properties on web-based applications with spatial and non-spatial attributes for the events repository hosted in the NDMC database. Provincial, district and local role players can use the NDMC database, together with web mapping technology, to generate reports on events based on temporal, spatial or attribute levels in the form of maps, graphs and reports.

Image: Working on Fire

July 2007 wildfires in Mpumalanga

**Case study: Air pollution in South Durban, KwaZulu-Natal**

Vulnerable communities are adversely affected by the low-level, long-term risks of living in close contact with the environment. South Durban provides an important example of human vulnerability to air pollution. Durban is the largest industrial centre of the eThekwini Metropolitan Area, where working class communities live in close proximity to chemical and other 'dirty' industries, and are exposed to the accompanying health risks. This industrial region includes the nation's largest petroleum refinery, its second-largest petrochemical factory, and 180 smokestack operations. The complex land-use mix is compounded by the geography of the area, the topography being a basin, with frequent inversion layers and poor air circulation that cause aggravating air pollution problems.

The scale and scope of the air pollution problem in South Durban has been fiercely contested over the years, abetted by a shortage of reliable information on the true extent of the problem. The area has seen intensifying environmental activism since the early 1990s, particularly from organizations such as the South Durban Environmental Alliance, an umbrella organization.

Until recently, little incentive or coercion existed for companies in South Durban to adhere to environmental emission standards. Despite a comprehensive framework of environmental legislation, enforcement in the area has been weak due to a lack of external monitoring and enforcement capacity.

In an effort to find a sustainable solution to the poor air quality problem in the South Durban Basin, the Government initiated the South Durban Basin Multi Point Plan (MPP), which received multi-stakeholder endorsement in May 2000 and cabinet approval in October 2000. Key project areas include establishing a modern air quality management system comprising 11 air quality monitoring stations; undertaking a health study to measure exposure levels; setting air pollution standards; and phasing out polluting fuels in an effort to reduce sulphur dioxide and fugitive gas emissions.

The MPP has contributed to a 45 per cent reduction in sulphur dioxide emissions and to the phasing out of fuels with excessive sulphur content. It has also initiated an investment of over ZAR1 billion from industries that contributed to the sulphur dioxide reduction plan. Further reductions in sulphur dioxide emissions are anticipated over the next few years through continuing regulatory intervention.

South Durban is a good example of how participatory processes involving stakeholders, the local community, government and industry, form the pivotal component in making MPP a reality and, most important, in delivering quantifiable results.

One outcome of the MPP is that the Government is considering other potential pollution hotspots in the country, such as the Vaal Triangle. These could be declared priority areas under the new Air Quality Act, and therefore deemed suitable for the MPP approach in dealing with air pollution, which in turn could help to address human vulnerability.

Image: Mpumalanga Disaster Management

April 2008 hailstorm in Mpumalanga

The South African Weather Service (SAWS) plays an integral role in the region's DRR activities. It is mandated to be the sole provider of weather-related warnings over South Africa in order to ensure a single authoritative voice in this regard. It therefore has established links for the dissemination of advisories and warnings to relevant disaster management centres through its regional forecast offices. Its officials participate in national and provincial disaster management advisory forums, and in meetings and conferences related to disaster management activities. The excellent collaboration between forecasters and disaster managers was highlighted during the devastating storms that affected the country in early August 2006.

The SAWS maintains a climatological database of weather data over South Africa, which is used regularly in DRR and mitigation activities. The South African Cabinet has tasked the NDMC and SAWS to develop clear guidelines for the South African Integrated National Early Warning System.

**Building a culture of safety and resilience**

HFA Priority 3 promotes the use of knowledge, innovation and education to build a culture of safety and resilience at all levels. The interplay between environmental change and socio-political and economic issues operating at different scales is a critical area requiring more research in South Africa. There is also a need to understand what generates vulnerabilities and what improves resilience in people's livelihoods in both 'normal' and 'stressed' conditions. Responding to human vulnerability in South Africa requires building on people's own responses, providing a range of institutional support, and promoting resilience and adaptive capacity among vulnerable people.

South Africa's Disaster Management Act provides for an integrated and coordinated disaster management policy that focuses on preventing or reducing disaster risks, mitigating their severity, emergency preparedness, rapid and effective responses to disasters, and post-disaster recovery. Linked to such a policy, vulnerability assessment can measure the severity of potential threats on the basis of known hazards and the level of vulnerability of societies and individuals. It can be used to translate early warning information into preventive action, and is necessary for early warning and emergency preparedness. Despite growing political will to twin vulnerability and development efforts and enhance resilience to stresses including climate variability, the institutional design and architecture that may be required are still in the formative stages.

**Education**

Over the years, various themes have been followed to observe International Strategy for Disaster Reduction (ISDR) Day. For ISDR 2006/07 and 2007/08 there was an emphasis on schools as a starting point for DRR. The Tshwane Disaster Management Centre, in collaboration with the African Centre for Disaster Studies, introduced a project in primary schools as part of the National Curriculum – it comprised a guide pack to serve as a tool for teachers to introduce disaster management principles into the curriculum in an engaging way. The content forms part of the social sciences and environmental management sciences learning areas for grade five, six and seven learners with the theme, 'Be Aware, Prepare and Share'.

In 2006, the NDMC participated in a joint venture with Chris Hani District Municipality (CHDM) to celebrate ISDR Week. The concept involved learners in primary, secondary and high schools competing in art, music and drama, portraying the impact of disasters on communities, how these can be prevented, and the role of communities in increasing their own resilience to disasters.

The South African Qualifications Authority (SAQA) is a statutory body responsible for overseeing the implementation of the National Qualifications Framework (NQF). Part of SAQA's responsibility is to generate and register qualifications. The Directorate Standard Setting

and Development worked closely with the NDMC to establish a standard generating body for the development of national qualifications standards in disaster management. SAQA registered the National Certificate: Disaster Risk Management on Level 7 of the NQF. A learning programme in Disaster Management on Level 4 was also developed and registered against the Generic Management qualification on Level 4. Work has been completed on developing a Level 5 and 6 qualification to complete the suite of qualifications in disaster management.

**Reducing risk**

HFA Priority 4 focuses on reducing underlying risk factors. The Department of Social Development has established a Social Relief of Distress Programme in terms of the Social Assistance Act, 2004. The programme provides temporary assistance to people who are unable to meet their families' most basic needs. Social Relief of Distress — in the form of a food voucher or parcel or, in the case of some provinces, cash — can be obtained from the Government if a person is in a crisis situation. Social Relief of Distress is usually given for up to three months, and sometimes for six months.

The Department of Housing has implemented the National Housing Programme which provides temporary assistance in the form of secure access to land, basic municipal services and/or shelter. The programme assists those who have, for reasons beyond their control, found themselves in an emergency housing situation. It is only applicable in emergency situations of exceptional housing need. Assistance under this programme should wherever possible represent an initial phase towards a permanent housing solution.

Sustainable development is not possible if disasters are continuously damaging infrastructure, property and livelihoods. It is important that the relationship between disasters and development is recognized so that proactive action can be taken to eliminate or at least reduce the impact of disasters.

The cost of a disaster sets back development, since projects are often delayed due to the diverting of funds. On the other hand, when disasters occur they provide an opportunity to rebuild 'smarter' — that is, to avoid the likelihood of repetition of the disaster, and to plan for a sustainable and safe future.

Integrated Development Plans (IDP) are a key tool used by the South African Government to tackle its new developmental role, fostering more appropriate service delivery by providing the framework for economic and social development within municipalities while factoring in disaster reduction measures as part of a disaster management plan. The IDP process aims to arrive at decisions on key issues such as municipal budgets, land management, promotion of local economic development and institutional transformation in a consultative, systematic and strategic manner. It therefore not only informs municipal management on key issues, but also guides the activities of other spheres of government, corporate service providers, NGOs and the private sector.

**Strengthening preparedness**

HFA Priority 5 advocates the strengthening of disaster preparedness for effective response at all levels. South Africa has been involved in foreign USAR response since 1999 when a volunteer team responded to the Izmet earthquake in Turkey. South African teams have subsequently responded to disasters in Mozambique (2000), India (2001), Algeria (2003), Iran (2003) and Pakistan (2005). The team has always been 'heavy rescue' capable, meaning that they are able to stabilize and enter major structural collapses (heavy construction).

**A voice for disaster management practitioners**

Disaster Management practitioners in southern Africa can voluntarily join a professional association called the Disaster Management Institute of Southern Africa (DMISA). The majority of South African provincial and municipal disaster management officials are members of this 22-year old organization. DMISA functions on a voluntary and non-profit basis with only one permanent employee – the rest of its governance structure (Council, Executive Committee and President) consisting of elected office-bearers that have full-time disaster management positions.

As the voice of the disaster management professional, DMISA maintains a close relationship with the South African National Disaster Management Centre (SA NDMC), communicating the collective concerns and opinions of those working in disaster management to the highest decision-making authorities.

DMISA strives towards continuous professional skills development in disaster management through nurturing a culture of disaster risk reduction and advocating international disaster management best practice, including the alignment of disaster management practice in southern Africa with the Hyogo Framework for Action.

DMISA activities provide learning and networking opportunities for disaster management practitioners and its annual conference has become a southern Africa disaster management pilgrimage for many. Training, capacity building and the development of qualifications standards for the profession remain a central focus of the Institute in its engagement with government and other disaster management role players.

Evolving from civil protection, embracing the focus on proactive disaster risk reduction and playing an active role in policy and legislation formulation as well as supporting members with implementation, DMISA has been able to raise the visibility and status of the disaster management profession in southern Africa and commits itself to continued constructive partnership with the SA NDMC and international bodies such as the UN/ISDR.

www.disaster.co.za

In 2005 the NDMC in cooperation with USAID presented an advanced USAR course to rescue instructors from throughout South Africa. Since then, more than 90 additional rescuers have been trained.

At present South Africa is the only country in the SADC region with a USAR capacity, and it has been improving the system to enable it to respond within eight hours to disasters occurring outside South Africa.

An important feature of South Africa's capacity, which sets it apart from similar international teams, is its ability to respond to a wider variety of incidents such as floods and chemical incidents. This was proved during the earthquake disaster in Kashmir, Pakistan in 2005 when the team was used to access victims in the Kashmir mountains and carried out medical operations in a remote field hospital. More than 100 people were rescued.

The Emergency Operations Committee (EOC), which is co-chaired by the Department of Foreign Affairs and NDMC, was established as a result of the Asian Tsunami Disaster in December 2004 and comprises key role players from national and provincial departments as well as relevant NGOs, depending on the nature of the disaster. Its purpose is to coordinate international response to a disaster.

# Cultural heritage and seismic risk: some European experiences

*Francesc Pla, European and Mediterranean Major Hazards Agreement, Council of Europe*

**Cultural heritage is a key element of the history and identity of societies, contributing to their economy and well being. Disaster reduction, as a tool of sustainable development, concerns not only the prevention of loss of lives and property, but also the protection of cultural assets and the environment from natural or technological hazards.**

Founded in 1949, the Council of Europe with its 47 member states seeks to develop common and democratic principles throughout Europe, based on the protection of individuals, democracy and the rule of law. Its main tasks include achieving a greater unity between its members to find common solutions to the challenges facing European society. Over the last 20 years, the Council of Europe has been promoting the reduction of the vulnerability of ancient buildings and historical settings from earthquakes and other risks through its European and Mediterranean Major Hazards Agreement (EUR-OPA).

EUR-OPA currently counts 25 member states, and has served since 1987 as a platform for cooperation between European and Southern Mediterranean countries in the field of major natural and technological disasters. Its field of action covers the knowledge of hazards, risk prevention, risk management, post-crisis analysis and rehabilitation. EUR-OPA also counts a network of 25 specialised centres, some of which develop projects and activities on cultural heritage and risks: more than 60 seminars, courses, round tables and workshops have been held over the years.

Image: Francesc Pla

Lisbon's historical centre

Four centres of the EUR-OPA network have been focusing much of their attention on this subject: these are the European University Centre for Cultural Heritage (Ravello, Italy), the European Centre for Prevention and Forecasting of Earthquakes (Athens, Greece), the European Centre on Urban Risks (Lisbon, Portugal) and the European Centre on Vulnerability of Industrial and Lifeline Systems (Skopje, the former Yugoslav Republic of Macedonia).

## Learning from the past

It is a fact that it is impossible to completely protect a construction against seismic force, which is sometimes beyond the limits of human capabilities. However, all over the Mediterranean, many historical monuments and traditionally constructed buildings and settlements exist, and for hundreds of years these have repeatedly survived seismic action, even in areas of particularly high seismic risk. Such a historical experience could and should be studied in order to identify possible aseismic techniques already used in the past, which have proved to be efficient and can therefore be reused or updated on ancient buildings and settlements.

### *Learning from monuments*

Trying to identify 'native' techniques used in past times to increase resilience of monuments (such as churches or palaces) seems an obvious course, as restoration techniques mainly attempt to keep the actual building as close as possible to its original configuration due to its clear historical value. Furthermore, many of those monuments are nowadays managed by public authorities (local, regional or national) which care about their public access as touristic facilities and can adopt quite sophisticated techniques and materials to protect them from future events.

The European Centre for Prevention and Forecasting of Earthquakes, in Athens, has devoted a large part of

Image: Francesc Pla

View of Ravello

its recent activities to improving the classification and manipulation of data concerning the present status of Hellenic region monuments facing seismic risk. A first step is to identify the monuments that actually suffered past impacts and the extent of such impacts. A second step is then to focus on the intrinsic structural properties that protected them from the successive disasters they suffered. After preliminary work to identify typical structural systems related to seismic vulnerability and response, a more systematic Digital Database is underway. This information will be useful to prepare guidelines on principles and criteria for mitigating the vulnerability of monuments through structural restoration that is adapted to each typical structural system, and which takes into account structural properties concerning their foundation aspects (such as topography effects, soil movements, action of underground water), that are generally ignored in the usual aseismic codes.

*Learning from traditional constructions*

Cultural heritage cannot be reduced to monuments: buildings that have survived also include many non-monumental ones, such as traditionally constructed housing or settlements. In those cases, the previous two-step methodology could also be used in order to identify the good practices of the past in terms of construction. However, their possible resilience to previous disasters turns out to be more complex: records on previous disasters they suffered are generally less systematic due precisely to their absence of symbolic value for past generations.

The European University Centre for Cultural Heritage in Ravello, Italy, has developed an active effort in that field, both in Italy and with international partners. As the use of such buildings evolved and their (mostly private) ownership has changed over time, they may have suffered more successive adaptations than monuments. After having identified traditional building techniques for disaster resilience (but also potential conflicts with modern techniques applied to such buildings), the work has emphasized the role of other factors such as associated land usage or maintenance habits, leading to the wider concept of 'local culture'. Thus, over many years the centre has developed a course to promote the rediscovery and adaptation of accurate traditional techniques as preventive measures against earthquakes, and to diffuse that knowledge among professionals such as architects and urban planners, and authorities that can support such local reinforcement projects.

**Preparing the future**

The approach presented above was mainly based on archaeological and historical works and thus mostly relies on the pre-existence of significative data on their historical resilience to disasters. As already pointed out for non monumental buildings, such prerequisites may be difficult to fulfil in some cases and more specially for quite 'recent'

Image: Francesc Pla

Orthodox church in Bucharest

Image: Francesc Pla

Hellenic vestiges in Paphos

monuments, for which historical data is insufficient, or for aggregates of historical buildings where interaction is crucial. Simulation approaches have been presented to better deal with such specificities.

*Focusing on individual monuments*

The first approach is to concentrate on a specific monument and study its possible resilience to a potential event without reference to previous similar events. To do so, an experimental approach has to be applied, simulating the potential impact on it of different earthquakes. Obviously, such an approach has to rely either on purely numerical calculations or on experiments on associated scale models. The adequacy in specific cases of various reinforcement measures to mitigate seismic effects can then also be tested along the same lines.

The European Centre on Vulnerability of Industrial and Lifeline Systems in Skopje is involved in the international project PROHITECH (within the FP6 of the European Commission) to develop suitable methodologies for the use of reversible mixed technologies in the seismic protection of existing constructions, with particular emphasis on buildings of historical and artistic interest. Such buildings cover a wide and diversified range of structural categories — such as masonry reinforced concrete buildings and some steel constructions — needing to be fitted with adequate aseismic provisions. Part of the activities focus on analysing four models, each representing a characteristic cultural heritage: an Islamic mosque, a Gothic cathedral, a Byzantine church and a Greek temple. The applied methodology includes:

1. In situ measurements of dynamic characteristics of the historical monument
2. Shaking table tests of original and strengthened models constructed in 1/10 scale
3. Based on the test results, a proposal for the implementation of strengthening measures.

*Dealing with aggregates of historical buildings*

If the previous approach is extremely useful, it turns out to be quite reductive when the ancient building is in fact embedded within a more complex network of other ancient and modern buildings. Historical buildings designed prior to the introduction of reasonable earthquake requirements into building codes, buildings with relatively low resistant structures and more recent ones built after major earthquakes can coexist in aggregates, and will determine different responses according to their specificities.

The European Centre on Urban Risks in Lisbon has developed a study to forecast the possible effect of various earthquakes on the historical centre of Lagos, in the Algarve region of Portugal. After characterizing the building area through an enquiry carried out to obtain experimental evaluations of building frequency, the seismic analysis of the building stocks behaviour must be determined taking into consideration previous studies on source locations, soil effects, past seismicity, typologies and spatial aggregations. This work has made it possible to characterize the exposed vulnerability of the aggregates, and the number of homeless and injured people, which is calculated by a percentage of the number of collapsed buildings with several damages (according to their frequencies and site location, for intensities of seven to ten). Policy decision-makers and populations can then design a more efficient emergency plan based on the different seismic scenarios and promote some complementary actions (including educational ones) to assure the minimization of damages.

**Future challenges**

In the future, work on cultural heritage and risk under the EUR-OPA Agreement will also have to address an additional challenge: the specific impact of climate change on risks via its possible consequences on cultural heritage. Even if climate change essentially affects meteorological risks and apparently has no impact on seismic risk itself, the ageing of the structures and their wearing out due to various causes (such as humidity, ground-settlements or pollution) make historical structures much more vulnerable than modern ones, and in particular with respect to seismic risk.

# Multidimensional post-earthquake reconstruction: the Chakama Valley in Pakistan-administered Kashmir and the Uri Block in Indian-administered Jammu and Kashmir

*Najmi Kanji, Aga Khan Development Network*

**The South Asian earthquake of October 2005 devastated large parts of Kashmir on both sides of the Line of Control (LOC) as well as significant parts of the North West Frontier province in Pakistan. The death toll in Pakistan was around 73,000 (almost 30,000 children) with another 70,000 severely injured or disabled and 4 million made homeless. On the Indian side, damage was confined to two districts with 1,300 deaths, 7,500 injured and over 37,000 buildings damaged. Within days of this catastrophe, the Aga Khan Development Network (AKDN) responded through its affiliate FOCUS, to provide relief assistance to the affected communities. On the Pakistan side, AKDN's fleet of helicopters flew over 1,500 sorties, providing food, blankets, tents and tarpaulin, and evacuated nearly 2,000 injured from the affected areas. On the Indian side FOCUS provided winterized tents and warm clothing to nearly 400 families in 14 villages. On both sides of the LOC, nearly 200,000 people were assisted.**

### Rebuilding lives and livelihoods

As the relief effort continued, AKDN began to conceptualize the implementation of a three-year, multi-input reconstruction programme in one of the poorest and remotest valleys in Kashmir, with the aim to mobilize and assist local communities to rebuild their lives quickly. It was felt that getting people to start working on daily existence problems would help them to deal with the

Image: AKDN Kashmir Programme

Communities in the Chakama valley take part in activity-based groups such as village organizations

Image: AKDN Kashmir Programme

Repairs helped to improve traffic on the valley road

Image: AKDN Kashmir Programme

Women collecting water from the river

deep trauma they had suffered. The Chakama Valley on the Pakistan side and the Uri Block on the Indian side, where rapport had been built up with communities during the relief phase, and which lie adjacent to each other across the LOC, were selected for the programme with the following objectives:[1]

- Promote the establishment and strengthening of civil society organizations
- Facilitate the construction of seismic resistant and thermally insulated homes

Image: AKDN Kashmir Programme

Household contributions have enabled the construction and maintenance of water systems

- (Re)construct critical economic/social infrastructure, including schools and health centres
- Facilitate the (re)creation of livelihoods
- Improve the quality of health services and schools
- Promote disaster risk management with an emphasis on community preparedness.

It was clear from the start that the enormous effort required to rebuild people's lives could not be achieved unless people themselves were central to the decision-making processes and the implementation of the programme. Thus, community mobilization, with the establishment of democratic village and women's organizations, formed the programme's fundamental activity, upon which all other aspects of the programme have been built.

**Chakama Valley and the Uri Block**

Both programme areas lie off the main Muzzafarabad/Srinagar highway, but comprise some of the remotest and highest valleys in the region. The Chakama area comprises 14 revenue villages and around 33 hamlets, with a population of around 34,000 in some 5,500 households. In the Uri Block, the programme covers around 20,000 people in 17 revenue villages. The topology is very similar across both areas, and maize, wheat and rice in lower areas, are grown mainly as subsistence crops. Walnuts are an important cash crop in Uri. Incomes are derived primarily from government/army employment and remittances. The areas' strategic importance, from a military perspective, meant that the population had been reasonably well serviced by the respective Government and army, and the desire to do things for themselves was limited. Furthermore, the communities were somewhat divided along party polit-

ical and clan lines, with decision-making firmly in the hands of clan leaders.

Overall earthquake-related damage in both the programme areas included:

- Over 2,700 deaths; 2,000 injured and around 200 disabled
- More than 90 per cent of homes destroyed, the rest damaged
- All 102 schools and nine health facilities destroyed or rendered unusable
- All shops and businesses destroyed
- Extensive damage to water systems, irrigation canals, link roads and to the main road connecting the Chakama Valley to the Muzzafarabad/Srinagar road and urban areas
- Increased vulnerability to landslides and flooding
- Generalized psychosocial trauma.

**Understanding and defining priorities**

In the early spring of 2006, we thought that community priorities would focus on rebuilding homes to ensure shelter for the next winter, and planting crops for the autumn harvest. As social mobilizers commenced dialogues with the communities, it became clear that whereas people wanted support to plant spring maize, the immediate priorities for the people of Chakama related to ensuring drinking water and to opening up the main valley and other link roads to facilitate vehicular transport of people and goods. Rebuilding homes was not seen as urgent, partly because the process of financial compensation from the Government had not been completed, partly because building designs initially proposed by the government were not suited to the lifestyles and traditions of remote rural areas, and partly because communities were fearful of building again. On the Indian side the situation was similar, with more support requested for repairing damaged irrigation channels. Improved maize seed was distributed to all households to ensure an autumn harvest.

Hence, crop inputs and water supply (for drinking or irrigation) became programme priorities. Water supply became the activity around which communities were mobilized and organized into village groups, with office bearers elected in open meetings attended by at least 75 per cent of villagers in all cases. Simultaneously, women were encouraged to form activity-based groups that could be supported through training or through the provision of grants or credit. Both programme areas now have around 50 village organizations (VOs) of development committees and around 70 women's groups organized around specific, income-generating activities.

A key element of the programme has been to help communities understand natural risk within their living environments and to prepare for potential disaster. As a first step in addressing the seismic risk affecting the area, AKDN commissioned a microzonation study which helped to divide the region into areas of relative risk. This categorization allowed discussions with government and communities on the absolute necessity of reconstructing seismic resistant homes and selecting areas where public buildings such as schools and clinics should, or should not, be built. This macro-level information is being combined with localized hazard assessments by a team of geologists working with village elders providing historical information on local level disasters, to create village-level vulnerability maps.

**Critical social and economic infrastructure**

With the clearing, repairing and rebuilding of some parts of the main valley road in Chakama, traffic along it improved dramatically and essential materials for building and general sustenance began to arrive in the valley. Simultaneously, the intense work of mobilizing communities to create their own organizations began. It was essential that the traditional leaders did not feel threatened by the process of dialogue that encouraged communities to elect officials they felt were dynamic, honest, and would put community needs before their own.

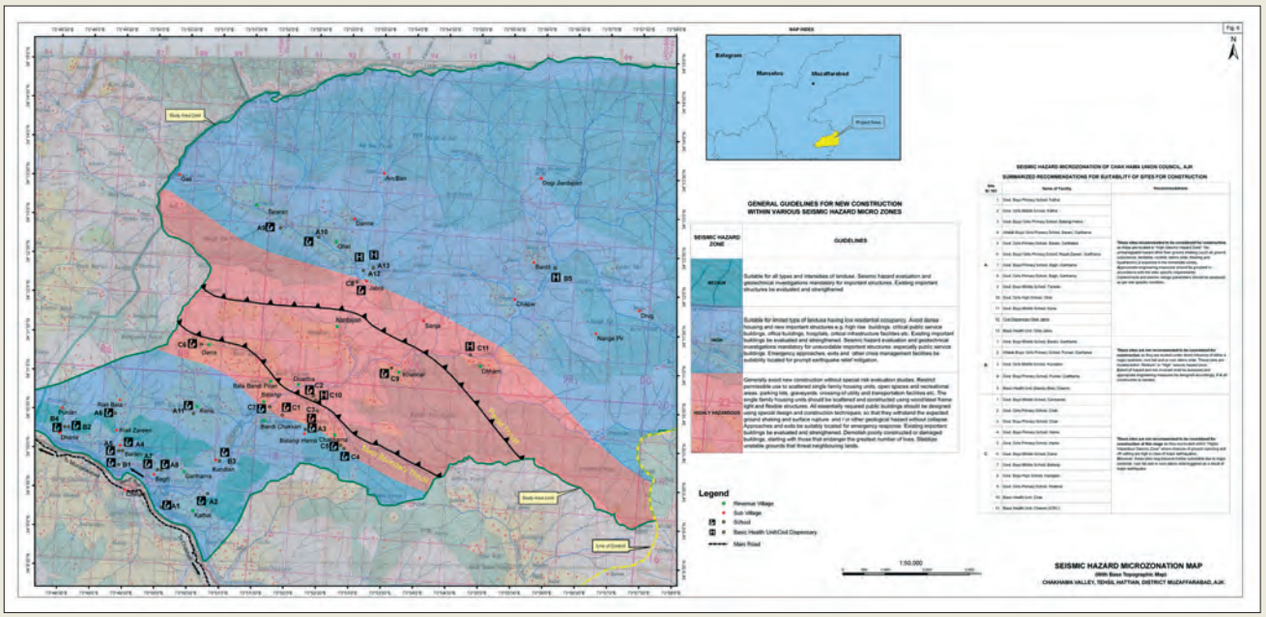
The enormity of collective and individual need, combined with AKDN's clear commitment to support infrastructure that would benefit whole communities, convinced people of the need to create democratic organizations that would take the lead in the reconstruction process. Thus, the size, route, types, and above all the sustainability of the priority infrastructure projects for drinking water and irrigation were intensely debated with communities before construction began. In all of the 42 water systems, 19 km of irrigation channels, 29 water mills and a micro-hydroelectric project, the communities have elected project implementation and audit committees to ensure quality and probity in the projects. In addition, significant community contributions have been made either in the form of labour or as a one-off contribution by each household together with an agreement to pay a nominal user charge to ensure that the systems can be maintained. The water systems provide each village with a steady income that is also used for other development purposes. In Chakama, health and hygiene committees (50 per cent women) work with communities on reducing the prevalence of water-borne diseases.

**Rebuilding seismic resistant homes**

With basic infrastructure reconstruction underway and the harvest completed, communities turned their attention to the coming winter and the need to rebuild their homes. It was imperative that people rebuild homes that were seismic resistant. To promote this, AKDN adopted the following approach:

- A subsidy (in the form of materials and transport) would be provided to each family wanting to build a seismic resistant house based on the guidelines for reconstruction that had been issued by the governments of India and Pakistan; the value of the subsidy would cover the cost of incorporating the elements providing seismic resistance and thermal insulation in the construction.[2]
- For the very vulnerable families in the villages, the value of the subsidy would be doubled.[3]
- For the poorest and most destitute family in each of the revenue villages, to be identified by the VO, AKDN would build a demonstration house, free of charge. The construction of this would provide the practical opportunity to train local masons in seismic resistant construction.
- Construction would be owner-driven with regular technical assistance and supervision provided by AKDN engineers to ensure compliance with seismic resistant construction guidelines.
- In Chakama, AKDN would establish a materials' hub at the foot of the valley to help offset transport

**The microzonation map**




AKDN commissioned a microzonation study to divide the region into areas of relative risk and allow discussions with government and communities on the construction of seismic resistant buildings

Source: Commissioned by AKDN

costs for families, and a transport subsidy would be provided to families living in the upper valleys of both programme areas.
- Each house would be provided with an environmentally friendly, smoke-free stove.

By the end of March 2008, almost 3,000 seismic resistant homes were being built, with around 900 completed. Nearly 200 local craftsmen (masons, plumbers, carpenters and electricians) had been trained. The training of local masons has ensured that seismic resistant building technology is now known in the area. A positive spin-off in the home construction programme has been the reintroduction of the traditional *dhajji* (timber frame) construction, a seismic resistant design that had been abandoned over recent decades in the quest for modern cement/steel structures. In addition to being technologically sound, the *dhajji* design is more appropriate for the higher valleys where wood is locally available, and where transport costs for steel/concrete can be exorbitant. In the Uri programme, homes are being built with roof-water harvesting pipes and tanks.

### Public buildings

The microzonation studies that categorized both programme areas into 'medium' (suitable for all types of land use), 'high' (suitable for limited land use) and 'highly hazardous' (generally avoid new construction without special risk evaluation), revealed that many of the schools and health clinics had been built in high and highly hazardous zones. This information was shared and discussed with government officials and VOs, and it was decided that in Chakama, AKDN would build four schools and one Basic Health Unit (all seismic resistant and thermally insulated) in zones deemed appropriate for constructing public buildings. To ensure that children continued to go to school, the Network partnered with the United Nations Children's Fund (UNICEF) to provide first winterized tents, and later prefabricated structures to replace the destroyed schools.[4] In Uri, AKDN is building three schools, including the only Girls' Secondary School in Uri, and retrofitting another four schools. The construction of schools has been complemented by training teachers in improved teaching and learning methods, materials development and the reactivation of school management committees which are beginning to play an active role in the running and maintenance of the schools.

Where soils studies have shown existing school sites to be unsafe either because of slope instability of flooding risk, communities have offered safer plots for their own land holdings when possible. Not only has the importance of safe sites for public buildings been fully internalized by communities, but when possible, they are willing to provide their own land for the collective safety of their children and of the sick.

In the Chakama programme, apart from the physical construction, a major effort has focused on the soft elements of health and education. Over 36,000 health consultations have been carried out; 500 children under one year old have been fully immunized; over 200 pregnant women and 1,200 women of child-bearing age have received anti-tetanus vaccination; and 29 community health workers, two health promoters, nine lady health visitors and 28 traditional birth attendants have been trained and are working. Similarly, over 150 teachers have received formal training and continue to receive support through a mentorship programme. A

Image: AKDN Kashmir Programme

A *dhajji* design demonstration home with its traditional timber frame construction

Image: AKDN Kashmir Programme

Children in a primary school class studying inside a transitional shelter

learning resource centre has been established for teachers to access teaching materials, and school management committees are functioning in all primary and middle schools. Six boys and four girls have received two-year, merit-based scholarships for higher education. The teacher training programme for the schools in Uri is scheduled to begin in July 2008.

**Recreating livelihoods**

Most households had lost the seed that they were saving for planting in the winter of 2005 and spring of 2006. Therefore, the first priority was to distribute maize seed to all households in April 2006, to be harvested in November of the same year; and then wheat seed in October to be planted after the maize harvest and reaped in May 2007. To improve incomes, vegetable seed was distributed to willing households in the lower and middle valleys, where climatic conditions are more suitable, at a subsidized rate.

Over 22,000 animals in the valley were wormed and vaccinated; sheep, goats, cows and buffalo were distributed to selected members of the communities to start the process of restocking the animals lost during the earthquake. To create livelihood opportunities for poor women, nearly a thousand poultry birds were distributed. In Uri, mountain-hardy goats have been distributed to women's groups on the basis that each woman will receive a kid to start the slow process of rebuilding animal stocks. Recipients were all selected by VOs on the basis of need and ability.

In an effort to stabilize some of the slopes and to provide an income for local communities, over 120,000 trees have been planted in block plantations, and over 30 demonstration orchards have been established with nearly 4,000 saplings planted. Another 55,000 fruit and forest trees have been planted in 30 backyard nurseries in the hope that, if afforestation can become an income and fuel source for communities, there is a better chance of deforestation continuing at current rates.

On the Pakistan side of the LOC, the AKDN has established a branch of the First Micro Finance Bank in Chinari, the nearest commercial hub to the Chakama Valley. This has allowed people to access credit for reestablishing or starting new businesses, and to open savings accounts that can be used to support loan applications. Up to March 2008, communities in Chakama had saved over USD90,000 and accessed loans of nearly USD200,000. Sixty per cent of the savings account holders and 59 per cent of those who received loans were women.

**Understanding risk and being prepared**

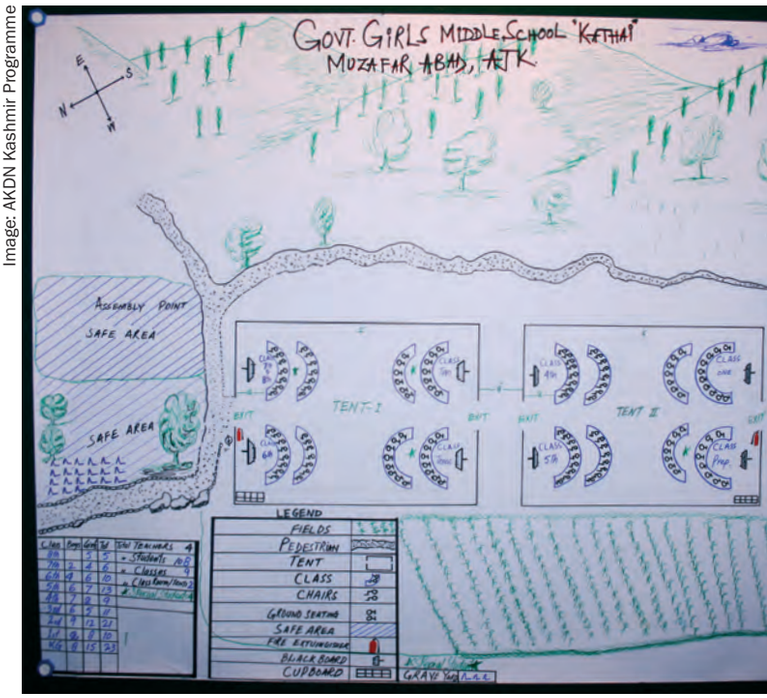
Mobilizing people to understand the types of natural risk in their environments and preparing to mitigate the effects of future disasters proved initially difficult. There was a general feeling of resignation and helplessness among communities, and a lack of belief about how anybody could do anything to withstand the sort of disaster they had recently experienced. It was only after the basics of life were reestablished and a limited sense of normality returned, that people started thinking of the future.

Simplifying the results of the microzonation study, soil studies and hazard assessments to share them with communities was critical in terms of people beginning to think of how to be more prepared for future disasters. Involving communities in developing village-level hazard/vulnerability maps allowed them to think through what measures were, or were not possible with regard to localized hazards such as rockslides, avalanches and flooding. The whole concept of building seismic resistant homes and public buildings brought about a level of confidence amongst communities on the issue of disas-

Image: AKDN Kashmir Programme

Maize seed was distributed to all households in April 2006

Image: AKDN Kashmir Programme




Local level village hazard map plan to evacuate a school in time of need

ter preparedness. Discussions about moving out of the area also prompted people to think that if they were going to stay in this earthquake prone area, they would have to reconsider where and how they built and, most importantly, learn skills and acquire knowledge about what to do before, during and after a disaster.

School students, teachers and health workers have all been trained in how to react when tremors are felt. Other risks such as fires, slides and floods have also been discussed and the basics of first aid and search/rescue techniques taught to teachers and older students. School and health unit evacuation plans have been drawn up, and regular simulation exercises are carried out to ensure a degree of preparedness. At the village level, 33 search and rescue kits, containing basics such as spades, rope, buckets, torches and batteries, have been housed at safe sites. A further 17 will be placed after the local emergency response teams have been trained. These kits are managed by a committee of the VOs and are for use by the Local Emergency Response Teams (LERTS) that have been formed to cover all the villages in the valley. The LERTS will have nearly 2,000 trained members, 40 per cent of whom will be women.

**What has been learned?**

One clear lesson is that much of the reconstruction effort may have stalled or had limited effect if communities had not been encouraged to be in the forefront of decision-making and taking responsibility for many of the activities. Secondly, community priorities were defined by social, economic and psychological factors that did not necessarily match the donor funding timelines or priorities. Thirdly, reconstruction after a major disaster cannot be limited to one sector or aspect of life — it needs to address them all. From the wider perspective of what risk means to people, how they can be supported to prepare for risk and how development agencies might promote this more effectively, some further points may be of consideration:

*Reconstruction efforts need time to plan and implement* — Often, people need time to overcome or deal with the trauma they have suffered before they can effectively start rebuilding their lives. In contexts like this, one year or less donor funding for infrastructure projects is unrealistic.

*Areas need to be assessed for risk* — If reconstruction is to avoid building public and other infrastructure in inappropriate (risky) areas, then time, effort and funds are required to carry out the appropriate studies to define areas and types of risk. Such understanding is currently limited in donor countries.

*Mainstream risk analysis and mitigation* — Donor support for reconstruction is currently provided through humanitarian assistance or rehabilitation funding lines. If people, governments and development agencies are to be encouraged in carrying out a reasonable amount of risk analysis before embarking upon development programmes, then risk analysis and mitigation must be mainstreamed into general development thinking and budgets.

*Information needs to be understood* — Risk analysis needs to merge hard science with community knowledge and create simple, understandable information that communities can internalize and act upon.

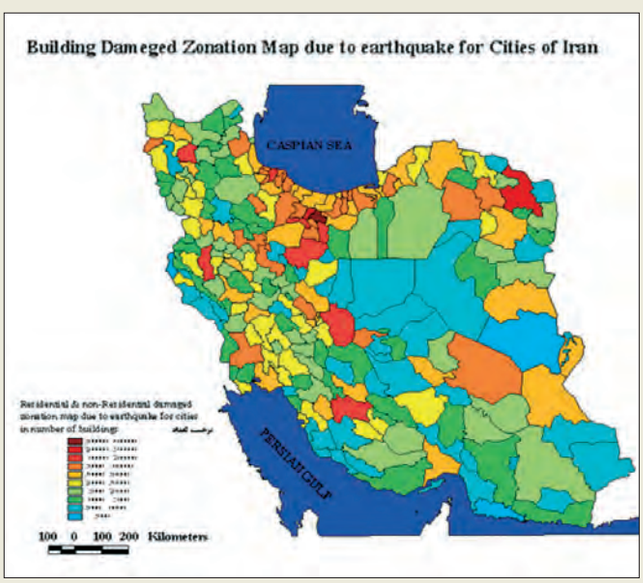
*Retrofitting is essential* — In many seismically active zones of the world, longer-term retrofitting programmes need to be initiated to make homes and public buildings seismic resistant. This requires sharing risk information with communities and also making available microinsurance and loans for home retrofitting. The costs of rebuilding after destruction are likely to far outweigh the costs of retrofitting.

# Iran earthquake risk reduction strategy and the International Institute of Earthquake Engineering and Seismology (IIEES)

*Mohsen Ghafory-Ashtiany, Distinguished Professor, Founder and Past President, IIEES*

**Iran, being located in high seismic hazard regions of the world with frequent occurrence of devastating earthquakes, has experienced high human, social and property losses in past decades due to vulnerability of the built environment, rapid population growth and seismically-incompatible urban development. To ensure the sustainable development of Iran requires a multidisciplinary risk reduction strategy with the objective of saving human lives and resources; along with an effective implementation programme. The establishment of the International Institute of Earthquake Engineering and Seismology (IIEES) in 1989, with the cooperation of UNESCO, provided an excellent platform for answering the increasing demand for safety, development of the required disaster reduction programme and providing the required know-how and expertise for hazard and risk mapping, vulnerability reduction and public awareness and preparedness.**

**A map showing building damage zonation for anticipated earthquake hazards in Iran**




Source: Ghafory-Ashtiany

Considering that not a great deal was done before the Manjil earthquake, for the purpose of the following discussion, the risk reduction efforts in Iran can be divided into two main eras: post-Manjil earthquake (1990-2003), and post-Bam earthquake (2003-present).

**Post-Manjil earthquake (1990-2003)**

The first move toward earthquake risk mitigation in Iran was started after the devastating Manjil earthquake of June 1990, with its heavy socioeconomic impact. After this tragic event and in the beginning of the International Decade for Natural Disaster Reduction (IDNDR), the Government decided to implement a multidisciplinary strategic research and mitigation plan called the Iran Earthquake Risk Mitigation Program (IERMP). The programme, which was developed by IIEES, had the following objectives:

- Increasing the scientific knowledge required for earthquake hazard mitigation
- Reduction of risk of failure in different types of constructions and the need to build safer structures
- Increasing public awareness of seismic hazards and promoting a collective prevention culture
- Developing plans for post-earthquake actions.

The comparison of the indexes before and after the implementation of the programme indicates the significant steps (though not yet sufficient) that have been taken toward risk reduction in Iran, which made the Manjil earthquake a turning point in the earthquake risk reduction history of Iran. The main practical achievements of this programme can be summarized as follows:

- Expanding seismic and strong motion networks as well as establishing advanced geotechnical and structural laboratories; this resulted in better assessment of Iran's seismicity and seismic related hazards
- Improvement of research, education, technical knowledge and the know-how required for implementation of a risk reduction programme in Iran

- Recognition of hazard, vulnerability and risk by decision-makers, engineers and the public; which created the will and demand for long-term risk reduction actions
- Capacity building: changing the civil engineering curriculum toward aseismic design and construction, as well training engineers, architects and construction workers in order to provide the required human resource for disaster risk reduction
- Public awareness: through extensive educational camping, especially in the school system and through all types of media, it can be claimed that people are more aware of hazard and risk, and consequently are more sensitive, though not prepared
- Construction quality: due to code and law enforcement and construction controls as well as the training programme and people awareness, the quality of construction in the urban area has been significantly improved and the trend is toward aseismic construction of public and private buildings. More incentive, encouragement and code enforcement is required
- The strengthening of public buildings and infrastructures has been underway since 2001
- Disaster management: in the past, due to the occurrence of many earthquakes and floods as well as eight years of war, the performance of rescue operations and reconstruction were considered quite acceptable. In recent years the focus of disaster management has moved toward a long term planning.

**Iran's preparedness achievement indexes before and after IEHMP**

| Indexes | Before Manjil earthquake | 2003 |
|---|---|---|
| Research | Low | Good |
| Public awareness | None | Good |
| Preparedness | None | Low-Average |
| Engineering practice | Very poor | Average |
| Engineering knowledge | Average | Good |
| Political will | None | Acceptable |
| Application & implementation | None | Low-Average |

Source: Ghafory-Ashtiany

**Scientific achievement of the IERMP programme**

| | Before 1990 | 2003 |
|---|---|---|
| Researchers | Less than 40 | More than 400 |
| Graduate students | Less than 20 | 635 |
| Seismic stations | 15 | 78 |
| Strong motion stations | 270 | More than 1,100 |
| Research laboratories | 2 | 12 |
| Books and technical reports | Less than 100 | More than 1,000 |
| Budget | 10 Years<IRR700m 1989: IRR104m | 10 Years>IRR128,000m 2003: IRR85,000m |
| Investment for laboratories | USD3,100,000 | USD21,500,000 |

Source: Ghafory-Ashtiany

**Good practice: knowledge and research development**

Based on the author's assessment, resulting from his deep involvement in all aspects of risk reduction in Iran at all levels, the most significant achievement of the programme lay in raising awareness, building know-how, and training the required human resources that were needed for risk reduction activities.

**Post-Bam earthquake (2003-present)**

Despite its high casualties and losses, the Bam earthquake disaster in December 2003 once again gave a strong signal to governments: although their past efforts and support were very important, effective and useful, they had not been effective in implementation, and had not successfully reduced risk. Governments need to make optimal use of developed and existing know-how on earthquake risk reduction and its integration into the country's development programmes. The event also compels the scientific and engineering community to provide more doable, usable and socioeconomic-cultural compatible solutions to national needs. Moreover, the public at large should become more concerned about hazards, and increase its own preparedness level.

Based on these facts, on the achievements of the first programme (IEHMP) in the area of knowledge development, and on 13 years of risk reduction experience as well as the lessons learned from the Bam earthquake, an action-oriented strategy was developed. The Natural Disaster Risk Reduction Strategy of Iran has been developed and approved by Iran's Council of Expediency and ratified by the leadership of Iran.

The strategy covers major natural hazards, namely earthquake, flood and drought with a special emphasis on earthquake. The main aims of this strategy are:

- Increase public awareness and promote a collective prevention and safety culture at all levels of society (people and government) through an extensive educational programme
- Increase the scientific and technical know-how required for risk mitigation through the increasing support and expansion of existing research institutions, especially those related to earthquake
- Create a united command and management system in order to be fully prepared for an effective disaster response (rescue and relief operations) using all types of civil and military resources
- Develop a comprehensive disaster information database for the facilitation of research and early warning systems
- Develop a comprehensive and scientifically sound programme for management and implementation of effective plans for post-earthquake recovery (mental, social and physical) as well as for rehabilitation and reconstruction of the damaged area
- Develop an effective system for financial recovery and compensation through insurance, financial incentives and supporting funds

Image: Organization of School Renovation, Development and Mobilization of Iran Ministry of Education

Child safety has been well addressed in all of the Iran risk reduction programmes, especially through safe school buildings

- Reduce the risk of future construction and developments of urban and rural areas and increase safety levels through adequate urban and rural planning and management; make sure that all structures are build safer by full implementation of building codes with 'zero tolerance' for any type of violation
- Substantial risk reduction of existing structures to save human lives, especially in schools, hospitals, public buildings, lifelines and infrastructures within the next ten years; provide special loans and incentives for the strengthening private buildings
- Improve the quality of city planning and management, and of the legal framework so that severe building violation is treated as a criminal act and not simply a civil violation
- Improve the understanding of climate change and its environmental effects; develop an effective programme for reducing the effects of floods and drought-related disaster.

It should be noted that the above-mentioned strategy needs to be formulated into a doable and executable programme by the respective organizations in Iran. The scientific communities should take a multidisciplinary approach in striving to translate current technical know-how into doable format and simplified solutions that are socioeconomically and culturally accepted by the general public. Moreover, straightforward do-it-yourself construction techniques for simple dwellings should be promoted in rural areas.

**School Building Safety Act**

In terms of human losses, the loss and injury of children, as a binding factor of each family, can create long-term psychosocial disorder in society. This has been observed in past earthquakes in Bam, Iran (2003), Gujarat, India (2001), Mozafarabad, Pakistan (2005), and Wenchuan (Sichuan), China (2008) with the loss of 6,898 classrooms and 9,000 students. Thus child safety, which should have the highest priority in any risk reduction programme, has been well addressed in all of the Iran risk reduction programmes, especially through safe school buildings. In other words, safe school building is key to successful the earthquake education programme in schools, which began in 1992 during IERMP in Iran.

After the Manjil earthquake, Organization of School Renovation, Development and Mobilization of Ministry of Education implemented a more rigorous inspection process in order to make sure schools were built according to the codes. However, this programme was not fully implemented, especially in rural areas and small towns. The destruction of old schools, damage to some of the newly built schools, and the loss of the many school children (in their homes and not in school), strengthened the campaign for safe schools.

Image: Organization of School Renovation, Development and Mobilization of Iran Ministry of Education

Budget has been allocated for the construction of new, safe school buildings

With this background, one of the first and most important outcomes of the new strategy was the School Safety Law for the reconstruction and strengthening of 257,945 vulnerable classes (39 per cent of the total public classrooms in Iran), with a USD4 billion budget that was proposed and passed by Iran's Parliament in 2006.

This important legislation for the safety of the children of Iran was passed following an IIEES initiative starting with the school education programme in 1992 and continued by school safety campaigners, in close cooperation with the Ministry of Education and support from parliament. It should be noted that equal budget has been allocated from the regular development fund for the construction of new, safe school buildings. This shows the awareness and concern of policy makers regarding earthquake safety in Iran.

Since the start of the project, 2,158 schools have been reconstructed, 2,193 are under reconstruction, and 2,500 schools with 30 per cent vulnerability are under the retrofitting process, with a budget of around USD1.5 billion throughout the 30 provinces of Iran. Of the 4,341 reconstructed schools, 3,321 were elementary schools, 1,007 middle schools and 752 high schools. The highest priority was given to the elementary schools with the most vulnerable children, and to those in the provinces with more vulnerable schools (mainly border provinces). The implementation of this important programme along with the ongoing Earthquake Safety Education programme, which has been in operation in Iranian schools since 1994, would hopefully ensure the safety of the future generations of Iran and consequently the sustainable development of the country.

**Conclusions**

Seismic risk is much more than a simple shock. It is a complex combination of the factors that determine the potential for people to be exposed to this type of natural hazard. Scientists, engineers, government officials and the general public must all be involved in finding realistic, achievable and appropriate ways of applying scientific knowledge to everyday life. Only by working together can we mitigate the impact of a natural hazards on human life and society, and solve the earthquake puzzle.

A combination of factors has made visible progress toward a seismically safe Iran. These include good timing in the establishment of IIEES; the timely response of IIEES to safety demands; the Iranian Government's decision to implement an earthquake hazard mitigation programme following the Manjil earthquake, and excellent cooperation among the scientific communities of Iran. The undoubted success of Iran's experience can be easily applied to the developing countries.

# RICS: building resilience

*Karen Gardham, Royal Institution of Chartered Surveyors, UK*

**Founded in 1868, the Royal Institution of Chartered Surveyors (RICS) provides the leading international professional qualification in land, property, construction and related environmental issues. With over 140,000 members in 146 countries, across the public, private and third sectors, RICS is one of the largest independent, not-for-profit professional bodies dedicated to serving the public interest. RICS provides expert, impartial advice to governments, non-governmental organizations (NGOs) and business worldwide.**

Following the Indian Ocean tsunami of December 2004, many chartered surveyors contacted RICS to offer their help and expertise to the relief effort. RICS set up a Major Disaster Management Commission (MDMC) to address how built environment professional skills and knowledge could be deployed to help vulnerable communities, at all stages of the disaster management cycle. The commissioners are chartered surveyors and other built environment experts with many years of experience in a range of disciplines and regions of the world, including disaster-specific and international development work.

**How do chartered surveyors work in disaster management?**

Rob is a retired member of RICS, formerly of project and cost management consultancy Faithful & Gould. He decided towards the end of his career to give up his company Jaguar and travel to the volcano-hit island of Montserrat. Rob started his professional life as a land surveyor, becoming a quantity surveyor and member of RICS because of the better pay. As a quantity surveyor, Rob used his professional skills to assist the reconstruction work as part of a humanitarian team for the UK Department for International Development (DFID). He went on to work for the British Red Cross in the Maldives, post-tsunami.

Image: Rob Worthington

Plymouth, the old capital of Montserrat, about ten years after the first eruptions. The ash now covers the top of the church steeple

In Montserrat, Rob encountered initial scepticism from government officials who were wary of outside advice. However, the advice, skill-sharing and capacity building that Rob helped achieve meant that the government recognised the value of DFID's work and welcomed it. Part of Rob's work was to oversee a materials grant scheme, which issued grants to households to enable them to rebuild their homes either themselves or through local skill-sharing cooperatives. Four hundred and thirty houses were built through the scheme, all individualized as people modified them to suit their needs. In addition to supervising reconstruction work, Rob identified a need for education on tenders and estimates for local construction workers. He ran classes for local workers on tendering, and on basic accounting, which he also identified as a weakness. The result of this was that he left behind a stronger infrastructure for local businesses. Rob also encouraged local contractors to form consortiums and work together to strengthen small business and maximize the efficiency of rebuild efforts.

Rob felt that it was invaluable to have professional skills available early following a disaster in order to plan and prioritise effectively. He says that he felt his age and experience were beneficial to working in challenging conditions and an unfamiliar cultural environment. He encountered many difficulties during his work in Montserrat and the Maldives; political circumstances were at times challenging, as foreign assistance is not universally welcomed (often due to historical experiences) and tact and empathy for local concerns was important. In terms of his employers, the agencies Rob worked for were familiar with what a land surveyor does but not other surveying professions. Part of the problem is that using professional firms charging commercial rates was often prohibitively expensive, and as agencies don't fully understand the professional skills on offer, such skills are simply not used. Raising awareness is an area the MDMC at RICS is focusing on.

**Mind the Gap**

The MDMC commissioned an independent report, *Mind the Gap!*[1] which identified the gap between immediate

Image: Rob Worthington

50 houses for old people were built at Lookout, a new village created after the volcano. The project was split into seven packages to assist local builders

Image: Rob Worthington

The old people's houses and community centre

humanitarian relief after a disaster and the long-term reconstruction process. The reasons for the gap include institutional constraints, gaps in communication, lack of access to appropriate use of professional skills and knowledge to support the local effort, and failures in management and planning. It was also found that the funding of recovery from disasters is inflexible and short term-focused, which made it difficult to plan and create a smooth and rapid transition to long-term reconstruction.

The report identified that long-term reconstruction is 'constrained by the lack of planning, coordinated management and targeted funding of the response in the post-disaster recovery phase.'[2] Significant shortfalls in knowledge, skills and capacity exist, which cause delays in the reconstruction of communities post-disaster, and restrict the efficiency of risk-reduction planning in disaster-prone areas. Built environment professionals can provide vital support in bridging these gaps, as the example of Rob's work in Montserrat has shown.

Image: M Rizal

A transitonal camp in the Lampu-uk area, Sub District Lhok Nga, Aceh Besar District, Aceh

The international organizations involved in disaster relief are often geared toward providing immediate relief and usually exit the situation once short-term relief has been provided. On the other hand, with the Indian Ocean tsunami there was enormous pressure to be visibly seen to spend the huge amounts of public donations that were made. However, NGOs acknowledged that they were not reconstruction experts — a report commissioned by the International Federation of Red Cross and Red Crescent Societies (IFRC), evaluating its response during the first few weeks after the tsunami, 'concluded that the organization had so much money that it entered areas — like house-building on a massive scale — that were outside its usual mandate and poorly handled'.[3] One of the few good things to come out of disasters is the opportunity to 'build back better', but that opportunity is too often missed, or comes too late for the affected communities.

**Discussions with the humanitarian relief community and needs identified**

The RICS Commission has built extensive links with the humanitarian community, and has advised NGOs and UN agencies, and the World Economic Forum on guidelines for public-private partnerships; it has also sourced professionals, on request, to advise on projects. Meeting with those already involved in disaster relief and recovery has been crucial to the MDMC's approach in seeking ways to bridge the gap. From the discussions with the humanitarian relief community (such as UN organizations, NGOs, professional bodies, the World Bank, the World Economic Forum) the following were key issues raised:

Image: Rob Worthington

Vilufushi, March 2007: after land reclamation but before the start of construction. The original island is within the ring of palm trees (the only things that survived the tsunami)

Image: Barry Davies

Vilufushi, May 2008: building progress on the 250 houses. The plots are small, as the Government wants to move more people here from more vulnerable islands

- RICS is seen as a way for the community to access firms in the built environment private sector, which it has not engaged in the past
- The humanitarian sector does not generally have expertise in the built environment
- There is a need for immediate professional advice at the scene of a disaster (for example mapping damage to infrastructure to identify routes to sites, assessing buildings for safety before people can return to their homes, identifying rubble materials that can be used again), and during the recovery phase
- The international community is looking more at disaster relief in terms of risk reduction and preparedness, so the work of the Commission should address this area.

Whilst initiatives such as the Hyogo Framework for Disaster Risk Reduction[4] have put into place policies for risk reduction, tools and processes are required for implementing these policies.[5]

**Skills of a chartered surveyor**

Millions of people live in areas vulnerable to natural disasters due to rapid urban growth.[6] More of the urban population is living in poverty, so increased urbanization has led to more people being vulnerable due to insecure land rights, poorly built housing and unstable informal settlements.[7]

Chartered surveyors are involved in the whole lifecycle of land and buildings, including:

- Master planning
- Building quality audits pre- and post-disaster, particularly resistance to disaster risks
- Advising on building standards
- Knowledge of local regulatory frameworks and ways they could be improved
- Land surveying, GIS and rapid mapping of disaster impacts and risks
- Assessing structural damage to buildings
- Knowledge of land and property legislation, providing support on land rights and claims and resolving disputes
- Valuation, cost planning and spending priorities
- Sourcing construction materials and equipment
- Managing money, and accounting for it to allow reporting back to donors with confidence
- Project managing construction — delivering buildings on time and on budget, by managing a range of competing interests and deadlines safely and sustainably
- Building local capacity and partnerships — training and knowledge transfer
- Links with other built environment professions; inter-disciplinary and team working
- Contacts with local business and industry.

There are chartered surveyors all over the world — RICS has 140,000 members in 146 countries. Local knowledge is important to applying some of these skills.

It is important that those involved in disaster risk reduction and management are aware of the diversity of skills offered by the built environment community, and one of the aims of RICS has been to raise awareness of these skills.

**BuildAction — delivering built environment skills**

The MDMC works with the private and public sector to provide built environment professionals on a 'for the public good' basis to help deliver projects initiated or identified by humanitarian agencies. The MDMC is calling this initiative BuildAction, and it will be managed by RICS.[8]

This opportunity is available to not-for-profit organizations working in disaster risk reduction or disaster recovery and reconstruction. Our member organizations are based all over the world, providing an ideal partnership to deliver staff with regional expertise on a 'public good' basis.

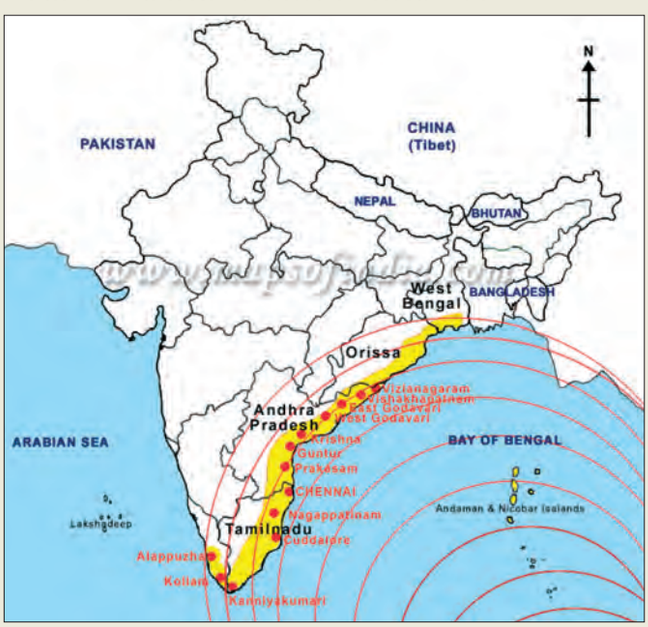
# Environmental management measures for tsunami-affected areas of Cuddalore district, Tamil Nadu, India: reconstruction, resettlement and future community resilience

*Dr Meenakshi Dhote, Department of Environmental Planning, School of Planning and Architecture, New Delhi, India*

**At 08:00 local time on 26 December 2004 a titanic shift of tectonic plates triggered an earthquake of immense magnitude (9.0 on the Richter scale) in the Indian Ocean, 250 kilometres from the west coast of Sumatra, Indonesia. The result was a massive tsunami that raced across the Indian Ocean devastating coastal areas in Thailand, Malaysia, Indonesia, Sri Lanka and India. The effects were felt as far away as the east coast of Africa.**

India suffered major setbacks due to the tsunami. The waves caused extensive damage to areas of South India including the Union Territories of the Andaman and Nicobar Islands and Pondicherry; and coastal districts of Tamil Nadu, Kerala and Andhra Pradesh.

**The tsunami hits eastern and southern coastal India**




Source: Environmental management measures; Cuddalore District: Studio Report, Department of Environmental Planning, School of Planning and Architecture, May 2005

As the survivors along the coasts devastated by the tsunami started to clear the debris, the attention of the world turned to how these communities were going to rebuild their towns and villages. When the unthinkable happens again, will they be any better prepared?

### Our concern

A multidisciplinary group consisting of students from the departments of Environmental Planning and Landscape Architecture at the School of Planning and Architecture, New Delhi; and the Master of Planning and Landscape Architecture, School of Architecture and Planning, Chennai, Tamil Nadu, undertook a study of the tsunami-affected areas of Cuddalore district in Tamil Nadu, India. The study was conducted about two months after the disaster, the trauma weighing heavily on the affected area; with the impact on the landforms and vegetation showcasing the fury of nature. It reinforced our determination to suggest long-term approaches to reducing the vulnerability of such areas in similar situations in the future.

The aim of the study was to evolve environment management measures for the tsunami-affected areas of Cuddalore district. This was achieved by carrying out a survey of the selected coastal belt of the district. The impact of the tsunami on the coastal belt was recorded and analysed. The study also attempted to validate the provisions of Coastal Regulation Zone (CRZ) notification of the Government of India and its adaptability, as a response to the context. The management measures tried to formulate a strategy to reduce vulnerability and achieve safe conditions in the study area.

### The study area

The study area was limited to a distance of one kilometre from the high tide line, which took into consideration the portion where the water had penetrated inland. The settlement and landscape features along the entire 57.5 kilometre stretch were mapped and recorded during the intensive field survey covering around 26 coastal settlements.

Image: Environmental management measures; Cuddalore District: Studio Report, Department of Environmental Planning, School of Planning and Architecture, May 2005

Sand deposition created by the tsunami

Cuddalore district lies between 11° 5´ and 12º 30´ of the northern latitude and 78º 37´ and 80º of the eastern longitude. The study area along the coastal belt is connected to Cuddalore and Chidambaram towns by district roads. The total population of the area was 38,206, which was 1.75 per cent of the total population of the district. The highest population in the study area was 8,478 (22 per cent), recorded at Devanampattinam, due to its urban characteristics. The rest of the belt was largely rural, constituting mostly of fishing villages. Average family size was four persons, with a literacy rate of 68.35 per cent. The major occupation was fishing and related activities, with a workforce participation rate of 39.3 per cent. Both sexes participated, the men being engaged in the actual fishing with women associated with processing of the catch and so on. With an average annual income of INR6,000, economic activities catered mainly to sustenance of the majority of the population. This made the study area even more vulnerable to any disaster. Situated in a backward rural area, the water supply and sanitation facilities were substandard. However, the electricity and communication network was found to be good.

The land use of the coastal belt showed the majority of the area under barren land (53 per cent), followed by vegetation (23 per cent), with settlements occupying 11 per cent, and agriculture and water bodies covering the rest at 13 per cent. Thus the impact of the tsunami was not only observed on the population but also the ecosystem. The major aspects of the study concerned the impact on people and property, and the ecosystem.

This was arrived at by carrying out a socioeconomic survey of the settlements and mapping of landform and vegetation. The impact of the tsunami was studied through official records of the district administration, discussions with the affected people and visual observations. This was followed by delineating zones within the study area based on CRZ notification and natural features. Proposals were prepared to address the issues of disaster mitigation through appropriate physical developments. The tsunami had eroded the occupational base of the people; therefore another focus area was to suggest sustainable occupational patterns for the residents.

**Impact of the tsunami**

Official records put the total number of casualties at 317, with 66 per cent being female and 33 per cent male. This was because most of the womenfolk were within the huts at the time of the event. A study of village causalities indicated that villages that had coconut groves on the seaside — those located at a higher elevation — had very few to no deaths. This reinforced the need to maintain a setback from the high tide line, as suggested in the CRZ notification. It also brought forth the need to address location specific guidelines — areas with higher elevations could be nearer and safer. The existing vegetation and landform types can be analysed for their protective value.

Since the major occupation was fishing, the extensive damage to boats, vessels, nets and equipment had rendered the inhabitants jobless. The fishermen were not entering the sea due to the trauma and fear. Also, the fishing points had changed. Some deepwater species such as jellyfish and starfish were spotted at the beach, which indicated a change in fish composition. The need for an alternate means of livelihood was at its highest at this juncture.

As water sources were mostly groundwater, the supply deteriorated with rising salinity. Sanitation facilities, which were mainly dry-pit latrines, were constructed again, but the few public toilets were damaged. Electricity poles withstood the tsunami and the area did not lose its communication network during the disaster. The single bridge over the backwater was a major lifesaver and withstood the tsunami. We found a huge

amount of debris and solid waste, piled up on the beaches as a precautionary measure.

The major plant species within one kilometre of the stretch consisted of coconut, casuarinas, cashew nuts and palm. The palm species was the most damaged amongst them — the trees were showing a withered condition due to water stagnation and salinity. Casuarinas and coconut plantations had acted as effective barriers in buffering the force of the tsunami. Terrestrial plants not adapted to saline conditions – agricultural crops, home gardens and grasslands were adversely affected.

Physical impacts on water bodies resulted in closure of the estuary mouth, discontinuation of water flow at the existing harbour and the creation of new water bodies. Large volumes of sand had been deposited on salt marshes, and the formation of barrier islands at the sea edge due to sand deposition modified the coastline in certain areas. Seawater had penetrated to a depth of about one metre, affecting the root zones. Preliminary salinity tests by the District Agriculture Office showed pH values in the range of 7-9. Colour changes in the soil — dark patches, deposition of new sediments — indicated a change in nutrient availability and other properties.

The study area was divided into three zones:

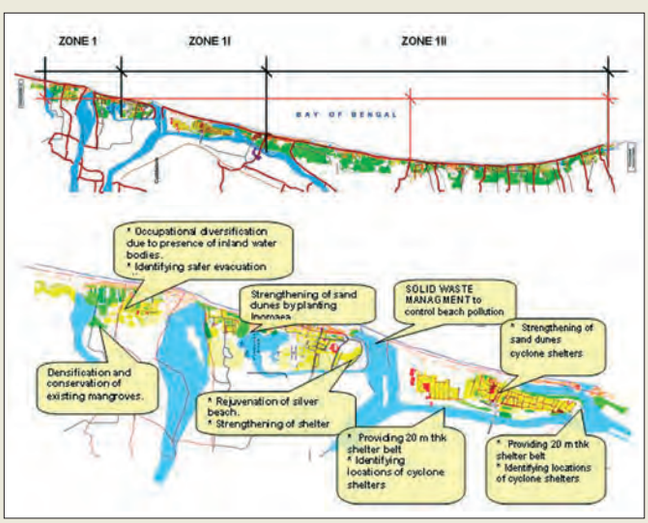
- Zone I: settlements having urban characteristics
- Zone II: settlements near water bodies such as backwaters and lagoons
- Zone III: settlements within vegetated areas — coconut, cashew plantations.

This helped in formulating proposals for the areas.

**Framework for proposals; environmental management measures**

The proposals were arrived at by attempting a strengths, weaknesses, opportunities and threats (SWOT) analysis of the study area, zone-by-zone, to address location specific issues within an overall framework to achieve safer conditions.

**Environmental management measures for the tsunami affected area**




Diagrams showing delineation of zones and time phasing of proposals

Source: Environmental management measures; Cuddalore District: Studio Report, Department of Environmental Planning, School of Planning and Architecture, May 2005

The management measures were formulated keeping in mind the three-tier decision-making and implementing mechanism prevalent in the study area. Any long-term measure should address national policy — to enable policy modification, especially amendments to the CRZ notification, by making it more location-specific.

At the state level, a strategic plan for disaster preparedness for vulnerable areas was suggested. The major focus of the proposals was for the local area. Depending on the characteristics of each zone the measures addressed:

- Location of future developments
- Provision of cyclone shelters
- Formulation of escape routes
- Landscape upgradation
- Infrastructural upgradation
- Occupational diversification.

**Time phasing of proposals**

The proposals were to be executed in a phased manner — short-term and long-term.

Short-term (six months to a year):

- Construction of cyclone shelters and boat shelters
- Defining escape routes
- Installing warning systems.

Long-term (one to two years):

- Shelter belts
- Rejuvenation of the beach
- Diversification of occupations
- Rehabilitation.

The study has been presented at various levels and through seminars held in various coastal cities of India. We hope that this will have triggered action in the right directions.

To conclude, the tsunami might have been a disastrous event in the history of mankind, but it has given an impetus to new developmental activities in the coastal hamlets. Although policies and programmes have always advocated the safety of people in these coastal villages there is always a huge gap between planning, implementation and management. The calamity of 26 December 2004 has modified the entire concept of coastal regulation.

Carried out by planners having a special concern for environment, the study attempted to understand the scenario post tsunami and its implications for different aspects of human settlements. One can easily envisage developmental activities for the coastal people, but the real test lies in the implementation on site. In the long run, it is the participation of the people and their response to such developmental programmes which matters. The dependence of human settlements on natural resources calls for management measures which are oriented towards the betterment of the people. This studio assignment[1] was a small endeavour in this field, which aims at evolving some basic environmental measures for the tsunami-struck areas, with Cuddalore as an example.

# Auditing school safety in India: lessons for Asia

*Vishal Pathak and Sanchit Oza, All India Disaster Mitigation Institute*

**Unsafe schools are a reality in India. With the spread of education, more and more children go to schools that are vulnerable to fire, floods, earthquakes, cyclones, pollution, food poisoning, stampede and so on. At repeated great cost, this has been seen many times in the last decade. Despite the opportunity of using schools as safe facilities for public shelter following disasters, school buildings are an additional liability, and the worst place to concentrate our children. It is a wonder that there is growing national demand for electricity, clean air, and safe water, but not for safer schools. Appreciating risk is a well-developed skill among India's growing retinue of investors and businesses including the insurance sector. Yet such risks relate to near-term issues — such as returns on stocks and mutual funds — and are not connected well enough with a critical lifelong investment: the safety of our own children in their schools. Indian children remain exposed to risks in schools. This paper highlights the experiences and lessons of the All India Disaster Mitigation Institute (AIDMI) and its partners, and the results of a recent school safety audit in India intended to help practitioners and policy makers in Asia.**

## Context

In recent years, India's schools have sustained many catastrophic incidents: a fire led to the deaths of over 400 people — about half of them students — at a school's prize-giving ceremony in Haryana in 1995; the Bhuj earthquake caused the deaths of 971 students, more than 400 in a single incident and 31 teachers, in Gujarat in 2001; a fire at the Lord Krishna School in Kumbhakonam, Tamil Nadu took the lives of 94 children in 2004; thousands of students and teachers were killed, injured or otherwise affected in the 2004 South Asia tsunami; in the 2005 earthquake in Kashmir, more than 17,000 children in India and Pakistan were crushed to death under their school buildings, and 15 children and three teachers died in a boat accident during a school picnic at Kerala in 2007. These are a few tragic examples of disasters that pose a regular threat to students and teachers.

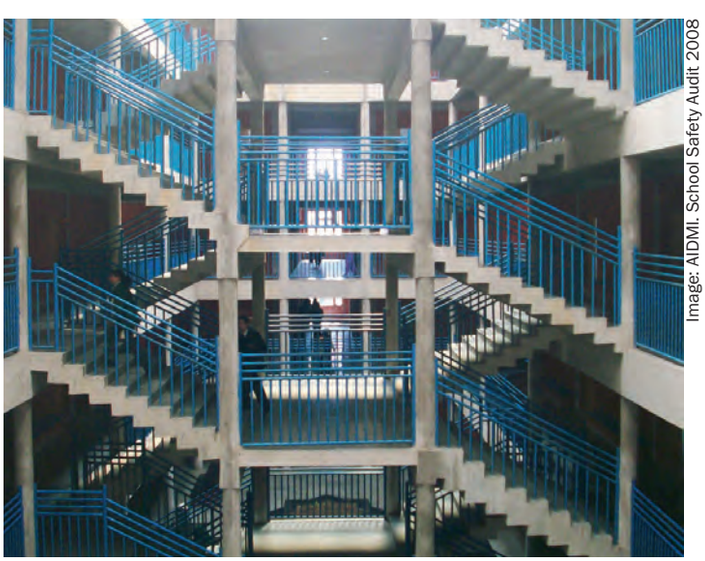


Image: AIDMI. School Safety Audit 2008

A school-specific safety audit can be a first step toward making schools safer

One of the Millennium Development Goals (MDG) is to enrol all children worldwide in school by 2015. With a large percentage of the Indian population living in poverty (36 per cent living below the official poverty line) and with a literacy rate of just over 50 per cent, it is imperative for the future development of India that children have access to education. Over 78 million children are currently in need of schooling. To meet this great demand, many schools are overburdened and compromise on safety.[1] The Government of India's District Primary Education Programme (DPEP) and Sarva Shiksha Abhiyan (SSA), which aim to achieve universal primary education by 2010, have yet to focus on school safety. The National Common Minimum Programme (NCMP) of the Government of India also puts direct and full emphasis on "providing universal access to quality basic education." However, unsafe schools adversely affect the quality of education in poor and low-income areas. Further, children have a right to education, but their right to safer schools is not recognized or even articulated.

In general, awareness of school safety issues is rising and is reflected in key global initiatives such as the global campaign on 'Disaster reduction begins at school'[2] launched by UNISDR in 2006 and the work of the Coalition for Global School Safety (COGSS) and its partners worldwide.[3] However, a lot remains to be achieved.

## Child's Right to Safer School campaign

AIDMI began working informally with school safety issues at its inception in 1989, and later consolidated and organized this important work as the Child's Right to Safer Schools campaign in response to the 2001 earthquake in Gujarat. The campaign aims to reduce hazard-induced losses in schools by increasing awareness, developing school-specific disaster preparedness plans, promoting structural and non-structural safety measures and insuring school children, teachers and administrators against accidents of any kind. The

Image: AIDMI. Bihar flood recovery 2007

Nearly half of all victims of natural disasters are children under the age of 15


Image: AIDMI. Jammu and Kashmir earthquake 2005

Damage to school structures induces injuries and also setbacks to enrolment and progress, which can last for many months

campaign has undertaken a dynamic effort to empower schools for disaster preparedness and response.

In conjunction with local partners in six states, the campaign identifies India's most vulnerable schools and supports them with training programmes, disaster education, risk-transfer initiatives and other capacity-building mechanisms. Its operations place emphasis on Hyogo Framework for Action (HFA)[4] and Tsunami Evaluation Coalition[5] recommendations, and the Minimum Standards of Education in Emergencies guidelines of the Inter-Agency Network for Education in Emergencies.[6] Awareness, education and training comprise the central elements of the campaign's work. The campaign reaches out to rural and urban schools in disaster-prone and disaster-affected areas, training staff in disaster and accident response, helping schools to develop emergency response procedures, educating students in disaster preparedness and distributing educational materials to students, staff and parents.

The Child's Right to Safer Schools campaign operates largely on a local level; it helps schools to build capacities for managing their own disaster risk reduction activities. It reaches schools specifically targeted for disaster mitigation assistance, and in doing so promotes disaster preparedness for vulnerable communities. It works in partnership with civil society organizations and government bodies such as District Chief Education Officers or Block Resource Centres. The campaign supplies schools with fire extinguishers and first aid kits, covers students and teachers with disaster microinsurance to ease financial hardship incurred by accidents and disasters, and provide additional community-tailored, need-based assistance. AIDMI, with ProVention Consortium,[7] is promoting the use of risk transfer approaches in India and beyond through demonstration and research. The campaign works with more than 400 vulnerable schools across these six states in India. It strives to meet the recommendations of the UN International Strategy for Disaster Reduction's HFA. The table below demonstrates how campaign activities comply with the Hyogo Framework.

**School Safety Audit**

A recent school safety audit in 60 schools in six hazard-prone states of India revealed that school safety is not a high priority for either public or corporate officials. The audit method was developed with schoolteachers, school administrators, parents and children, in coordination with the respective local government authorities and uses range of quantitative and qualitative methods to gather evidence on school resilience. In many ways this is a mitigation measure.

The audit covered schools in a range of disaster-prone areas: flood-affected portions of Assam, Rajasthan, and Maharashtra; earthquake-affected portions of Gujarat and Jammu and Kashmir; and tsunami-affected portions of Tamil Nadu. In each of these areas the audit assessed the staff understanding of hazard safety, the structural safety and preparedness plans, and the impact of existing mitigation measures. The influence of non-school actors — government, non-governmental organization (NGO) and corporate — on school safety was also reviewed. Although the comprehensive analysis of findings is pending, the following five points are clearly emerging:

1. Processes and methods that reduce disaster risks — such as the design of seismically safe buildings — are not considered even after the area served by the school has faced a major disaster. School buildings are often structurally unsafe.

2. The focus of reconstruction after any disaster has been on new and big buildings and not on safer school buildings. Size matters. Safety does not.

3. The schools that are safer have not shared their experiences with schools that need to rebuild. Schools are temples of learning but school-to-school learning on safety is not occurring.

4. The teachers in the surveyed schools have high levels of interest in making schools safe. They do not know where to access basic, useful information. Current constraints in time and resources inhibit this access.

5. Where school safety activities are promoted by NGOs, government or the corporate sector, follow-up is often lacking. This almost guarantees that the high-cost initial effort will have diminishing returns. In short, we are not demonstrating sufficient concern for the safety of our children.

**How can the HFA framework comply with Safer Schools campaign activities?**

| HFA priority: | Safer Schools campaign application |
|---|---|
| Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation. | Opportunities for disaster risk reduction through safer schools initiatives are synthesized into publication and disseminated on local, national and regional levels. In its direct work with local communities, the Safer Schools Campaign assesses human resource capacities and promotes community participation. |
| Identify, assess and monitor disaster risks and enhance early warning. | The Safer Schools campaign works with partner institutions in their respective states to identify disaster-affected and vulnerable schools. School Safety Audit has been conducted to identify specific needs in a representative sample of India's vulnerable schools. School Safety training strengthens local capacities for identifying hazards and reducing risks. |
| Use knowledge, innovation and education to build a culture of safety and resilience at all levels. | The Safer Schools campaign is imparting knowledge through education directly to school staff, or to local trainers working directly with school staff, to build a culture of safety by spreading scientific awareness. The campaign works in partnership with local governments and civil society agencies, thereby involving a broad range of institutions in building a culture of safety on many levels. |
| Reduce the underlying risk factors. | In addition to assistance in the identification of risk factors, the Safer Schools campaign works to reduce those factors. Structural improvements are made to buildings when resources allow, and innovative plans such as disaster and accident microinsurance are used to reduce risk for students, teachers and their families. |
| Strengthen disaster preparedness for effective response at all levels. | School Safety training sessions promote preparedness tools and strategies in schools. Supported schools are also provided with fire extinguishers, first aid kits and IEC displays. Case studies have shown that children extend preparedness strategies to their families, including lessons on what to do before, during and after disasters. |

Source: All India Disaster Mitigation Institute (2008). "School-based Disaster Risk Reduction: Lessons for South Asia" www.southasiadisasters.net

## The way ahead

International Financial Institutions such as the World Bank and Asian Development Bank should consider allocating a certain percentage of their relief and development budget for disaster risk reduction in schools of hazard-prone countries.

The International Federation of the Red Cross and Red Crescent Societies, being one of the oldest humanitarian movements having physical presence in many countries, should encourage its national chapters to demand safety from school authorities and develop national action plans to work with vulnerable schools.

ISDR is situated at the core of the UN system to develop global risk reduction strategies, and can influence other UN agencies such as UNESCO, UNDP and national governments. ISDR is best placed to build on its own global campaign and other initiatives in developing countries to further integrate safety issues in ongoing programmes on HIV/Aids, climate change adaptation and good governance. In addition to developing strategies, capturing lessons and promoting best practices, ISDR should focus more on supporting pilots and demonstration projects on the ground.

National governments should undertake nationwide school safety audits backed up with resources to implement recommendations and safety measures identified by such audits. National governments must also promote and integrate disaster risk reduction in school curricula at various levels.

Private sector insurance companies should inspire their policyholders to demand certificates of school safety from their respective education authorities. Authorities should certify if the school is safe and prepared for any possible disaster risk. Once such a demand is built, schools and governments are bound to act. The insurance sector has the resources and the weight to take the lead. As in politics or economics, progress will follow the law of demand: let policyholders create a demand for protecting children at school.[8] Similarly, construction firms and contractors must provide a certificate of safety after completing a school building or retrofitting old buildings.

Civil society organizations should directly engage with and support vulnerable schools in learning and implementing risk reduction measures through demonstration projects, influencing government policies, and introducing programmes to integrate risk reduction for children.

A world without poverty is not possible without the poor having access to education, to schools — indeed, to safer schools. The poor have the right to life: the life of their children and the life of their children in schools. School safety is not possible without scientific awareness. Safety and poverty removal are not two separate issues.

Image: AIDMI. School safety training 2005

A student presenting a risk assessment for his school during School Safety training by AIDMI and the European Union in Kutch. Active participation of students in designing school safety measures ensures their better response during emergencies

# How the Global Earth Observation System of Systems can support disaster managers

*José Achache and Veronica Grasso, Group on Earth Observations*

**Hazards such as wildland fires, volcanic eruptions, earthquakes, tsunamis, land subsidence, landslides, avalanches, storms and floods are an inevitable part of living on this planet. Fortunately, we can often minimize the likelihood of such hazards turning into disasters that destroy human life and property. One way we can reduce risks is to use Earth observations for monitoring and predicting emerging hazards, providing early warnings and responding and adapting to those disasters that we cannot fully avoid.**

Timely access to weather forecasts, satellite images, in situ data about water levels or seismographic changes, and maps that integrate information on transport routes, health services, and socioeconomic conditions can save uncounted lives. The key words here are access and integration. This is why the Group on Earth Observations (GEO) is actively seeking to empower decision-makers and disaster managers with rapid access to integrated data and information services from a diverse range of sources.

To achieve this, GEO's 120 member governments and international organizations are constructing a Global Earth Observation System of Systems (GEOSS). In addition to addressing climate change, public health, biodiversity and other critical issues, GEOSS promises to improve our ability to monitor, forecast, mitigate and respond to natural, human-induced, and compound hazards and disasters. It will also strengthen the capacity of disaster managers for exploiting disaster-related information and for coordinating monitoring and prediction activities with those of experts in other fields.

Image: Canadian Forest Service, Natural Resources Canada

Northern boreal forest fire

**GEO's disaster-management activities**

GEO is building GEOSS through a series of activities to which governments and organizations voluntarily contribute. Its key tasks on disaster management are the following:

*Reducing earthquake damage by strengthening seismographic networks* — Interlinking national and regional seismographic networks and extending their coverage to more ocean regions will help to improve earthquake prediction. It will give researchers and experts greater access to real-time and historical seismological data and products. GEO is working closely with the International Federation of Digital Seismograph Networks to improve global seismographic networks and to encourage data sharing among GEO's participating members.

*Establishing a global tsunami early warning system* — UNESCO's Intergovernmental Oceanographic Commission is leading GEO's effort to improve the network of ocean-bottom systems for tsunami detection. A key aspect of this work involves integrating this network with land-based sensors and satellite-based optical and radar instruments. These networks also need to be made interoperable with emergency-response systems and with other relevant observation systems.

*Constructing a global early warning system for wildland fire* — The high level of loss and destruction caused by wildfires highlights the need for improving early warning systems. Disaster managers, fire-fighters, foresters and vulnerable communities need timely information about the location and trajectory of blazes, while researchers and risk-reduction experts must be able to monitor and analyse trends in the frequency and distribution of forest fires. The GEO wildfire team is working to improve and coordinate existing warning systems and risk models. It is also addressing information gaps and the need for training and capacity building.

A prototype of this global early warning system has already been established for sub-Saharan Africa. The South African Advanced Fire Information System (AFIS) is the first near-real-time, satellite-based fire monitor-

ing system on the continent. The system combines spectral data from satellite-based sensors with observations from a geostationary weather satellite. Once a fire is detected, e-mail and SMS text messages are immediately sent to the affected parties. Future plans include adding tools for managing fire risks.

*Monitoring regional risks through SERVIR and Sentinel Asia* — By improving the speed and accuracy of information for disaster preparedness and early warning, these two regional services aim to minimize deaths and socioeconomic losses resulting from disasters. Sentinel Asia has been established by 44 space agencies and disaster management agencies from 18 Asia-Pacific countries together with seven international organizations. It uses remote sensing and Geographic Information Systems (GIS) technologies to monitor all of the major kinds of risk facing the region. Similarly, SERVIR enables Central American countries to access satellite imagery, geospatial data and interactive online tools to address a wide range of needs. It monitors weather, forest fires and ecological changes, as well as extreme events such as red tides, tropical storms and floods.

**Meeting the cross-cutting needs of users**

The Global Earth Observation System of Systems is being assembled out of numerous national and regional systems. Existing national and regional seismographic networks and early warning systems, for example, are being coordinated and interlinked in order to form coherent global networks. But because information is often needed at the local, national or regional levels (as with the SERVIR and Sentinel Asia examples above), GEOSS needs to be made relevant to the users operating at these levels.

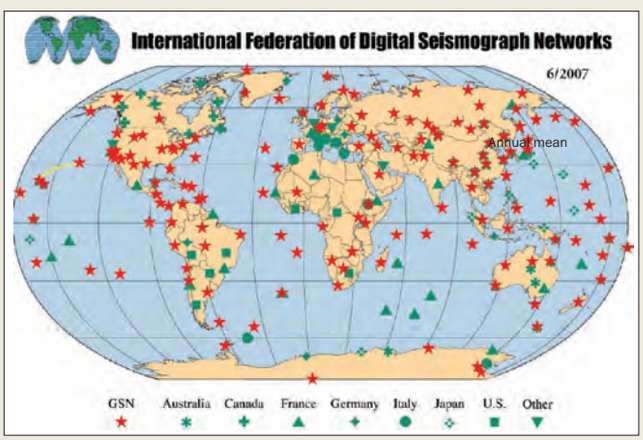
The success of GEOSS will depend on how actively users engage with it. Given its scale and its cross-cutting nature, GEOSS must simultaneously address the needs of a large variety of users, from developed and developing countries, from the regional and global levels, and from governmental departments and ministries, scientific institutes, industry, and national and international organizations.

To ensure that GEOSS fully supports the needs of disaster managers, GEO is coordinating its disaster-related activities with the United Nations International Strategy for Disaster Reduction (ISDR). It is also aligning its efforts with the Hyogo Framework for Disaster Risk Reduction, which is defining and promoting the multi-hazard risk-management approach.

Other key partners include the World Meteorological Organization, which is initiating a disaster risk reduction programme; the Committee on Earth Observation Satellites, which supports the use of satellites for risk management; the Intergovernmental Oceanographic Commission, which promotes tsunami early warning systems; and the United Nations Office for Outer Space Affairs, which is implementing the UN Platform for Space-based Information for Disaster Management and Emergency Response. GEO is also working with the humanitarian aid community led by the United Nations Office for the Coordination of Humanitarian Affairs.

In the longer term, effective disaster risk management and reduction will require using Earth observations to better understand the relationship between natural disasters and sustainable development. For example, increasingly dense urban populations, emerging health threats and the impacts of climate change are generating new types of hazards and magnifying existing ones. Integrating information to improve forecasts on climate, health, water, disasters and other fields addressed by GEOSS will therefore be increasingly important for both sustainable development planning and disaster risk management.[1]

**Geographic distribution of FDSN 'Backbone' stations**




The FDSN 'Backbone' stations' data are archived at the Data Management Center of IRIS and distributed in real-time by FDSN members. The different symbols indicate the different parent networks contributing the data

Source: Incorporated Research Institutions for Seismology (IRIS)

**About GEO and GEOSS**

The Group on Earth Observations was established in 2005 after the World Summit on Sustainable Development (WSSD), the Group of Eight leading industrialized countries (G8) and three ministerial Earth Observation Summits all called for improving existing observation systems. Its membership now includes 73 countries and the European Commission; 51 'participating organizations' also contribute to its work.

GEO is coordinating the construction of the GEOSS, which will link together diverse monitoring networks, instruments, databases and models and other decision-support tools. GEOSS addresses nine priorities of critical importance to the future of the human race. In this way, it aims to help countries to protect themselves against natural and human-induced disasters, understand the environmental sources of health hazards, manage energy resources, respond to climate change and its impacts, safeguard freshwater resources, improve weather forecasts, manage ecosystems, promote sustainable agriculture, and conserve biodiversity.

GEO also serves as an advocate for investments in disaster-management and other Earth observation systems. Greater investment is essential to ensure the adoption of new and emerging technologies for monitoring land-use change, the interaction between extreme weather events and other aspects of the environment, and other variables that can affect disasters and human well being.

# Saving lives through early warning systems and emergency preparedness

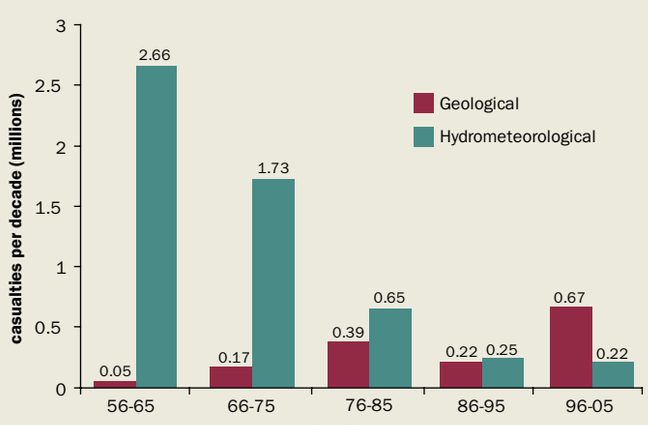
*Maryam Golnaraghi Ph.D, Chief; James Douris, Technical Officer and Jean-Baptiste Migraine, Junior Professional Officer, Disaster Risk Reduction Division, World Meteorological Organization*

**Every year disasters cause significant impacts around the globe. Disasters caused by meteorological, hydrological and climate-related hazards such as floods, tropical cyclones, droughts and heat waves are the most frequent and extensive geographically, resulting in the largest share of overall impacts. Statistics from the Centre for Research on the Epidemiology of Disasters (CRED) reveal that during the period 1980-2007, nearly 8,500 disasters caused by natural hazards worldwide killed about two million people and resulted in losses of USD1.5 trillion.**

During this period, about 90 per cent of disasters caused by natural hazards were of meteorological or hydrological origin, accounting for 1.3 million losses of life and 1,200 trillion US dollars (respectively 71 per cent and 78 per cent of overall impacts).

Over the last 50 years, globally, the recorded number of disasters and their associated economic losses have increased by nearly 10-fold and 50-fold, respectively. However, the associated loss of life has decreased ten-fold. This reduction in loss of life is linked to the development of effective disaster risk reduction (DRR) policies and strategies, particularly related to linking early warning systems to emergency preparedness and planning at national to local levels.

**Decadal loss of life related to geological versus hydrometeorological hazards**




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

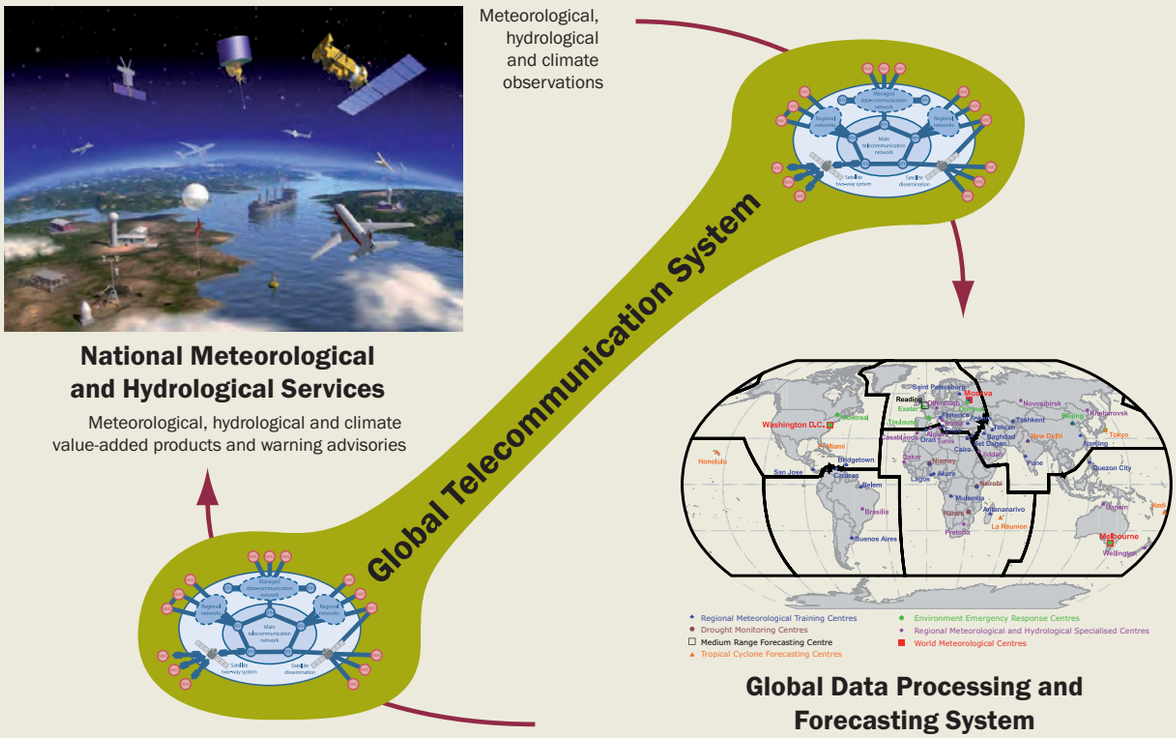
**50 years of international cooperation to support national capacities for early warning systems**

Over the years, the World Meteorological Organization (WMO), a specialized agency of the United Nations, has acted as an authoritative voice for weather, water, climate and disasters of hydrometeorological origin, and has promoted the importance of prevention and preparedness measures including risk assessment, early warning systems and sectoral planning to reduce the impacts of weather, climate and water-related hazards. Through the coordinated networks of the National Meteorological and Hydrological Services (NMHSs) of its 188 members, WMO coordinates the networks of Global Observing System, Global Telecommunication System and Global Data Processing and Forecasting System, providing a wide range of products and services based on observations, monitoring, hazard analysis, forecasting to provide capacities to developing and least developed countries for issuance of warnings.

One of the core activities of WMO has been the consolidation of general requirements for global Earth observations and the coordination of consistent, systematic and continuous collection and archiving of hydrometeorological observations. Furthermore, through establishment of standards, guidelines and procedures for data collection, quality control, formatting, archiving and rescue, WMO has assisted countries, through their NMHSs, to enhance their capacity in this area. WMO continues to work towards ensuring consistent data quality and accessibility across national boundaries for the purpose of improving risk management capabilities at the regional and subregional levels.

Through the WMO Global Observing System, operated by the National Meteorological Services, data are collected from 17 satellites, hundreds of ocean buoys, thousands of aircraft and ships and nearly 10,000 land-based stations. More than 50,000 weather reports and several thousand charts and digital products are disseminated daily through the WMO Global Telecommunication System, which interconnects all countries through their National Meteorological Services around the globe. The WMO Global Data Processing and Forecasting System involves three World Meteorological Centres (WMCs) and 40 Regional

**WMO coordinated global operational network in support of national early warning systems**




Source: World Meteorological Organization

Specialized Meteorological Centres (RSMCs), as well as regional climate and drought monitoring centres. These centres, which are operated by NMHSs, ensure cooperation at global, regional and national levels to process data and routinely provide countries with analyses and meteorological forecasts, supporting early warning capacities through their NMHSs. An example is the WMO Global Tropical Cyclone Early Warning System. It comprises a coordinated observing network for collecting and sharing data, six Regional Specialized Meteorological Centers[1] providing tropical cyclone analysis, forecasts and alerts to the National Meteorological Services and five regional committees, which ensure ongoing improvements in the tropical cyclone forecasting and operational coordination for the upcoming season. This enables the availability of tropical cyclone warning capacities in all countries at risk. WMO is working on an integrated approach to ensure utilization of this coordinated network to support national warning systems for a wide range of hazards including floods, droughts, sand and dust storms, severe storms, storm surges and other marine related hazards.

### Components of effective early warning systems

Effective early warning systems involve four operational components, including:

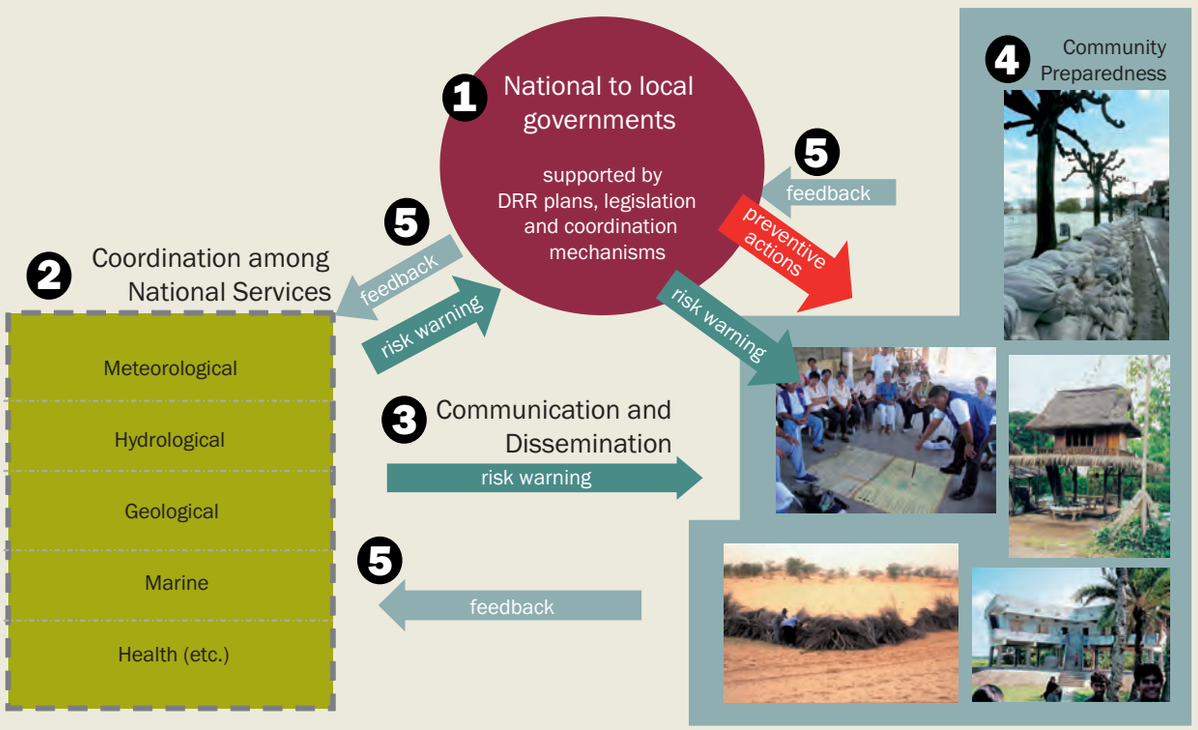
- Observing, detecting, monitoring and forecasting hazards, and developing warning messages
- Assessing the potential risks and integrating risk information in the warning messages
- Distributing, rapidly and reliably, understandable warnings to authorities, risk managers and the population at risk, with levels of warning that are linked to levels of preparedness, readiness and emergency operations
- Community-based emergency planning, preparedness and training programmes to ensure effective response to warnings to reduce the potential impacts.

Development of capacities along these four components would require political commitment and investments for development of early warning systems and emergency preparedness reflected in disaster risk management plans and budgets, legislations that define explicitly roles and responsibilities of various authorities and agencies at national to local levels. Operational implementation of warning systems would also require a coordinated approach among different stakeholders with clear protocols and procedures that enable effective coordination at national to community levels. Furthermore, there is need for systematic feedback and evaluation of the system at all levels following each event, to ensure improvements over time.

### International cooperation for strengthening national early warning system capacities

While the benefits of early warning systems have been demonstrated over the last decades, national policies in many countries continue to stress post-disaster response and relief operations. There remain significant defi-

**Criteria for effective early warning systems**




Source: International Experts' Symposium on Early Warning Systems for Integrated Disaster Risk Management, May 2006

ciencies in investments in systematic and sustainable early warning systems and emergency preparedness programmes at the national to community levels, posing urgency for the scientific and technical, development and humanitarian community to work together to raise political awareness on the benefits of early warning systems and emergency preparedness and to assist countries in developing these capacities.

The concept of early warning systems has received significant international attention in the past few years.[2] Results of the Global Survey of Early Warning Systems, commissioned by the Former UN Secretary-General Kofi Annan, together with national and regional capacity assessment surveys conducted by the WMO, indicate that in many countries there is need for development of early warning systems as an integral part of national DRR strategies.

The adoption of the Hyogo Declaration and *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters* (HFA) by 168 countries during the World Conference on Disaster Reduction (January 2005, Kobe, Japan), marked the beginning of a new era for disaster risk management, with the second high priority area stressing the importance of 'identifying, assessing and monitoring disaster risks and enhancing early warnings.'

In May 2006, following the Third International Early Warning Conference (Bonn, Germany), WMO convened the First International Experts' Symposium on Multi-Hazard Early Warning Systems (Geneva, Switzerland, May 2006) (MHEWS-I), also co-sponsored by the World Bank, United Nations Development Programme (UNDP), UN Office for the Coordination of Humanitarian Affairs (OCHA), International Federation of Red Cross and Red Crescent (IFRC), International Strategy for Disaster Risk Reduction (ISDR) Secretariat and UNESCO, in which nearly 100 experts from the networks of 20 technical, humanitarian and development agencies participated. The MHEWS-I:

- Provided recommendations pertaining to major gaps in governance, organizational coordination and operations aspects of early warning systems along the four components of early warning systems
- Identified criteria for good practices in early warning systems
- Identified examples of good practices including the France Vigilance System, Shanghai Multi-Hazard Early Warning and Emergency Response Programme, Bangladesh Cyclone Preparedness Programme, and Cuba Cyclone Preparedness and Response System
- Recommended the need for strengthened coordination and collaboration among agencies across components of early warning systems.[3]

Since 2007 WMO, through an integrated planning approach with other partner humanitarian and development agencies (e.g. IFRC, World Bank, OCHA) and regional agencies, has been initiating national demonstration and pilot projects to develop, analyse and document good practices in early warning systems. In

**The Saffir-Simpson Hurricane Scale**

| | |
|---|---|
| **Category One Hurricane:** | Winds 74-95 mph (64-82 kt or 119-153 km/hr). Storm surge generally 4-5 feet above normal. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal road flooding and minor pier damage. |
| **Category Two Hurricane:** | Winds 96-110 mph (83-95 kt or 154-177 km/hr). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. |
| **Category Three Hurricane:** | Winds 111-130 mph (96-113 kt or 178-209 km/hr). Storm surge generally 9-12 feet above normal. Some structural damage to small residences and utility buildings. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. |
| **Category Four Hurricane:** | Winds 131-155 mph (114-135 kt or 210-249 km/hr). Storm surge generally 13-18 feet above normal. Some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Extensive damage to doors and windows. |
| **Category Five Hurricane:** | Winds greater than 155 mph (135 kt or 249 km/hr). Storm surge generally greater than 18 feet above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. |

Source: National Hurricane Center Miami: http://www.nhc.noaa.gov/aboutsshs

May 2009, WMO will be convening the 2nd International Experts' Symposium on Multi-Hazard Early Warning Systems (MHEWS-II), to be hosted by Météo-France in Toulouse, France. Through collective analysis of lessons learned from demonstration and pilot projects, the goal of MHEWS-II is to develop the first set of comprehensive guidelines on governance, organizational coordination and operational aspects of early warning systems leveraging cooperation at regional, national and community levels.

**Examples of good practices in early warning systems**

*French Vigilance System* — In December 1999, the severe winter storm Lothar led to nearly 100 casualties and an estimated USD8 billion economic losses in France. Following this disaster, the French Vigilance System was established in close collaboration between the Ministry of Transportation (responsible for provision of weather forecasts and warnings through Météo-France) and the Ministry of Interior (responsible for emergency preparedness and response), and was later complemented by a hydrological component, involving the Ministry of Ecology, Environment and Sustainable Development (responsible for flood forecasting). The French Vigilance System, supported by an inter-ministerial steering committee, became operational in November 2001.

However, the 2003 heat wave led to nearly 20,000 casualties and an estimated USD4 billion economic losses in France. Lessons learned from this event were instrumental in setting up the heat/health warning module within the Vigilance System, involving close collaboration between Météo-France and the Ministry of Health (through the National Institute for Health Surveillance).

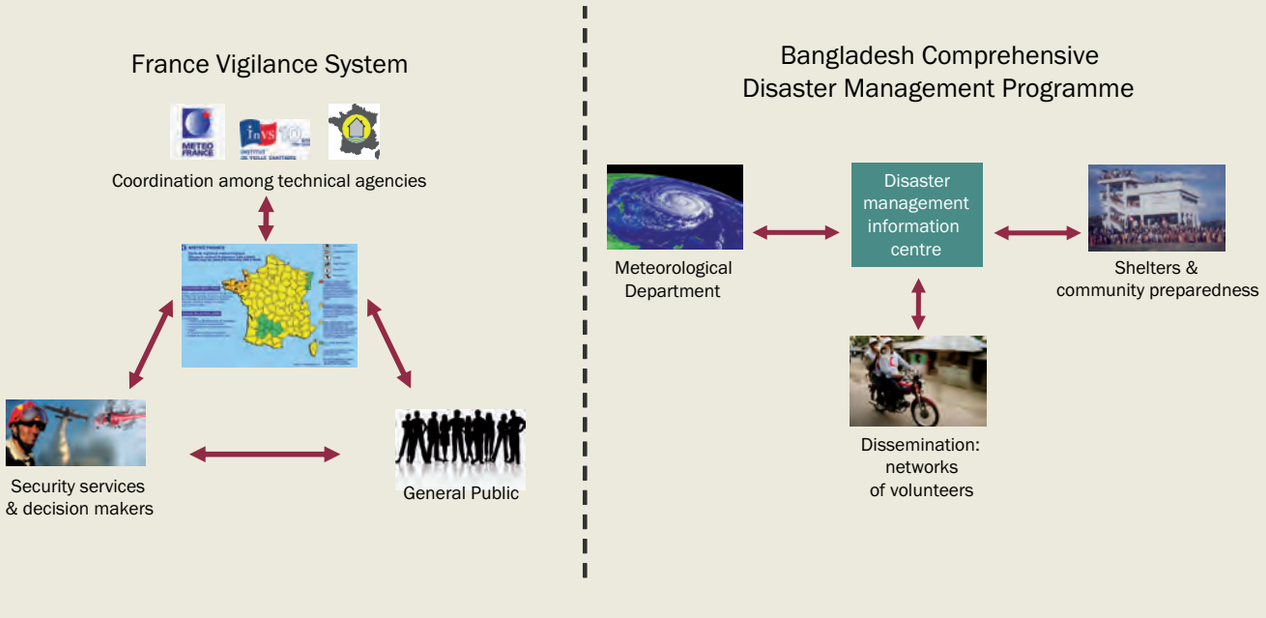
Since 2003, new legislation has been enacted to enhance emergency preparedness and response to the Vigilance System, including:

- The law for natural and technological risks (30 July 2003) which is administrated by the Ministry of ecology and sustainable development, promoting adequate urban planning, protection measures, and dissemination of precise information about risks to the citizens
- The law for civil protection and crisis management (13 August 2004), which defines the roles and responsibilities of the different agencies in the context of crisis management, calls on the responsibility of citizens in ensuring their security, and emphasizes the need for continuous government watch on any risks that would require operational response
- The Organic Law (1 January 2006) on finance, which allows for the distribution of budgets among different agencies, further strengthening inter-agency collaborations for implementation of specific programmes.

In the French Vigilance System, information about risks of hydrometeorological and climate phenomena at sub-regional and local levels is communicated on a map, with four colour-coded levels of vigilance. This map is updated at least twice a day and distributed to authorities and the public. If needed, authorities also get additional customized information for better planning and response operations. The system is continually improved through a feedback mechanism involving all partners.

*Bangladesh Comprehensive Disaster Management Programme* — Bangladesh is one of the good practices in demonstrating benefits of investments in emergency preparedness and tropical cyclone early warning system. Cyclone Bhola, on 12 November 1970, has been the deadliest tropical cyclone ever recorded in modern times. Up to 300,000 people lost their lives, primarily as a result of the associated storm surge that flooded much of the low-lying islands of the Ganges Delta. This cyclone was the sixth cyclonic storm and the most powerful of the 1970 North Indian Ocean cyclone season, reaching a strength equivalent to a category three hurricane. The coastline of Bangladesh was yet again devastated by Cyclone Gorky in 1991, leading to an estimated 140,000 deaths. Following

**Two examples of good practices in early warning systems: France Vigilance System and Bangladesh Comprehensive Disaster Management Programme**




Source: World Meteorological Organization

these tragic disasters, the Government of Bangladesh through the Ministry of Food and Disaster Management, together with the Bangladesh Red Crescent Society, developed the Cyclone Preparedness Programme. Since 2003, the Comprehensive Disaster Management Programme (CDMP) complements the Cyclone Preparedness Programme, promoting community participation in the construction and maintenance of cyclone shelters. In November 2006 the Bangladesh Meteorological Department, CDMP, the Ministry of Food and Disaster Management and the Ministry of Defence signed a Memorandum of Understanding to clarify roles and responsibilities of each agency for early warning dissemination. A Disaster Management Information Centre has been initiated under the Ministry of Food and Disaster Management, to archive and disseminate meteorological, hydrological and climate information and warnings provided by the Bangladesh Meteorological Department, anticipate and assess damages, coordinate relief operations, and advise national planning processes so as to reduce disaster risks. Bangladesh's regulative framework for disaster management, as updated in 2008, includes a Disaster Management Act, defining mandatory obligations and responsibilities among Ministries and agencies; a National Disaster Management Policy, describing the national objectives, and strategies in disaster management; a National Plan for Disaster Management 2007-2015, complemented by hazard-specific management plans (flood, cyclone, storm surge, tsunami, earthquake, drought, river erosion), and Standing Orders on Disaster, detailing roles and responsibilities of committees, ministries and other organizations in DRR and emergency management.

On the operational levels, this programme involves a coordinated approach to emergency preparedness and planning at national to community levels, linking the early warning of tropical cyclones issued by the Bangladesh Meteorological Agency (BMA) to an emergency preparedness and response programme which builds upon a network of 33,000 volunteers at the community levels who assist with preparedness planning, drills, alert dissemination, evacuations, first aid, relief, and ongoing community education and training. A warning preparedness mechanism using a flag system enables the linking of different levels of threat to appropriate actions to minimize the impacts. This preparedness programme is complemented with the development of concrete shelters raised on 12-foot pillars to allow tidal surges to flow beneath, allowing the population in the low-lying coastal region an effective evacuation mechanism. Furthermore, in 2006 the system was further enhanced, with the setting up of the Disaster Management Information Centre, which archives and disseminates up-to-date weather, climate and seismic observation data from the Bangladesh Meteorological Department, anticipates and assesses damages, coordinates relief operations, and advises national planning processes so as to reduce disaster risks. The benefits of this programme were realized in November 2007 during the Cyclone Sidr, the equivalent to a category four hurricane, when loss of life was significantly reduced to 3,000. Following this event, the assessments carried out in the region and with consideration for potential increase in risks associated with such hydrometrological hazards linked to climate change, loss of life and economic losses in Bangladesh could be further reduced through development of additional cyclone shelters in the low-lying areas and more investments in infrastructure that could withstand the powers of the cyclones and storm surges in this region.

# Between human security and disaster management — the role of satellite derived information in achieving the goals of the international community

*Francesco Pisano and Einar Bjorgo, UNITAR/UNOSAT*

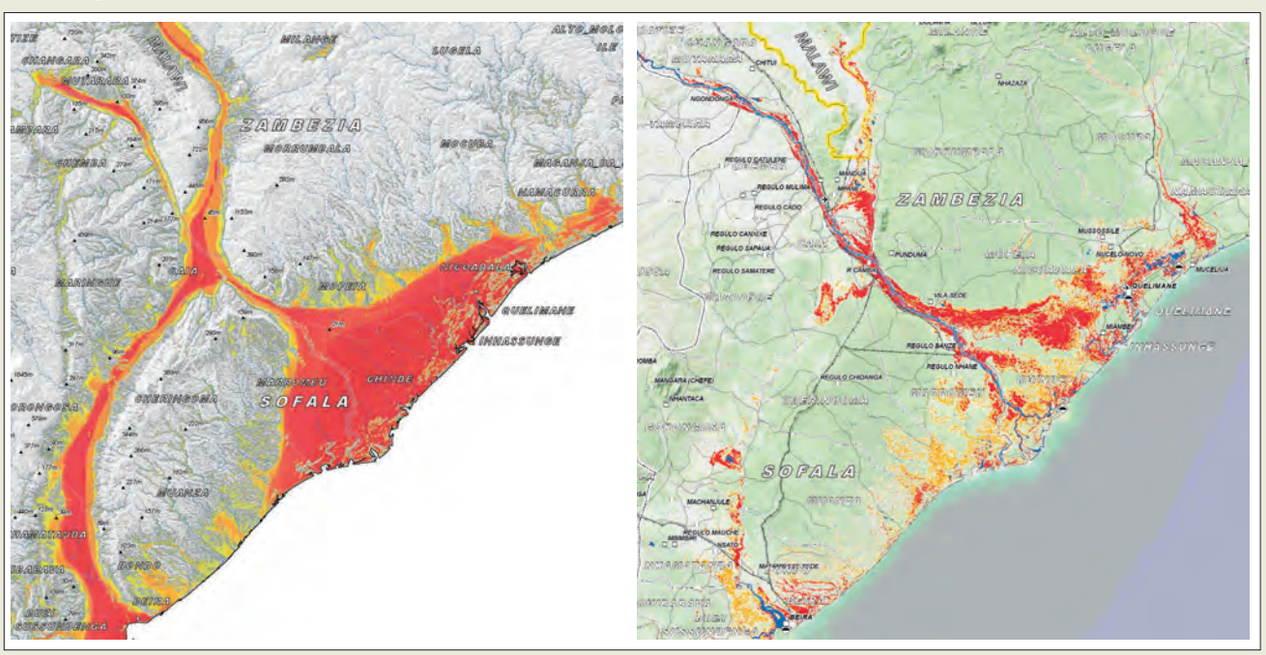
**What is the role of satellite applications in achieving the goals and objectives of the United Nations (UN) and the international community? One of great and increasing support, bringing advanced technology to bear for the benefit of all and relying on objective data to produce updatable information.**

Earth observation data and geographic information systems (GIS) are useful tools for effective decision-making. The environment, human security, vulnerability reduction, adaptation to climate change, emergency response and recovery are all areas in which these tools are becoming common requirements, and their effects on current practices are already established.

For developing countries in particular, with relatively poor territorial documentation and outdated maps, routinely acquired satellite imagery combined with local field surveys can be invaluable information sources. Local institutions, for example, can run analyses on the geophysical risks facing their communities, and develop plans for improved urban and rural territorial management. Time-stamping the environmental situation at certain intervals allows monitoring of environmental parameters, such as forest cover and urban expansion.

UNOSAT is dedicated to developing and applying, together with an ever-growing number of partners, the entire range of satellite solutions to all UN goals and

**Mozambique delta**




Left: Potential risk area for floods in Mozambique delta; Right: Satellite-observed flooding

Source: UNOSAT

objectives.[1] This includes the use of integrated solutions. The UNOSAT approach is innovative in that it suggests a new paradigm, combining technical soundness with a constant focus on users and their needs. The result is a number of activities and methodologies aiming to produce concrete solutions with high impact at low cost.

Structural as well as technical running costs are still an issue in the world of space applications, but their relative weight is constantly decreasing. UNOSAT's experience since 2001 has taught us lessons which we have submitted to the attention of both donors and users, with positive outcomes. Here we would like to share some of these experiences, followed by some issues that are raised by them.

The study of the applicability of satellite solutions to risk and vulnerability begins with the post or pre-disaster phase, depending on the point of view of the observer. Satellite applications best express their intrinsic potential when addressing disaster prevention, (defined as the assessment and reduction of vulnerability to manage a certain risk until its impact may be considered preempted). Satellite remote sensing offers the best bird's eye view of hazards and vulnerability levels because it couples objectivity with the possibility of repeating observation over time.

From the macro-level to the micro-level, all solutions seem to be within reach now that very high resolution is available from commercial satellites. Yet imagery alone is not enough to ensure disaster prevention: the importance of local knowledge and indigenous practices is paramount. Satellite maps have shown incredible value as background geographic information on top of which multiple databases can be overlaid.

Local risk analyses are carried out by combining geophysical and geographical parameters, (such as satellite-derived analysis, land-cover type, elevation, slope, hydrographic network, administrative units and place names), with security or socioeconomic parameters, (population distribution and density, income, asset values etc). All this information can be allocated to a geographical distribution, and is therefore applicable to a GIS.

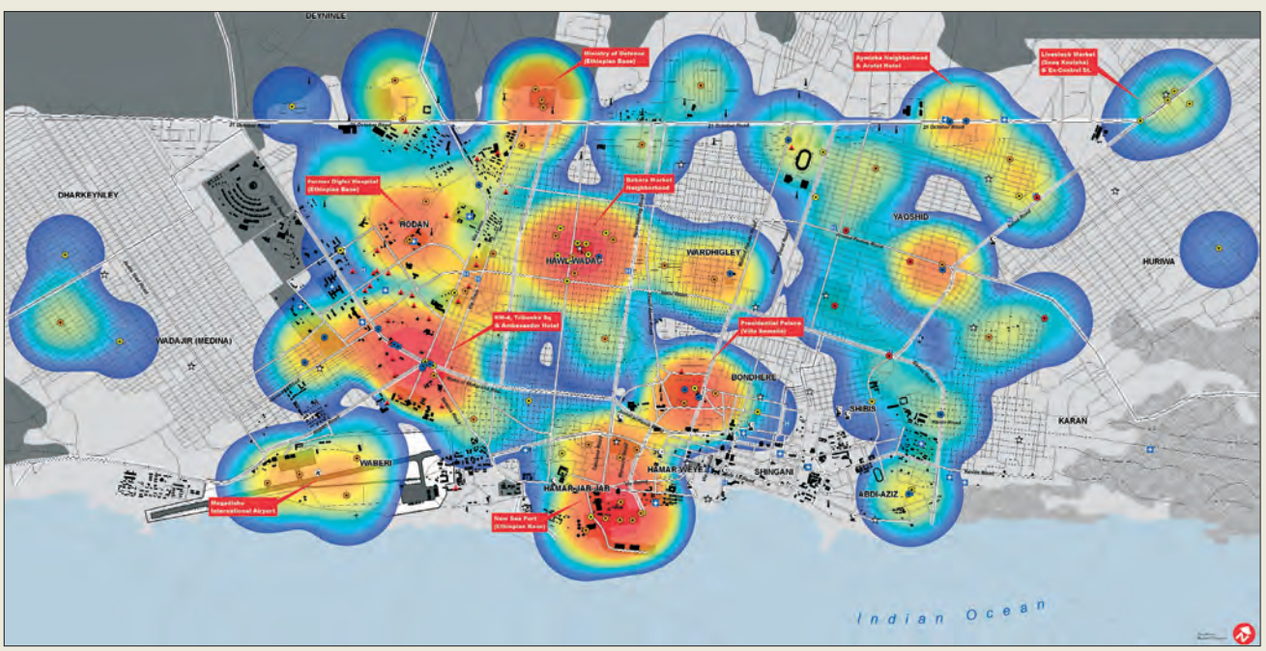
When supporting early recovery and development activities carried out locally by actors in dire need of geographic information on the territories of which they are in charge, one realizes that data and information generated at the time of previous crises and disasters is an information resource yielding excellent returns if properly stored and accessed.

UNOSAT works by offering crisis response mapping to users (UN and non-UN, international as well as national), at no cost. These products are enriched later with additional information, or layers, to be used in support of recovery and development measures on the ground. Although the user requirements are multiple and sometimes cannot be met with the same type of map, we maintain constant efforts to ensure that users in the field can also access these products at no cost.

Our participation in the Global Monitoring for Environment and Security (GMES) project 'Respond', for example, has enabled several users to enjoy free dedicated mapping. In addition, their feedback is factored into the overall GMES process so that user needs are part of the design and planning activity of the entire GMES programme.

In supporting a growing number of national and international development projects, we have grown deeply aware of the central role of remotely sensed information in strategic territorial planning and advanced GIS appli-

**Security incidents in Mogadishu**




Reported security events in Mogadishu, Somalia: 29 December 2006 to 3 March 2007

Source: UNOSAT

Image: UNOSAT

Capacity development at local and regional level: training of officials from Nigeria

cations. Today's integrated projects require an exact knowledge of the territory. Vulnerability reduction projects usually take on a regional dimension in which satellite derived maps become indispensable for their ability to generate information over extensive territories. They can do this in a shorter time and more economically than previous tools.

We have learnt much from our experience in oil producing countries, for example, where the topics of risk and vulnerability are interlinked with the issue of local investment of the benefits generated by the oil industry, taking account of agricultural, social and economic variables that are difficult to represent in a non-GIS environment.

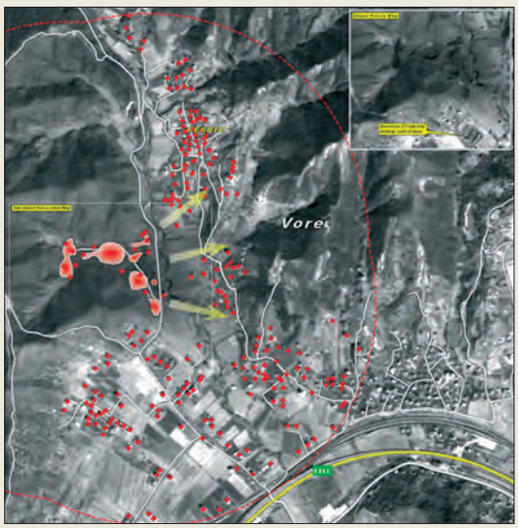
Information management tools are more effective when coupled with the capability to handle them. This capability exists today in most international organizations with an operational mandate, even at the level of field office. Conversely, when developing this capability at local level in developing countries, the issue of capacity retention arises and must be tackled. The expertise accumulated within UNOSAT's technical team, including extensive field experience, allows the programme to provide a new technological edge to local capacity development. This takes the form of specific training modules for both users and trainers. The aim is to create a local GIS and cartographic centre that will continue operating autonomously after the conclusion of the project.

Disaster prevention is part of a cycle that will inevitably include emergencies. During crises, satellite solutions help the planning, implementation and coordination of humanitarian relief operations. Since 2003, UNOSAT has run the humanitarian rapid mapping service, which has been activated over 120 times by relief and coordination agencies. UNOSAT operates the service 24 hours a day, all year round. It ensures that experts are available whenever needed for rapid acquisition and processing of satellite imagery and data for the creation of map and GIS layers, in support of emergency response and humanitarian relief coordination. This support service is available at no cost to users involved in emergency response. UN staff in the field access the products via local UN structures or the Web, while other users may download maps from our website or the sites of various partners, as well as GeoRSS-feeds.

Image: WHO

Participatory mapping using satellite imagery to plan a polio vaccination campaign, India

**Satellite analysis of an ammunition explosion in Albania**




Source: UNOSAT

Users can contact UNOSAT via the 24/7 hotline to request rapid mapping services, or to be included in the mailing lists that are created during each emergency.

Humanitarian satellite mapping is now widely used in the field, with varying degrees of efficiency. In some cases, the driving force is still a push by the space community to show that satellites are a social benefit in humanitarian situations. As users begin to integrate space solutions into their routines, equilibrium tends to be restored, with demand creating the offer, rather than vice-versa. This process is normal, and it has characterized several episodes in the history of integrating technological solutions into practice in the international development and cooperation field.

As in previous cases, the UN system has been applied with caution, taking the time to understand the advantages brought about by technological innovation, test them and absorb the relevant practices gradually. A large number of space applications are emanating from the private sector, which constitute up-to-date use of the underpinning technology but are not tailored to the requirements of the UN family. Although many satellite programmes have adopted labels indicating that they are 'user-driven', it is nonetheless a reality that the whole data procurement sector is driven by commercial considerations. The response to this should be one of constructive collaboration between the UN and the private/public sector, not one of closure. The policy should not be one of entrusting to the space sector the entire responsibility of creating solutions for the international community.

The space sector has strong scientific and engineering components, and it is not always easy on these levels to think in terms of beneficiaries at the local scale. For the UN this is an imperative. The case of the International Charter 'Space and Major Disasters' (Space Charter) is a good example of how the relationship between the space community and the UN can evolve from experimenting to supporting operations in the field. It has recognized that each party has its own role and accountabilities, and that intermediaries like UNOSAT and humanitarian users in the field occupy a specific position in the information chain which must be respected and leveraged if one wants results, not merely promotion. The Space Charter experience shows that the use of space solutions can grow exponentially if the right players are involved.

The next step to take is to combine 'user-driven' with 'need-based'. The needs of users are not sufficiently considered today. They are mostly known only in disaster management and humanitarian circles. It is almost impossible in a policy report to translate the needs arising from humanitarian coordination and relief distribution on the ground. This is why we keep a stringent need-based approach in our work, in parallel with relying on a number of partners from public and private sectors, including the European Centre for High Energy Physics (CERN), which hosts the UNOSAT operations and training centre. Our partners are vital to ensure that our colleagues in the field can carry out their mission, and that local communities and authorities can gain access to knowledge and solutions they know how to use.

UNOSAT can respond to specific user requests with dedicated solutions. Alternatively, a number of typical support services are available:

- Satellite imagery search and procurement assistance
- Image processing
- Map production, including information extraction and analysis
- Research and methodology (design and guidance)
- Field and remote technical assistance, including strategic consulting
- Field verification and data collection
- Training and capacity development
- Integrated satcoms solutions
- Data storage and information and communications technology (ICT) solutions.

*The views expressed in this article are those of the authors and do not represent any position attributable to the UN organization.*

# Development of an Environmental Surveillance Network for South Carolina, USA

*G. Scott, S. Cross, W. McFee and S. Morton, NOAA; J. Miglarese, FedSolve; K. Kirkwood, J. Burdine and J. Richter, University of South Carolina; L. Brock, South Carolina Department of Natural Resources; A. Caver and M. Martin, Clemson University Livestock & Poultry Health Programs; E. Covington, S. Finklea, P. Lee and J. Rice, South Carolina Department of Health and Environmental Control; J. Davis and T. Murphy, South Carolina Emergency Management Division; J. Shelton and E. Strom, USGS, South Carolina Water Science Center*

**Since the 9/11 attack on the United States there has been a significant focus on preventing future attacks, including development of new methods that may more rapidly detect an event and may save lives and property as a result. Bioterrorism is a real threat that may affect both environmental and human health in many different ways. The more recent emphasis on homeland security as a separate national preparedness effort distinct from the national emergency preparedness response efforts has created gaps in planning among state and federal agencies. The Department of Homeland Security (DHS) has provided guidance in a coordinating role by providing accountability and integrated communications among the agencies most depended upon to respond to disasters. DHS thus becomes the single point-of-contact for federal, state and local entities.**

As a result, the DHS has established target capabilities including environmental monitoring and assessment, environmental health, natural resources and restoration, and natural hazards monitoring as key areas for technology development and detection.[1] In both human health and the general environment, there are certain keystone indicators that may serve to inform public health and environmental managers that adverse effects from a homeland security event are being detected and observed — adverse effects that may warrant additional oversight, review and response by emergency preparedness and law enforcement agencies. In the public health setting, surges in emergency room admissions, increased number of prescriptions for medicines used to abate certain types of infections or illnesses, and increased number of hospitalizations may be early indicators that something unusual is occurring. Because some bioterrorist events may exhibit symptoms that mimic a natural disease outbreak, bioterrorism preparedness often rests in large part on public health preparedness.[2] While the West Nile virus outbreak is considered by the Centers for Disease Control and Prevention (CDC) to have been a naturally occurring event, at one point there was speculation that it might have had an unnatural (bioterrorist) origin. The ensuing investigation and post-outbreak assessments illustrate the challenges in identifying the source of an outbreak, supporting officials' views that public health preparedness is a key element of bioterrorism preparedness.[3] This stems in part from a lack of understanding of ecosystem responses to unusual events.

The vulnerabilities and risk associated with incidents of national significance involving natural ecosystems are economically, socially and environmentally significant. All natural ecosystem incidents, accidents or natural disasters require a fuller understanding with regards to scope and scale of resiliency. The complexities of ecosystems bring special kinds of challenges to the emergency preparedness responder during an incident. The responder may have insufficient knowledge about ecosystem changes that may occur and be important in determining long-term remediation, restoration and recovery efforts. Utilizing natural disasters, and unplanned accidents or incidents and through post-incident analysis, emergency management personnel may gain keen insight, resulting in many lessons learned.

In natural ecosystems, adverse environmental events such as fish kills and unusual mortality events among natural resource keystone species, can serve as early warning indicators of adverse conditions that may potentially affect the general public. Understanding these natural resource mortalities on any given day and time of year may assist in the timely identification of an intentional or overt biological/chemical act of terrorism. Additionally, these natural resource species may serve as the 'canaries in the coal mine' in the early detection of bioterrorism events. Currently there are many ongoing environmental monitoring and assessment activities distributed among various federal and state agencies, which are not connected to provide this type of ecosystem information in a timely manner.

Links between public and environmental health agencies are becoming more important. The term 'biosurveillance' describes the monitoring of a population for changes, against a standard or norm.[4] In these post 9/11 times, biosurveillance has evolved to mean monitoring ecosystems and public health communities for changes that could indicate the presence of a silent biological or chemical agent release from a terrorist attack.[5] Many emerging diseases, including West Nile virus, affect both animals and humans. So do many

**List of charter ESN participants and the natural resources mortality or environmental databases they regulate or manage**

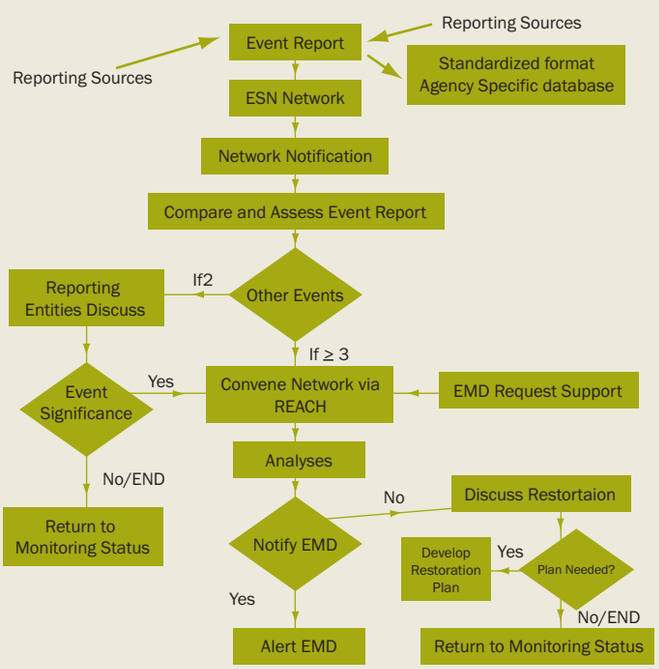
| Participant | Environmental database contribution to the ESN |
|---|---|
| NOAA Center for Coastal Env. Health & Biomolecular Research | Phytoplankton monitoring network and marine mammal strandings |
| SC Department of Health and Env. Control (DHEC) | Fish kills |
| SC Department of Natural Resources (DNR) | Fish kills and bird/wildlife mortalities |
| United States Geological Survey (USGS) | Water level and water quality network |
| SC Veterinarians Office | Domestic/companion animal and wildlife surveillance |
| DHEC/State Law Enforcement Division (SLED) | Coordination with DHS under SLED |
| SC Emergency Preparedness | Coordination with state emergency preparedness |
| USC Center for Public Health Preparedness | Coordination role – public health preparedness |
| NOAA NESDIS National Coastal Data Development Center (NCDDC) | Data management architecture |
| Operation Sea Hawk Department of Homeland Security (DOJ) | Future member |
| DOE Savannah River National Laboratory | Future sensor development |

Source: University of South Carolina Center for Public Health Preparedness

viruses or other disease-causing agents that might be used in biological agent bioterrorist attacks. The length of time it can take to connect the bird and human outbreaks of the West Nile virus signals a clear need for better coordination among public and environmental health agencies.[6] One key lesson that emerged from the West Nile disease outbreak investigation was the importance of local disease surveillance and response systems. Surveillance involves the ongoing collection, analysis, and interpretation of health-related data. In the West Nile outbreak, many aspects of the local surveillance system worked well, for example the outbreak was quickly spotted and immediately investigated. Assessments of the infrastructure for responding to outbreaks suggest that surveillance networks in many other locations may not be as well prepared, particularly in integrating public and environmental health data.

There is a clear need for the detection of adverse natural resource responses such as disease and mortality, which may serve as an early warning system to better protect environmental health. The objective of this study is to define a process for developing a natural resource Environmental Surveillance Network (ESN) that will provide horizontal integration of existing natural resource databases into an early warning detection system for unusual mortality and disease events in natural ecosystems.

**The environmental surveillance network**




Communication tree for the ENS including notification and alerts

Source: University of South Carolina Center for Public Health Preparedness

## Background and need

The integration of numerous state and federal environmental surveillance monitoring efforts into an integrated database resulted from discussions among state and federal agencies involved in assessing State of South Carolina deficiencies in detection of chemical and biological threats associated with bioterrorism threats. The ESN was created as an outgrowth of a series of tabletop style preparedness workshops built around biological incidents in coastal environments. These workshops included the following scenarios:

- A disease outbreak on a cruise ship with sick passengers thought to be affected by ricin, which was later identified as Norwalk Agent Virus. The ship was attempting to dock in the Port of Charleston, South Carolina
- A dirty chemical nuclear bomb explosion in a downtown Charleston Marina aboard a hijacked fishing vessel
- An avian flu outbreak caused by a docking ship of foreign registry in the port of Charleston.

The workshops highlighted the need for more routine communication with the law enforcement, public health, natural resource and environmental research community for two major reasons:

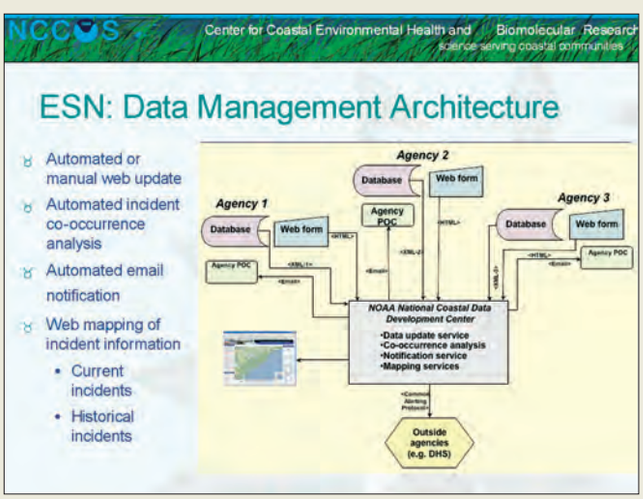
1. Emergency managers were unaware that mortalities in the natural environment could indicate a potential public health crisis
2. During the recovery phase environmental and natural resources restoration issues become major components in supporting public health.

The workshops also identified the fact that many different federal and state agencies were gathering environmental data, but they rarely share information, since there is no common system to report and link data. Even more important it was revealed that emergency managers had little understanding of the potential implications relating to reports of natural resource mortalities. Following the workshop, a commitment was made among participants to develop the ESN, as a system to address this data gap. These findings match a GAO study conducted in 2003 that reviewed preparedness levels across state and local jurisdictions. A key finding was that state and local jurisdictions expressed a desire for more sharing of best practices.[7]

Environmental agencies are developing approaches to measuring ecosystem health within the context of socio-economic realities. The Integrated Ecosystem Assessment provides information so managers and scientists can evaluate an ecosystem, develop options for future action, and identify gaps in the understanding of the issues.[8] The ESN is a component of the integrated assessment process that more quickly highlights the mortalities of important ecosystem keystone species. Additionally, the ESN is a part of the Department of Homeland Security's national preparedness capability development process of: environmental monitoring and assessment; natural resources restoration; and natural hazards monitoring.

Environmental insults are assessed within the context of long-term and site-specific data sets. Ecosystem characterization and modelling of ecosystem stressors are fundamental for scientists and policymakers to identify the knowledge and data gaps that limit our understanding, forecasting abilities and ultimately our decision-making. The critical first step is to create a notification process among the agencies and experts that regulate keystone species. These data sets are compiled by agencies and experts alike. This network provides for linking these data sets into real-time reporting of mortality events that allow quick notification among experts and quick evaluation to determine if there are links between and among the reported mortalities.

**Data management architecture of the South Carolina ESN**




Source: NOAA NESDIS/NCDDC

**Development of the South Carolina environmental surveillance network**

The South Carolina Environmental Surveillance Network is a real-time surveillance network of mortality incidents (such as fish kills, bird kills, animal disease outbreaks, harmful algal blooms and marine mammal strandings) that:

- Notifies participating network science and regulatory experts of mortality incidents
- Allows for quick assessments of potential links between and among mortalities
- Provides a mechanism to alert the emergency management community of incidents that could impact commerce and the public health.

The ESN founding network participants are initially composed of state and federal agencies that have regulatory responsibility over natural resources. Most of these agencies have some natural resources responsibility including terrestrial, freshwater and marine environments. The State Law Enforcement Division and Emergency Management Division are also participants. Initially, the participants are developing the network and sharing the notification and communication responsibilities. The agency and the subject matter species are also listed for each agency within the ESN.

Expansion of the network is planned and future participants managing species of concern will be encouraged to participate. NOAA-CCEHBR and NOAA-NCDDC will manage the network initially.

**ESN development and training: a consensus building process**

The ESN was developed as part of the Team Based Training Institute (TBTI) of the University of South Carolina Center for Public Health Preparedness (USC-CPHP) funded by US Centers for Disease Control and Prevention (CDCP). The TBTI was a series of in-person workshops held over a six-month period with the goal of providing teams of stakeholders the opportunity to unite in their efforts to strengthen their communities' preparedness to prevent, protect against, respond to, and recover from threatened or actual emergencies. The TBTI utilized a standardized planning process aligned with the National Preparedness Guidelines. The planning process allowed for flexibility and adjustment dependent upon the individual group's focus and accomplishment. The USC-CPHP and TBTI are funded by Cooperative Agreement U90/CCU424245-03 from the

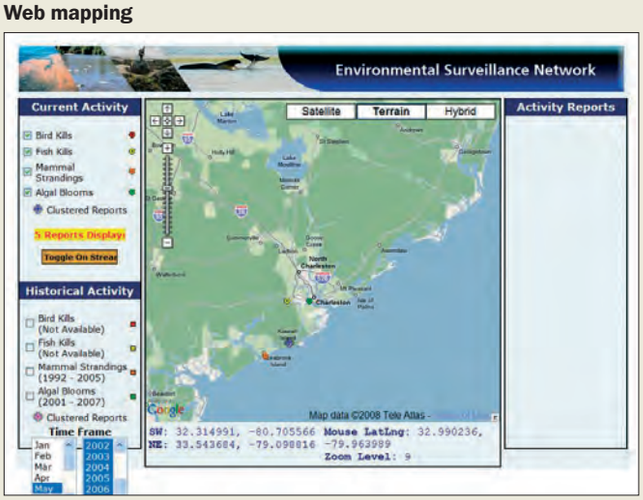
CDCP. There were four separate TBTI sessions that began in January 2008 and culminated with a peer review panel in June 2008.

The TBTI training session focused on identifying aspects and functionalities of the network that were critical to enhancing information sharing, communications, and desired features that the network should convey. There were both technical-scientific and data management design function issues that had to be resolved, along with development of a common data and minimal notification/alert input. In addition, procedures to be followed by the ESN in issuing notification and alerts were developed.

Participants believed it was important to keep the common data input simple and complementary to procedures already used by each respective member of the ESN, so as to avoid duplication and complexity. What emerged was a straight-forward consensus-driven agreement and process consisting of three primary elements.

First, that each single event is reported into the ESN and each ESN member is notified. Second, if two incidents occur within 24 hours and within a 10-mile radius, the two reporting parties are notified, confer and report back to the network on the relatedness and significance of the two events. This may range from two completely unrelated events (low level concern) to two events that have co-occurred and appear to be related (most severe), which result in an additional notification that indicates whether further action by the network is warranted. Finally, if three or more events occur within a 24-hour period, the entire network is notified to confer and after conferencing, a determination will be made as to the relatedness, severity, and cause of each event. Unrelated events with multiple insignificant causes not related to perceived DHS threats, would no longer be considered and the ESN would return to its normal monitoring state. If the three events are found to be related, significant and possibly related to a perceived DHS threat, a decision to notify and alert the SC Emergency Preparedness Office (SCEPO) would occur using REACH (SC Emergency Notification System including reverse 911 capabilities) which would then convene SCEPO and the ESN Team as needed.

**Web mapping**




Map display of the Environmental Surveillance Network, depicting the location of near real-time fish kills, marine mammal strandings and harmful algal blooms

Source: NOAA NCCOS/CCEHBR and NESDIS/NCDDC

Following this notification by REACH, SCEPO would then decide what additional assets are needed, as well as the steps that need to be taken to notify, alert, and/or evacuate the public. In addition law enforcement, military and other appropriate assets would be alerted.

The ESN data management system, hosted by NOAA's Coastal Data Development Center (NCDDC), comprises components for data entry, web mapping display, and constituent notification. Data may be entered manually through a web form or may be harvested automatically (every two hours) through web service access into networks member databases. This approach was used for several reasons, as it allows flexibility among members in alerting the network, given competing work demands within each agency. It also permits an agency to provide alerts without access to restricted data, such as some of the farm animal databases used by the SC Veterinarian's Office in conjunction with the US Department of Agriculture. This flexibility encourages reporting and assures multiple alerts occur in a timely manner.

The types of alerts the system reports are primarily of mortality, disease, or adverse environmental quality. This may include fish kills, marine mammal strandings, harmful algal blooms (HABs), companion and domestic animal mortalities, bird kills, wildlife mortality, water quality factors (such as dissolved oxygen, pH, and temperature conditions) and water quantity alterations such as stream gauge data on flows for drought and flood conditions.

The system allows for visualization of reported information to the ESN using a Google Map format. This in turn allows data overlays of multiple information such as fish kills, marine mammal strandings and HAB events, which if clicked upon provides more detailed information about each event such as the species involved, size of the event and contact information. It also catalogues historical data for each ESN data entry and permits both historical and real time data to be visualized and displayed.

Historical data are very important, since the system analyst's first question will be: "Has this ever happened before?" And, if so: "At what location?" This provides great insight into better defining the degree of uniqueness and unusual nature an individually reported ESN event may have. This will not only enhance communication among ESN members but will also provide the proper historical context to assess each event or multiple events.

## Outcomes and accomplishments

The following outcomes and accomplishments have been achieved to date in regard to the ESN:

- Agreement that knowledge of real-time natural resource mortalities is important to the alert and warning processes
- Participant commitment
- Notification process is simple without much development effort
  - Visual reporting that is location driven

  - Standard notification information content
- Agency points of contact
- Direct link to EMD and law enforcement
- Direct link to companion and domesticated animal network
- Direct link to state veterinarian
- Ease of expansion for other participants
- Directly relates to natural resource and environmental agency missions
- Directly relates to homeland security national preparedness capability development

### Implementation requirements

Critical implementation requirements fall under three categories: (1) Funding and technical personnel commitment; (2) science assessments; and (3) a scheduled timeline for implementation. Initially, the ESN concept was finalized and completed, with comments from participants of the TBTI process incorporated in the design. Next, the data management development process began, with a separate data management committee working on details of connectivity, data compatibility, common metadata sharing, notification/alert features and technical data sharing capabilities. The final aspects of the ESN will be an effort to better define the science requirements that would support an alert notification to EMD.

The planned schedule for implementing this ESN is as follows:

*12 June 2008* — peer review and comment.

*1 July 2008* — assess additional comments and peer review and incorporate into concept paper; and initiate network development by NOAA-NCDDC.

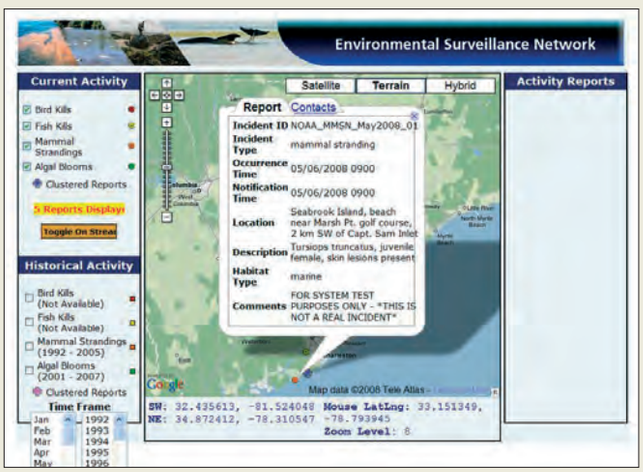
*1 August 2008* — final draft of concept paper completed for additional review; begin briefing executive management at network participants' respective agencies; define funding requirements and sources of income.

*30 September 2008* — identify and assess data bases using DHEC model; complete list of science projects needed to support and assess mortality bases utility; begin to define performance parameters associated with ESN notifications.

*1 January 2009* — initiate pilot ESN.

*March/April 2009* — convene a workshop/symposium describing the network to SC science and emergency management community.

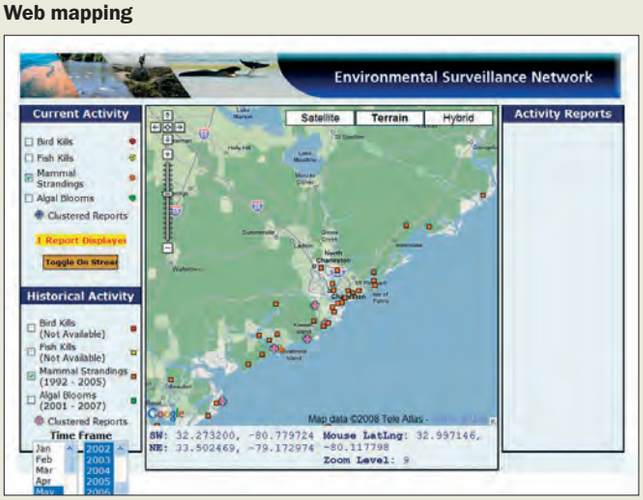
**Web mapping**




Once an ESN notification is received, users can click on the map icons and more information about each event will pop up

Source: NOAA NESDIS/NCDDC and NCCOS/CCEHBR

**Web mapping**




Environmental Surveillance Network historical data overlays of marine mammal strandings

Source: NOAA NESDIS/NCDDC and NCCOS/CCEHBR

### The future of the network

Federal and State Agencies in South Carolina involved in the ESN have a demonstrated commitment to seeing its initial implementation in January 2009. By combining their information regarding natural resource disease and mortality events, South Carolina will have a network that can detect the occurrence of multiple environmental events that may occur in the environment. Most of these events will be unrelated, naturally occurring events or accidental, unintentional environmental releases; however, in the event of a covert bioterrorist attack involving a biological or chemical agent, the ESN can provide recognition of multiple mortalities and disease events in a more timely and information-rich manner that may result in earlier detection, notification and warning to emergency management officials. This earlier detection could save lives and enable emergency management officials to better control and manage these events. In addition, ESN will enhance natural resources interagency communication about the unusual mortality events, as well as result in more coordinated and unified responses among ESN agency partners. Further during natural disaster events, such as hurricanes, the ESN will provide enhanced communication among federal and state natural resource agencies for better managing clean–up and recovery efforts.

# Development and implementation of a forecasting and warning system for harmful algal blooms by the US National Oceanic and Atmospheric Administration (NOAA)

*Nathalie Valette-Silver, Quay Dortch, Richard P. Stumpf, R.Wayne Litaker, Marc E. Suddleson and Gary C. Matlock*
*National Centers for Coastal Ocean Science, NOAA, USA*

**The US National Oceanic and Atmospheric Administration (NOAA) is working with partners to develop forecasting systems for harmful algal blooms (HABs) to increase the capacity of local managers to mitigate impacts. HABs impact human and animal health as well as coastal economies through the production of toxins or deterioration of water quality. The completed forecasting system will encompass areas prone to HABs along the east, west, and Gulf of Mexico coasts of the US as well as in the Great Lakes. An operational HAB forecast was established on the west Florida shelf in 2004. A demonstration is currently underway in the western Gulf along the Texas coast. A second operational forecast is functioning in the Pacific Northwest along the Olympic coast. Progress is also being made in the Gulf of Maine, other areas of the Pacific Northwest, in California and the Great Lakes. The forecasting and warning systems use in situ and remote sensing observations, oceanographic models, and forecasts of physical forcing mechanisms to predict and detect blooms, their movements, and impacts. New technologies are being developed to further these capabilities, including informing the public and managers so as to maximize the likelihood for responding to these potentially disastrous events.**

Phytoplankton microscopic plants form the basis of the food webs that support most aquatic life. While phytoplankton species are generally harmless, a few species can produce powerful toxins, hypoxia or a significant degradation in water quality. These effects are most serious when favourable conditions allow detrimental species to proliferate, resulting in HABs. HABs are natural phenomena that appear to have increased in recent years due to environmental changes and human activities (e.g. increased water temperature, enhanced nutrient supply, introduction of invasive species).[1] Many adverse effects on both humans and living resources are due to toxins released directly into the air and water, concentrated by shellfish or other grazers and bio-accumulated in the food chain.

HABs became an issue when it was discovered that they impacted human health and economic well being. In the marine systems, fish, birds, marine mammals and humans can all suffer significant illness or death after being in contact with the toxins (via swimming or breathing) or after ingesting shellfish, fish or other food items tainted with these dangerous toxins.[2] In freshwater systems, HAB toxins or compounds cause taste and odour problems that impact drinking and recreational waters. HAB events also result in significant economic losses associated with reduced tourism and restaurant business, regional fish or shellfish closures, aquaculture mortalities, increased cleanup costs associated with dead fish and marine mammals or unsightly accumulations and scum on the beaches. In the US alone these losses are conservatively estimated at USD82 million per year.[3]

**Need for early warning**

Most of the human health impacts result either from consumption of contaminated shellfish and drinking water or from exposure to toxins during recreational activities (e.g. beach-going, swimming, and boating). Preventing or minimizing these impacts relies in the US on extensive and costly monitoring programmes usually conducted by state agencies. As soon as a HAB has been detected, shellfish beds are closed to commercial or recreational harvesting and warning signs are posted to prevent use of beaches and recreational waters. Forecasts and warnings allow state public health and resource managers to better protect public health, reduce the costs of monitoring, and minimize the economic impacts of unnecessary closures.

Several kinds of forecasts are needed:

*Nowcasts* — providing today's HAB locations and impacts, to better target sampling efforts

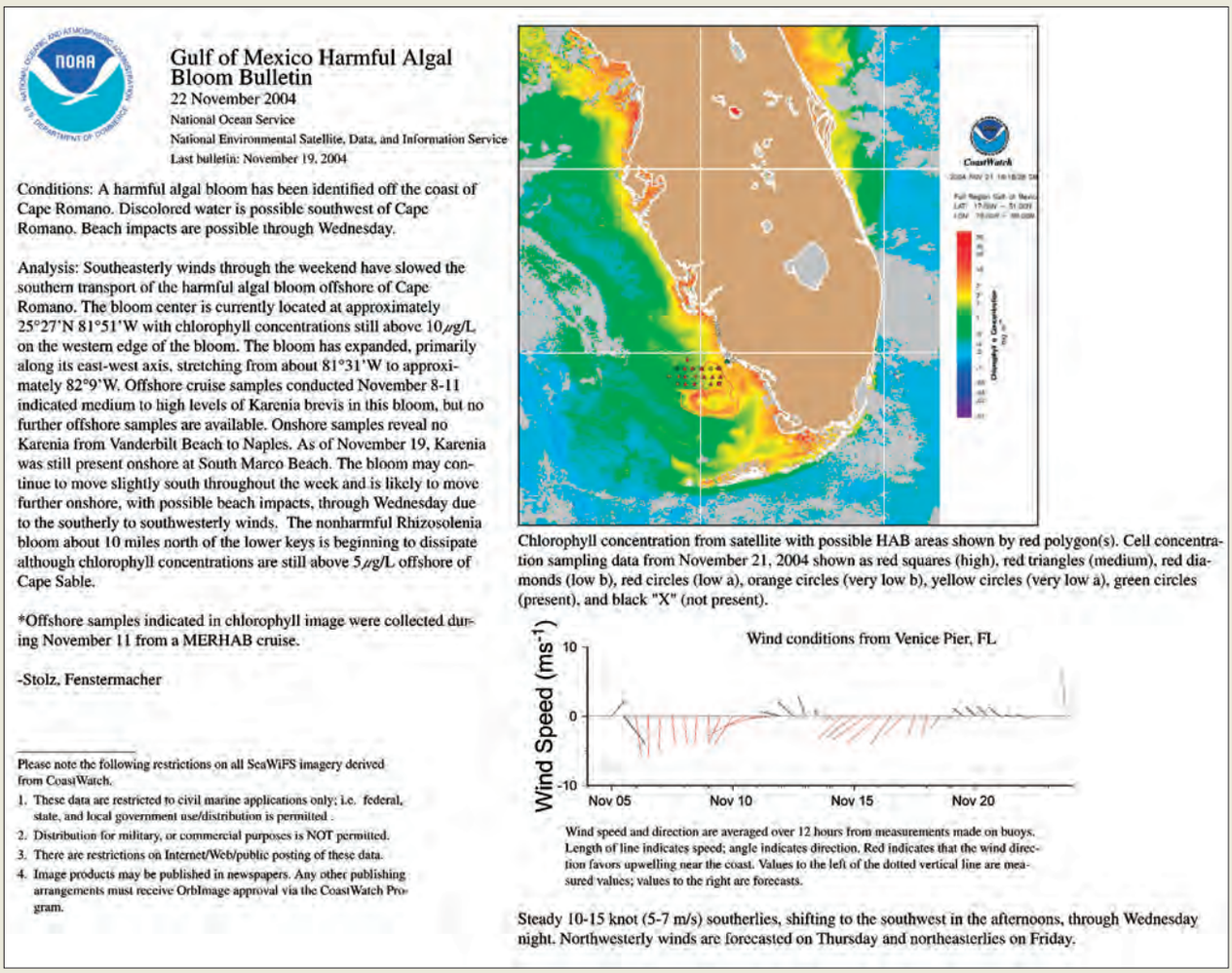
*Forecasts* — giving the likely HAB locations and impacts over the next few days, to allow time for managers to take necessary actions in advance of the event

*Long-term predictions* — anticipating when HABs are likely to start, their potential severity, expected persistence and timing of dissipation[4]

*Annual predictions* — assessing the likelihood of severe HABs this year, using long-term data sets in conjunction with improved weather and hydrodynamic models.

Having these capabilities would allow strategic planning weeks or months in advance by environmental

**Example of the bulletin provided to managers in the eastern Gulf of Mexico**



Gulf of Mexico Harmful Algal Bloom Bulletin

22 November 2004

National Ocean Service

National Environmental Satellite, Data, and Information Service

Last bulletin: November 19, 2004

Conditions: A harmful algal bloom has been identified off the coast of Cape Romano. Discolored water is possible southwest of Cape Romano. Beach impacts are possible through Wednesday.

Analysis: Southeasterly winds through the weekend have slowed the southern transport of the harmful algal bloom offshore of Cape Romano. The bloom center is currently located at approximately 25°27'N 81°51'W with chlorophyll concentrations still above 10 μg/L on the western edge of the bloom. The bloom has expanded, primarily along its east-west axis, stretching from about 81°31'W to approximately 82°9'W. Offshore cruise samples conducted November 8-11 indicated medium to high levels of Karenia brevis in this bloom, but no further offshore samples are available. Onshore samples reveal no Karenia from Vanderbilt Beach to Naples. As of November 19, Karenia was still present onshore at South Marco Beach. The bloom may continue to move slightly south throughout the week and is likely to move further onshore, with possible beach impacts, through Wednesday due to the southerly to southwesterly winds. The nonharmful Rhizosolenia bloom about 10 miles north of the lower keys is beginning to dissipate although chlorophyll concentrations are still above 5 μg/L offshore of Cape Sable.

*Offshore samples indicated in chlorophyll image were collected during November 11 from a MERHAB cruise.

-Stolz, Fenstermacher

Please note the following restrictions on all SeaWiFS imagery derived from CoastWatch.

1. These data are restricted to civil marine applications only; i.e. federal, state, and local government use/distribution is permitted .
2. Distribution for military, or commercial purposes is NOT permitted.
3. There are restrictions on Internet/Web/public posting of these data.
4. Image products may be published in newspapers. Any other publishing arrangements must receive OrbImage approval via the CoastWatch Program.

Chlorophyll concentration from satellite with possible HAB areas shown by red polygon(s). Cell concentration sampling data from November 21, 2004 shown as red squares (high), red triangles (medium), red diamonds (low b), red circles (low a), orange circles (very low b), yellow circles (very low a), green circles (present), and black "X" (not present).



Wind speed and direction are averaged over 12 hours from measurements made on buoys. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts.

Steady 10-15 knot (5-7 m/s) southerlies, shifting to the southwest in the afternoons, through Wednesday night. Northwesterly winds are forecasted on Thursday and northeasterlies on Friday.

The bulletin includes an analysis of satellite imagery with various data sets, and includes forecasts of potential impacts at the coast, as well as possible transport of the HAB

Source: NOAA, National Ocean Service

managers, health officials as well as the tourism, restaurant and recreational industries.

Given these significant health, environmental and economic costs, the primary goal of the NOAA National Centers for Coastal Ocean Science is to develop a regional warning system that forecasts bloom initiation, persistence, movement, landfall and toxicity. Once research has provided a clear understanding of the interaction of physical and biological processes promoting HAB development, it is possible to develop reliable models that can identify times and places potentially susceptible to outbreaks. Presently, NOAA has developed two operational HAB forecasts and others are in various stages of development and demonstration.

### Examples of successful operational forecasts

*Florida HAB Forecast System — Karenia brevis* blooms occur almost annually along the West Florida shelf, less frequently throughout the rest of the Gulf of Mexico, and can even be transported up the east coast of the US. *Karenia brevis* produces potent neurotoxins that:

1. Accumulate in shellfish, causing Neurotoxic Shellfish Poisoning in humans consuming contaminated shellfish
2. Are aerosolized in coastal areas, resulting in human respiratory problems
3. Cause massive fish kills and mortality of protected species (e.g. dolphins, manatees, birds and turtles).

In 1999, with the launch of new satellites, remote sensing monitoring for *Karenia brevis* blooms, using ocean colour, became possible. The Florida HAB Forecast System (FHABFS) works by integrating data from satellite imagery and sampling results from the State of Florida combined with local wind and current model data. The satellite imagery allows bloom location using the light absorption caused by chlorophyll in the HAB cells. The anomaly in satellite-estimated chlorophyll, obtained by comparing imagery of the previous two months, indi-

Image: Mike Valiquette, Purre Water Coalition (Florida, US)

Red algae accumulation on Sanibel Island, Florida (US) in January 2007

cates new blooms considered as candidates for HABs. Summer and autumn blooms following upwelling winds and near fronts are flagged as potential HABs.[5] The chlorophyll concentration in the anomaly also provides an estimate of the number of cells present.[6] Once potential HABs are identified, their presence is rapidly confirmed by in situ sampling by the State of Florida environmental managers.

After the bloom is confirmed, a team of experts integrate and interpret the data with wind and current models to predict likely bloom movement and landfall. Nowcasts and forecasts are issued through a website for the public[7] and through bulletins for managers. Both of these are critical for strategic planning of sampling efforts and timely dissemination of advisories. After almost 15 years of preliminary research, NOAA was able to validate this approach[8] and by 2004 sufficient capability existed for NOAA to start the operation of the HAB Forecast System for the West Coast of Florida, providing monitoring and forecasting capabilities to local coastal managers.[9] Advisories are now provided to over 250 officials in the region and are used for diverse purposes ranging from redirecting tourists from potentially affected areas, to preparing county health officials for increased caseloads, to preparing agencies for unusual mortality events of marine mammals. Presently, the only fully operational unit is the forecast provided for the eastern Gulf of Mexico. In addition, since 2006, a demonstration project has also been successful for the Texas coast of the US.

*ORHAB forecast* — Another success story is the forecast developed in the Pacific Northeast by the Olympic Region HAB (ORHAB) partnership in response to seemingly random closures of shellfisheries due to razor clam contamination by algal biotoxin. Of particular concern were blooms of the algae *Pseudo-nitzschia* that produces Domoic Acid (DA). When ingested, DA is responsible for Amnesic Shellfish Poisoning (ASP) in humans. With five years of support from NOAA, ORHAB developed collaboration among federal, state and local management agencies, coastal Indian tribes, marine resource-based businesses, public interest groups and academic institutions. Their focus on HAB research led to increased local ability to monitor and mitigate the effects of such events. ORHAB partners investigated the origins of toxic blooms, monitored where and when they occurred, assessed the environmental conditions conducive to blooms and contamination by toxins of shellfish. Ultimately, ORHAB developed and adopted a combination of analytical techniques, including twice-weekly microscopic determination of total *Pseudo-nitzschia* cells and levels of DA in seawater particulates to provide managers with an effective early warning of DA problems.[10]

In May 2002, the first 'ORHAB Alert' was sent to coastal managers indicating a rapid rise in *Pseudo-nitzschia* cells in several areas along the Olympic coast. Teamwork between Washington State agencies and

ORHAB personnel resulted in proactive testing of razor clams. The samples came back negative for toxin (< 4 ppm DA), assuring that the popular May harvest could occur with safe shellfish.[11] Recognition of ORHAB's value by the State of Washington created a sustainable source of funding using license fees for recreational harvesting of razor clams. The forecasts generated by ORHAB have increased the commercial, subsistence and recreational harvest of razor clams and lowered the health risks to consumers.

**Expansion of the programme**

In the Gulf of Maine almost annual blooms of *Alexandrium fundyense* can cause human illness and death from Paralytic Shellfish Poisoning due to a potent neurotoxin that accumulates in shellfish. A concerted effort to understand *Alexandrium* dynamics in the Gulf of Maine has led to significantly enhanced regional response capabilities. This effort began in 1998 with the NOAA and National Science Foundation-supported ECOHAB-Gulf of Maine project, and has continued through a variety of projects. New molecular methods for rapidly detecting and mapping *Alexandrium* are now used to track the bloom in almost real time. These data, combined with oceanographic and meteorological data from ships and moorings, are coupled with a biophysical model to forecast the spread of the bloom.[12] This forecast is used to provide weekly updates of probable bloom magnitude and location to marine resource managers so they can focus sampling. The model, coupled with annual cyst location maps, is also used to predict bloom potential prior to the bloom season. Model results are presently provided in a demonstration mode to 150 regional shellfish managers and researchers via a listserv. This integration of ocean observing system data with models is an example of the predictive, regional, ecosystem-based research being supported by NOAA to address coastal ocean issues.

Preliminary work has also begun in adapting the Florida HAB forecast concept to other regions of the US. These include the Great Lakes, where toxic cyanobacterial blooms degrade water quality and release hepatotoxins and along the California coast where ASP is a problem. In each of these instances, satellite imagery results integrated with local meteorology, the best hydrological models available and local sampling capacity are used to determine if relevant forecasts are possible.

**Real world issues**

Some issues need to be solved before development and implementation of a HAB warning system. The transition of research into application and operation is not a straightforward proposition. Funding is often available either for research or for operations. Unfortunately, as the transition from research to operation is a hybrid capability bridging these activities, transition projects do not fit into the existing planning modes and suffer from lack of funding. However, this bridge is indispensable to allow for the use of new management knowledge.

Each HAB organism is unique and the causes and impacts of each are different, resulting in significant differences between regions (e.g. morphology, currents, temperature). Although some aspects of forecasting HABs can be transferred between types of HABs and regions, forecasts are generally not entirely transferable from one region to the other. Considerable additional research and information is needed for each new forecast and further efforts are required in order to provide the Nation with a National Warning System for HABs.

The potential liability associated with any forecast is another issue to consider. In the case of an inaccurate forecast, for example an error on the landfall location of a HAB, who is responsible if some people get sick or die or if a beach is closed and nothing happens? What are the possibilities for lawsuits? This also brings to light the different roles of the public versus private sectors in operating forecasts. Should the operation of such ecological forecasts be reserved to Federal or State entities or should there be a close collaboration between public and private sectors in the same manner that presently exists for weather forecasts? These are some of the questions that NOAA is presently addressing.

NOAA is a US Federal Agency, and a member of the President's Office of Science and Technology Policy Subcommittee on Disaster Reduction. One of its goals is to provide its users with useful tools that can assist the US in becoming a safer and more resilient nation. The research performed on HABs by NOAA/NCCOS and its collaborators at all levels of government (federal, state, local and tribal), academia, and private industry has led to advanced capabilities for HAB detection and prediction not possible only a decade ago. HAB forecasts result in faster and better focused responses by health and natural resource managers, reduce losses to coastal communities, allow for better resources management, and could serve as a basis for international collaboration.

Image: Hedy Kling, Algal Taxonomy and ecology Inc. (Canada)

Cyanobacteria HAB scum along the shores of the Lake of the Woods (Ontario, Canada)

# The Singapore Civil Defence Force: a new state of readiness

*LTC N. Subhas, Director, Public Affairs Department, Singapore Civil Defence Force*

**The experiences of many overseas incidents have taught us that the real challenge posed to the authorities in the aftermath of a terror attack is not only the search and rescue efforts, but also restoring normality within the shortest possible time. Should a disaster strike, the critical issue is the ability of the population to take care of themselves during the initial minutes of the attack before rescuers arrive. Realizing this, the Singapore Civil Defence Force (SCDF) has embarked upon radical transformation to redefine its operational parameters and capabilities, and enhance its engagement with communities which must be prepared to a new state of readiness.**

In order to respond effectively, SCDF operates a three-tier command structure, with headquarters at the apex, with four territorial Civil Defence Divisions as the second tier, and 15 fire stations and 26 fire posts at the frontline to provide immediate response to any incidents.

SCDF also operates two training institutions, the Basic Rescue Training Centre for new recruits and the Civil Defence Academy for specialist training. Apart from providing training, these institutions have an operational role — their commanders, staff and trainees will respond to major incidents as our strategic 5th and 6th Divisions.

Of the 15 fire stations, four are fully equipped with specialist teams trained to mitigate incidents involving HazMat, which also encompasses unconventional chemical, biological and radioactive (CBR) threats. The remaining 11 stations' personnel are trained and equipped to the level of conducting rescue, detection and monitoring in HazMat incidents.

SCDF's operational concept is a taskforce approach that is calibrated to the nature and scale of an incident, with the flexibility to swiftly increase forces whenever necessary. Upon activation, responding forces will leave their respective bases within one minute, and our target is to arrive at any incident within an average of eight minutes from activation.

Apart from local incident response, since 1993 SCDF has responded to ten overseas search and rescue missions under the humanitarian framework of Operation Lion Heart. We also have six trained officers who can assist the UN Disaster Assessment and Coordination (UNDAC) team in their international response to crisis situations.

## New operating environment

Although the attacks in other countries to date have involved only the use of explosives, we know that terrorists are capable of using CBR materials as improvised weapons. To address such threats, SCDF has been steadily building up its capabilities. SCDF adopts a three-pronged strategy to deal with the new challenges:

- Strengthening our incident management system
- Enhancing operational readiness and frontline capabilities
- Tightening preventative and regulatory provisions.

## Strengthening incident management

*Integrated incident management* — In 1997, SCDF was appointed as the incident manager for civil emergencies by the Government. Correspondingly, the Ops Civil Emergency Plan (Ops CE) was promulgated to enable us to organize a multi-agency response to any major disaster in Singapore. Ops CE lays down the functions and responsibilities of all agencies involved in incident response. They are organized into a Joint Planning Staff to enable integrated incident management during any emergency. The Ops CE Plan is regularly practiced in a series of exercises codenamed 'Exercise Northstar' to ensure familiarity with the response framework by all agencies. The most recent was held on 23 May 2008 and tested a multi-agency response to managing a large-scale fire and rescue scenario on board a cruise ship.

*Integrated forward command and control capability* — In the area of incident management, SCDF believes in onsite management with the incident manager exercising effective leadership, command and control. To put this into effect, SCDF designed five Forward Command Vehicles equipped with all necessary technical support and communications systems to field an integrated incident management capability.

*Enhanced command and control for HazMat incidents* — Management of HazMat incidents is qualitatively different to conventional situations like bomb explosions. HazMat incidents are dynamic because they can change rapidly; it is essential that commanders get accurate and timely information so that mitigation measures can be initiated. For

Image: SCDF

The Total Containment Vehicle can be deployed to neutralize biological agents and decontaminate chemical agents

this purpose, SCDF is supported by the HazMat Incident Management System (HIMS). It uses advanced communication technology to gather information from a site, process it and transmit the results to commanders on the ground. This translates into informed decision making. The results obtained from the real-time reading of HazMat detectors can also be translated into plume models for both indoor and outdoor scenarios.

**Enhancing operational readiness**

*Special Rescue Battalion* — Terror attacks usually result in mass casualties who must be rescued and given immediate medical attention to improve their chances of survival. This requires a large number of rescuers, and the Special Rescue Battalion (SRB), comprising full-time national servicemen, was formed for this purpose. These men are trained in fire fighting, decontamination, urban search and rescue and basic first-aid, and are on constant standby. Every SRB platoon is equipped with a specialized Personnel Decontamination Vehicle (PDV), an SCDF innovation.

The PDV is a three-in-one vehicle — essentially a personnel decontamination facility, a mass casualty ambulance, and a troop and equipment transporter. Unlike most mobile decontamination facilities, which require about 20 minutes to establish operations, the PDV can be set up in under seven minutes. Each PDV can decontaminate up to 60 walking casualties or ten lying casualties per hour. When converted into an ambulance bus it can carry up to 12 casualties on stretchers, the same capacity as six ambulances. The PDV can carry a platoon of 26 rescuers. Compartment spaces are also available to hold a full range of rescue equipment.

*Response to chemical agent incidents* — SCDF first embarked on developing a chemical agent (CA) response capability in 1995 following the Tokyo Sarin attack. Today, all fire stations possess the capability to respond to CA incidents. SCDF's personnel are trained and equipped to detect and monitor the presence of CA, conduct rescue in contaminated environments, and decontaminate casualties.

*Pump ladder hasty decontamination capability* — In any CA incident, quick decontamination is critical to improve casualty survivability and to prevent secondary contamination. Recognizing this, SCDF fire pumpers have been retrofitted to enable the establishment of casualty decontamination facilities within three minutes of arrival, through the integration of a shower system into the vehicle. This innovation enables SCDF to decontaminate up to 36 walking or six lying casualties every hour.

*SWIFT* — SCDF also developed the Station With Immediate First Aid Treatment (SWIFT) vehicle. The facility can be set up within five minutes of arrival and has eight treatment tables for the stabilization of severely injured casualties before hospital admission.

*Response to bio agent incidents* — When there is a suspected point source bio agent (BA) release (for instance, powdered anthrax incidents), SCDF will be activated to perform sample collection and decontamination of the affected areas. The response system is very similar to that of a CA attack. With BA screening and analysis capability in our HazMat Control Vehicle, we are able to distinguish bio agents from hoaxes within 15 minutes.

*BioSensor, Minidox, PID detector* — SCDF is also equipped with the latest range of equipment to detect the presence of BA. One of them is the Smart BioSensor, a continuous, real-time monitoring device for detecting biological warfare agents in ambient air. It takes just two minutes for detection and five minutes to classify.

The Minidox is a chlorine dioxide gas generator system designed for use in any decontamination; it is particularly effective for ducting. The use of chlorine dioxides is also highly desirable because it is a registered sterilant and, as a true gas, highly penetrative, providing excellent distribution into hard-to-reach areas.

The new photoionization detector (PID), Phocheck, is capable of detecting toxic gases at very low thresholds, from one part per billion to up to 10,000 parts per million. This wide range gives the versatility to detect toxic gas at levels low enough to constitute a health hazard, as well as detect signs of leakage.

*Total Containment Vehicle* — SCDF has also developed a new specialist vehicle, the Total Containment Vehicle (TCV). It features a special 100 per cent gas-tight container that can be deployed to neutralize biological agents and decontaminate chemical agents.

**Enhancing preventive and regulatory measures**

While SCDF is confident in conducting consequence management, it believes in prevention as a first line of defence. This is reflected in the expansion of regulatory controls to prevent hazardous materials from being incorrectly used in the areas of import, transport and storage.

*Implementation of flammable material regulations* — Given the rapid growth of petrochemical and pharmaceutical industries in Singapore, new flammable materials regulations were established in February 2005 to control non-petroleum based flammables.

*SSM data centre* — In today's global security environment, non-traditional sources of raw materials such as toxic industrial chemicals, explosive precursors, poisons and flammable materials may be exploited by terrorists. To maintain control of all security-sensitive materials (SSM) that are regulated by various national authorities, SCDF is leading the development of a SSM Data Centre that also involves the Ministry of Health, National Environment Agency and Singapore Police Force. The 24/7 centre will serve as a focal point for SSM-related issues, and provide trending and analysis assessments that will enhance detection of unauthorized SSM use.

*HazMat transportation drivers' permit* — SCDF realized that vehicles transporting HazMat may be used as improvised terror weapons. It implemented the HazMat Transport Drivers' Permit (HTDP) Scheme in April 2003 to counter this threat. All drivers of vehicles transporting HazMat must possess the permit before they are allowed to drive in Singapore. The scheme subjects them to security screening and training at our academy. It is very successful and has been expanded to cover the transportation of explosives.

*HazMat transport vehicle tracking system (HTVTS)* — SCDF further increased HazMat security in July 2005 by tracking the movement of these vehicles on our roads. Today, all Hazmat transport vehicles, including foreign registered entering Singapore, are tracked in real time. Vehicle movement, driver identity and inventory are monitored constantly by the SCDF control room. Horns and hazard warning lights on transport vehicles are designed to trigger automatically as an alert if they deviate from approved routes or transportation timings. In April 2007, SCDF embarked on the next phase of HazMat security,

which involves the installation of an immobilizer in all vehicles. The immobilizer system complements the existing HTVTS to effectively prevent any HazMat transporting vehicles from being put to ill-intended use to achieve terror-related objectives. The system essentially enables SCDF's Control Room to immobilize vehicles that deviate from its approved route by employing the Limp Mode technology that restricts fuel supply to the fuel injectors, bringing the vehicle to a gradual stop.

**Community engagement**

In an emergency an unprepared population will be thrown into chaos and helplessness. Before the arrival of emergency forces, it is crucial for those who are caught in an emergency to help themselves or to help those in need. Observations of past terror attacks and disasters show that it is common for unaffected people within the vicinity to come forward to manage the crisis and render assistance. It is therefore imperative that the entire Singapore population is equipped with emergency preparedness skills and ready to face any emergency.

To address this challenge, SCDF has adopted a dual approach to developing community capacity. To promote greater community ownership and self-help in tackling local issues, the Community Safety and Security Programme (CSSP) was introduced. Then, public education initiatives such as Community Emergency Preparedness Programme (CEPP) and Emergency Preparedness (EP) Day were created to introduce systematic, convenient platforms for the public to pick up knowledge and skills.

**Promotion of community self-help**

The CSSP is a proactive approach to implementing projects and action plans which tackle community issues and problems affecting the safety and security of local neighbourhoods. Jointly carried out by grassroots leaders, residents and authorities, it is central to promoting the spirit of self-help and mutual support. It also serves to foster community cohesion and bonding among local people, and promotes 'active citizenry' among Singaporeans.

Successful CSSP projects include 'Citizens-on-patrol' (COP), where volunteers patrol their local neighbourhood on bicycles to look out for any suspicious persons or objects, as well as responding to minor emergencies. 'Hawker Emergency Life Saving Point' (HELP) involves hawkers in Holland Village, an area identified as a possible 'soft target', working closely with SCDF. Trained hawkers are equipped with first aid kits, fire blankets and extinguishers, helmets and loud hailers — essential items that will help in the extinguishing of fires or evacuation. This platform has empowered members of the public to start taking charge of safety and security issues within their neighbourhood.

**Enhancing public education outreach programmes**

*EP Days* — EP Days have been held at various residential constituencies annually since September 2003. SCDF hopes to sensitize and educate residents in dealing with unconventional threats such as chemical release and bomb explosions through 'live' demonstrations, as well as emergency preparedness validation stations. To elicit greater self-reliance among the community, SCDF also encouraged grassroots organizations such as the Emergency Preparedness Groups (EPGs) and Civil Defence Executive Committees (CDECs) to lead the conduct of EP Day. The 72 EP Days held annually serve as an important platform for SCDF to reach out effectively to the masses, by bringing emergency preparedness knowledge to the doorsteps of homes and workplaces.

*CEPP* — Public education was reinforced by the establishment of a modular Civil Defence public training programme that is conducted daily. This signalled a move from ad-hoc training courses to a convenient, systematic and holistic programme. Known as the Community Emergency Preparedness Programme (CEPP), it packages essential civil defence skills and knowledge into five separate modules — First Aid; Cardio-Pulmonary Resuscitation; Fire Safety and Casualty Evacuation; Emergency Procedures, and Unconventional Threats. Conducted free-of-charge at four SCDF Public Education Centres in various parts of Singapore, each module comprises theoretical and practical lessons. Members of the public are allowed to register via the Internet or telephone and attend any combination of CEPP modules on their preferred date. This flexibility and convenience makes training more accessible to members of the public.

Image: SCDF

It is imperative that the entire Singapore population be equipped with emergency preparedness skills and ready to face any emergencies

*Leveraging technology* — SCDF also leverages innovation and technology to enhance public outreach. In addition to traditional means such as road show exhibitions and the CD Emergency Handbook, the public can access emergency preparedness knowledge from the SCDF website at any time. They can also download animated emergency preparedness clips and text onto their mobile phones for reference.

To allow individuals to measure their level of emergency readiness, SCDF designed an interactive online assessment tool known as the 'Individual Readiness Assessment' (IREA), which gives an automatic tabulation of the individual's readiness status and advises them on the steps to be taken to improve it based on their current performance.

To effectively educate a multi-ethnic Singapore population, SCDF has also introduced a multilingual video broadcast system that simultaneously broadcasts public education videos in multiple languages during EP Day and CEPP. In addition, a variety of interactive simulators such as an emergency preparedness IT bus called the I-Buzz and In-Place Protection Simulators are deployed at outreach events to enhance public learning. Leveraging innovation allows SCDF to introduce interactive means for the public to get involved in civil defence.

Since the 11 September attacks in the US, we have made progress in our readiness to respond to any challenge. Given the uncertain global security environment, it is only prudent that we remain vigilant and prepared.

# NASA science serving society: improving capabilities for fire characterization to effect reduction in disaster losses

*Vincent G. Ambrosia, California State University — Monterey Bay/NASA-Ames Research Center;*
*Everett Hinkley, USDA-Forest Service — Remote Sensing Applications Center; Stephen D. Ambrose, NASA Headquarters*

**In late summer/fall of 2007 a series of large wildfires, spawned by strong, hot, dry Santa Ana winds blowing off of the interior southwestern US deserts, rampaged across southern California. The Santa Ana winds, blowing up to 85 miles per hour (140 km/h), downed power lines, directly causing fires as well as influencing the starting of others by arson. On 20 October 2007 Santa Ana winds spawned a series of 11 major wildfires in the Los Angeles and San Diego regions. At least 1,500 homes were destroyed and over 500,000 acres (2,000 km²) of land burned from Santa Barbara County to the US-Mexico border. Over 900,000 residents were evacuated from affected areas. Nine people died as a direct result of the fire; 85 others were injured, including at least 61 firefighters. California Governor Arnold Schwarzenegger declared a state of emergency in seven California counties where fires were burning. President George W. Bush concurred, and ordered federal aid to supplement state and local response efforts. The last fire was fully contained on 9 November 2007.**

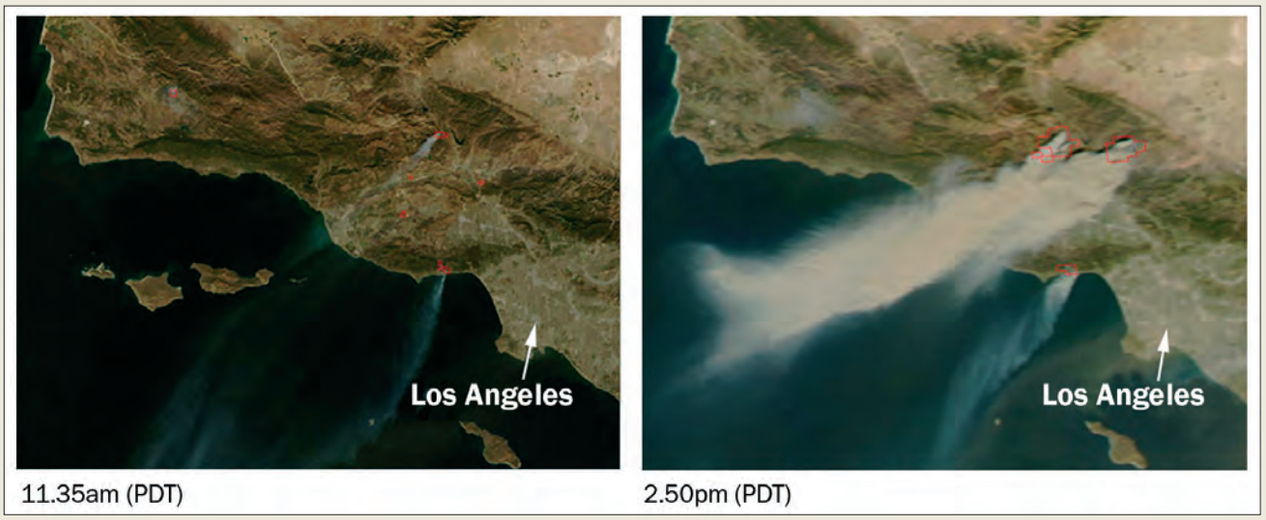
### Importance of real-rime, simplified information for disaster management

One of the most critical elements in effecting a reduction in losses from disasters such as the fires in southern California is the provision of near-real-time data or imagery of the affected areas and the event itself. In the case of fast-moving wildfires at the urban fringe, timely and accurate fire locations are critical in order to deploy firefighting resources, assets and personnel and to determine safe public evacuation routes, threatened or burning structures and the vegetative component and status in front of the fire line. To assist disaster managers during the southern California wildfires, the National Aeronautics and Space Administration (NASA) and the US Forest Service (USFS) collaborated to develop, demonstrate and utilize innovative airborne and satellite remote sensing

Image: courtesy of David S. Roberts

Image of the Harris Fire burning in San Diego County, California, October 2007

**MODIS satellite images of southern California wildfires**




Two NASA MODIS satellite images from 21 October 2007 show how quickly the fires spread. The right image was taken just three hours and 15 minutes after the left image

Source: NASA MODIS

tools and capabilities for gathering, distributing and analysing real-time wildfire information.

**NASA capabilities and science teams respond**

NASA responded to the request for federal aid by making available both satellite and airborne sensor data to assist in the fire observations and management operations conducted by the Incident Command Centers (ICC) and the county-level Emergency Operations Centers (EOC). Concurrent with the southern California fires, NASA and the USFS were collaborating on a project focused on improving various wildfire observation and management capabilities, using NASA-derived technologies. Those capabilities and technologies included using unmanned airborne vehicles (UAVs) as observation platforms, improving the thermal sensing capabilities of instruments on those platforms, providing real-time derived data and products from those sensors, and demonstrating an easy-to-use data 'collaborative environment' and visualization tool to effect improved fire management by teams on the ground.

When the southern California wildfires struck, the two federal agencies (NASA and USFS) responded with all their available resources, including the provision of various satellite imagery and the use of the NASA *Ikhana* UAV platform with the Autonomous Modular Scanner — Wildfire instrument on-board. All the derived data, imagery and products were delivered via a common visualization Collaborative Decision Environment (CDE), based on GoogleEarth® visualization software. The fire ICCs and the EOCs received and used all of the data through operations of the CDE during the NASA airborne support missions.

**NASA UAV**

The NASA *Ikhana* UAV is a modified General Atomics Predator-B aircraft, designed specifically for supporting NASA science missions. The platform is capable of 24-hour duration, and 50,000 feet altitude. Flying at 150-200 knots, the aircraft is able to cover over 4,000 miles during flight operations. The *Ikhana* was first put into service for NASA in January 2007, and flew its first science missions in support of wildfire observations in August 2007. The platform is intended for aeronautics and earth science research within the US Government. The *Ikhana* is ideally suited to support long-endurance/duration missions, such as those found in a major disaster scenario, where critical observation time over the event is required. Special coordination with the Federal Aviation Administration (FAA) was required to safely operate the *Ikhana* UAV in the National Airspace (NAS).

**AMS-Wildfire sensor**

The AMS-Wildfire airborne sensor was developed at NASA to serve the fire research and applications community. The sensor is a twelve-spectral-channel instrument (visible through thermal-infrared), capable of high-altitude, autonomous operations on a multitude of airborne platforms. Two critical channels in the thermal-infrared allow discrete, high-temperature discrimination of fire properties, and were used to derive the critical fire front locations for the fires in southern California. An automated fire-detection threshold temperature processing model was also developed. The temperature threshold model produces an additional file set from the sensor that displays the active hotspots, in addition to the thermal imagery. All the data processing was done autonomously, on-board the UAV. This processing included both geo- and terrain-rectification, and development of GEOTIFF files from various spectral band combinations, determined by the fire personnel on the ground.


Image: NASA-Dryden flight research center

The NASA Ikhana UAV aircraft. The NASA AMS-Wildfire instrument is located in the instrument pod, attached to the inboard wing-mount location on the UAV

The resultant geo-rectified imagery was transmitted from the aircraft through a satellite communications system, down to the ground control station and distributed to the community via the Web. The data was formatted for visualization in a standardized GIS environment and other data visualization applications. The full-on-board data processing, from raw image collection through delivery of geo-coded products to the ground, takes less than five minutes. The project team then made the data 'viewable' in the GoogleEarth-based CDE. This timely data distribution was critical to saving valuable resources and effectively combating the various wildfires.

**Collaborative Decision Environment (CDE) tool**

An easy-to-use commercial-off-the-shelf (COTS) fire data integration and visualization solution tool was implemented. The Wildfire CDE was originally developed to support data and sensor sharing for NASA's Mars Exploration Rover programme, and was modified to allow use as a data and information sharing tool for wildfire disaster managers. This technology spin-off allows the integration of numerous web-enabled data sources to be collaboratively viewed and implemented to aid in determining appropriate fire management strategies.

To simplify the fire data visualization capabilities, NASA teamed with Google to utilize and expand the capabilities of the GoogleEarth freeware, allowing the integration of multiple, pertinent fire-related data elements into a single package. These web-distributed elements included real-time satellite weather information, predicted and actual cloud cover data, predicted winds, satellite-derived fire hotspot detections, Remote Automated Weather Station (RAWS) data, the US Weather Service Critical Fire Weather information, Ikhana aircraft tracking positional information, sensor information and real-time imagery feeds, the Federal Aviation Administration (FAA) flight restriction area data, the National Interagency Fire Center's Large Fire Location data, the wildfire management team's infrared mission support requests, and real-time lightning detection data. In addition, the CDE included a real-time display from the *Ikhana*'s onboard video tracking camera. A secure instant messaging client capability allowed the NASA flight and science operations teams to remain in full contact with partners distributed at various ICCs, EOCs and other interested team members spread throughout the world.

Project team members were embedded at various ICCs and EOCs in southern California to assist the wildfire management teams with the sensor data integration and the implementation of the GoogleEarth CDE capabilities during the week-long mission series.

**Southern California UAV wildfire imaging missions**

NASA responded to a request on 22 October 2007 from the National Incident Fire Center-National Incident Command Center (NIFC-NICC), the California Governor's Office of Emergency Services (CA-OES) and the Federal Emergency Management Agency (FEMA) to support the southern California wildfire teams with critical airborne and satellite data resources, particularly the data from the AMS-Wildfire instrument, flown on the NASA *Ikhana*. The AMS-Wildfire instrument and *Ikhana* had previously flown four wildfire observation missions during the summer of 2007, and was ready to support the southern California conflagrations.

On 24 October 2007, at 9:00 a.m. local time, the *Ikhana* took off from NASA-Dryden Flight Research Center at Edwards Air Force Base near Palmdale, California for a mission over the 11 major wildfires burning in the southern California vicinity. Over a five-day period, the aircraft flew four missions, relaying real-time fire information to the ICCs and EOCs. Each mission extended for seven to ten hours, with approximately 1,300 miles duration.

During the missions, the NASA team integrated real-time hotspot detection data from the Terra and Aqua satellite's MODIS instrument into the CDE. The MODIS data was collected two to four times daily at low-moderate spatial resolutions. The data was used to develop

Image: J. Mendelsohn - Google

San Diego County Emergency Operations Center (EOC) during the southern California wildfires, 25 October 2007. Note the large display on the left highlighting the Collaborative Decision Environment (CDE) with the pertinent fire imagery datasets visible on the GoogleEarth freeware display. The ICCs and EOCs used the NASA-derived technologies to improve their disaster management capabilities

flight profiles for the *Ikhana* UAV in order to maximize mission acquisitions over the most intense fire areas. The team prioritized mission flight parameters based on a myriad of information, including weather patterns, intense fire areas, fires affecting urban fringe areas, busy air traffic areas/times, and other variables. Real-time collaboration with ICCs and EOCs via the CDE instant messaging provision also allowed their input to fire and mission priorities.

For each fire area, a mosaic of geo- and terrain-corrected image scenes were collected and transmitted to a NASA server. The GoogleEarth CDE allowed real-time access to that data at the NASA server. When a fire area image was collected, a camera icon for that location immediately appeared on the GoogleEarth CDE screen. The icon could then be selected to display a snapshot thumbnail image and pertinent collection information (location, time, file name, etc). The full scene images can be 'opened' from the thumbnail and are immediately geo-positioned on the GoogleEarth terrain background. The GoogleEarth tool allows 3D viewing of the terrain and imagery, 'fly-throughs' and various perspective views. This allows the ICC and EOC members to derive fire condition and behavior in relation to the surrounding environment. Additionally, the hotspot detection polygons were also autonomously processed on the *Ikhana* and sent to the CDE through the same satellite communications protocol.

The hotspot detection data layer provides hotspot polygons of the fire front and also small hotspot locations that may otherwise go undetected. Combined, these two data sets, derived from the AMS-Wildfire sensor on the *Ikhana* UAV platform, provided critical, real-time fire location information to the ICCs and EOCs. Over the five days of mission operations, all the sensor data was available through the CDE, allowing for the creation of fire progression maps.

On 28 October, the final southern California wildfire UAV imaging mission was flown. At that time, the fires were coming under control and some were in 'mop-up' condition. On that date, the NASA team switched the AMS-Wildfire sensor acquisition mode in mid-flight to collect post-fire burn area assessment spectral band imagery. This data was provided in real-time to the southern California ICCs and EOCs, to begin initial post-fire vegetation rehabilitation assessment activities. During the four missions, the *Ikhana* and AMS-Wildfire sensor logged over 32 hours of operation.

**Overall impact of the UAV-sensor-acquired data**

The ICCs and EOCs readily adapted the data provided through the CDE and easily assimilated the information, processing and visualization tools into their operational environment during the southern California wildfires. During the five days and four missions of the effort, over 150 daily users of the CDE were registered. Of the 400 image files collected (as well as the fire hotspot detection vector file data) during the missions (one hundred images per mission day), the community downloaded 40,000 file sets.

The capabilities demonstrated during the southern California wildfires are currently being adopted by the various wildfire management agencies at both the state and federal level. NASA will continue to engage the disaster community in developing, demonstrating, evaluating and implementing new strategies and capabilities to support disaster management and facilitate a reduction in disaster losses. The rapid acquisition of essential disaster data, delivered in near- real time, will ultimately improve the capabilities of agencies to combat and recover from disaster events. In many instances, the disaster manager is 'lost in the fog of war' when faced with the blinding realization of a large event occurring, where he/she has no 'intelligence' about the condition of the disaster event. The tools, science and capabilities demonstrated under emergency conditions during the southern California wildfires will prove beneficial to disaster management agencies and personnel worldwide and will lead to an effective reduction in disaster losses. NASA looks forward to its role in bringing space-age capabilities to fruition to support the disaster-prone communities of the United States and the world.

This activity helps support the Subcommittee on Disaster Reduction Grand Challenges for Wildfire — specifically, Grand Challenge number one in the Implementation Plans that states: "Provide hazard and disaster information where and when it is needed". NASA continues to support the Grand Challenge goals. More information on the Grand Challenges can be found at the subcommittee's website.[1]

# A multi-sensor approach analysing atmospheric signals for possible earthquake precursors: application of remote sensing for disaster management

*Dimitar Ouzounov, Shahid Habib, NASA Goddard Space Flight Center;*
*Stephen D. Ambrose, NASA Headquarters, Applied Sciences Program, Disaster Management*

**A new multi-sensor approach for analysing atmospheric signals and the search for possible earthquake precursors is being studied using science and remote sensing techniques. The new interdisciplinary approach is still in the early stages of validation and is based on data fusion of satellite thermal infrared observations from NASA and other national and international space assets. This technique is used in conjunction with ground multi-parameter continuous measurements. The method uses existing satellite sensors and ground observations in one integrated Sensor Web framework defined by a Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) concept.**

Initial results of the research show that simultaneous satellite and ground measurements, using an integrated web of observations, could provide pre-earthquake alerting capabilities by combining the information from multiple platforms. The significance of joined satellite electromagnetic (EM) methodology is analysed and demonstrated in the most recent major earthquakes in Asia — the M7.6 Kashmir earthquake of 8 October 2005 and the Mw7.8 earthquake of 12 May 2008 in Eastern Sichuan, China.

This work contributes to the implementation strategies of the US President's Office of Science Technology and Policy, Subcommittee on Disaster Reduction Grand Challenges to: "fully explore the predictability of earthquakes based on testable and credible methods, and provide objective reviews of predictions."[1]

About once a year a catastrophic earthquake of magnitude 7 (on the Richter scale) or more strikes somewhere in the world. Such events claim thousands of lives and cause extensive economic losses. For example, the 12 May 2008 earthquake in Eastern Sichuan, China caused widespread devastation with a death toll of well over 75,000 people. The cost to human life of such events is another indication to the science community that development of an earthquake hazard mitigation scheme requires diverse interdisciplinary efforts; as was suggested in 1995 by the famous seismologist Ari Ben-Menahem: "Unless we launch a concentrated interdisciplinary research effort, we shall always be surprised by the next major earthquake."[2]

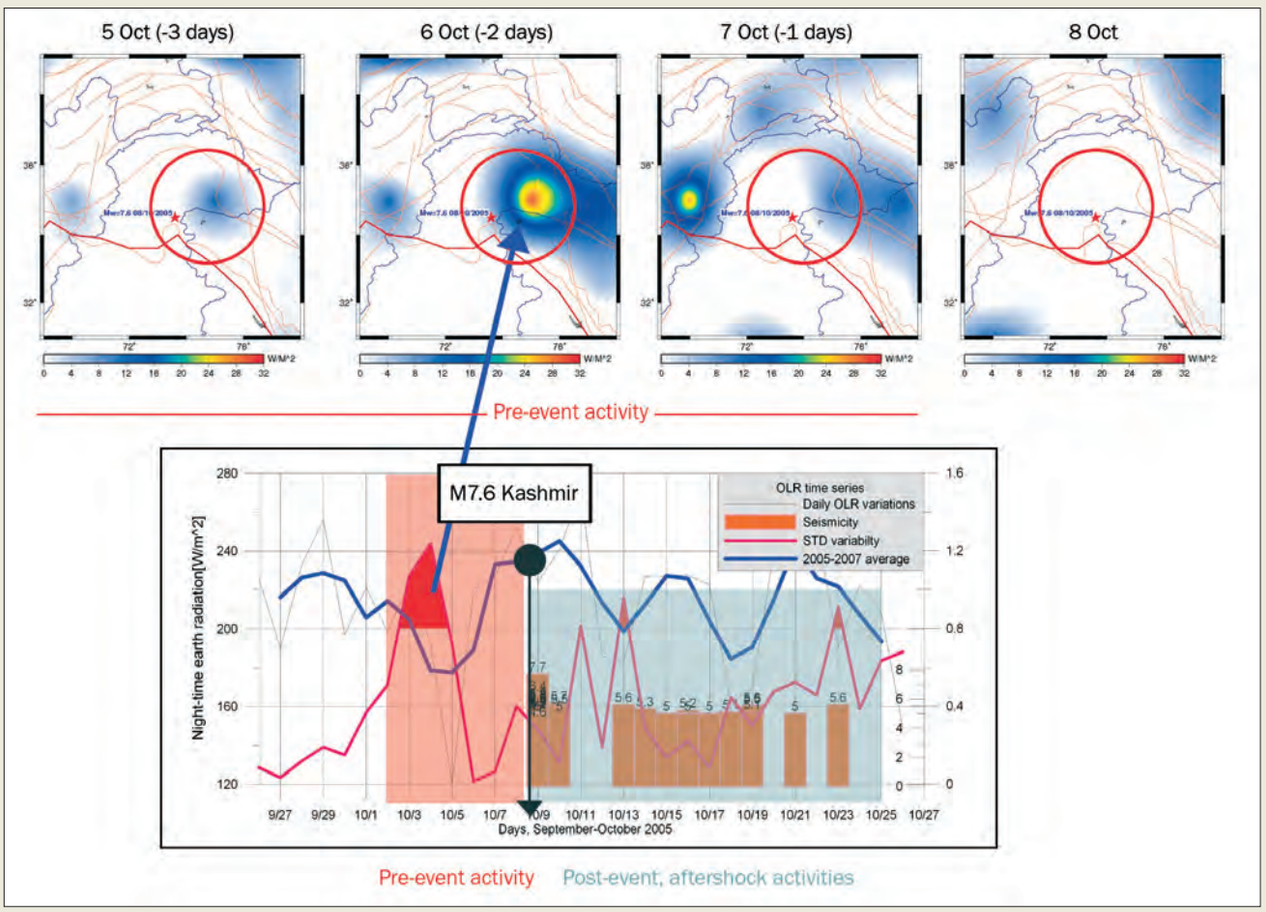
Nevertheless, such events can trigger a cascade of follow-on events such as tsunamis, floods, landslides and public health catastrophes in the affected region. Such potential catastrophic impacts are due to the growth of population, and rapid development of the technological infrastructure. The science community and operational agencies are struggling with how to provide early detection of such climactic events and reduce the loss to human lives and property.

NASA, the latest review by the panel on Earthquake Remote Precursor Sensing[3] and others working in this area have found that there were many cases showing precursory electromagnetic signals observed on the ground and space associated with major earthquakes. Advances in solid earth sciences and remote sensing capabilities provide strong support to the new interdisciplinary satellite studies of the electromagnetic environment near to seismic tectonic active faults. The observational evidence from the last 20 years confirms the existence of EM phenomena accompanying or preceding some of the earthquake events. Most recent studies confirm strong coupling between the atmospheric boundary layer and the ionosphere, which are strongly related to enhanced tectonic activity.[4] Our latest experience from several post-earthquake independent analyses of more than 100 major earthquakes has been very encouraging, and motivates us to comprehensively address the problem for more discrete detection of future magnitude 5.0 (M>5.0) earthquakes.

Discrete observations (temporally, spatially and spectrally) are spatially and temporally insufficient in coverage of any one of these parameters to reliably determine the earthquake precursor signals. This requires an integrated set of observations of several physical and environmental parameters (outgoing long wave earth radiation, ionospheric parameters, temperature and humidity of the boundary layer, seismicity, etc.) that can be combined in a multi-sensor system to identify earthquake precursors.

Traditionally space-based methods for earthquake study include GPS navigation systems and Interferometric Synthetic Aperture Radar (InSAR). These methods measure the slow build-up of deforma-

**Thermal atmospheric signals observed during the M7.6 Kashmir earthquake of 8 October, 2005**




Top: Maps of daily night-time anomalous OLR (NOAA/AVHRR) over Pakistan/Kashmir region for 5-8 October. The M7.6 Kashmir Earthquake occurred on 8 October 2005. Bottom: Time-series of daily night-time OLR variations for 25 September-25 October 2008 over the epicentral area

Source: Ouzounov D. and S.Habib, Application of remote sensing technologies for disaster risk management: Mutisensor approach of analyzing atmospheric process related to M7.6 Kashmir earthquake of October 8, 2005 in *Remote Sensing Applications for Societal Benefits* Editor: S.Habib, Springer-Verlag, 2008 (in preparation)

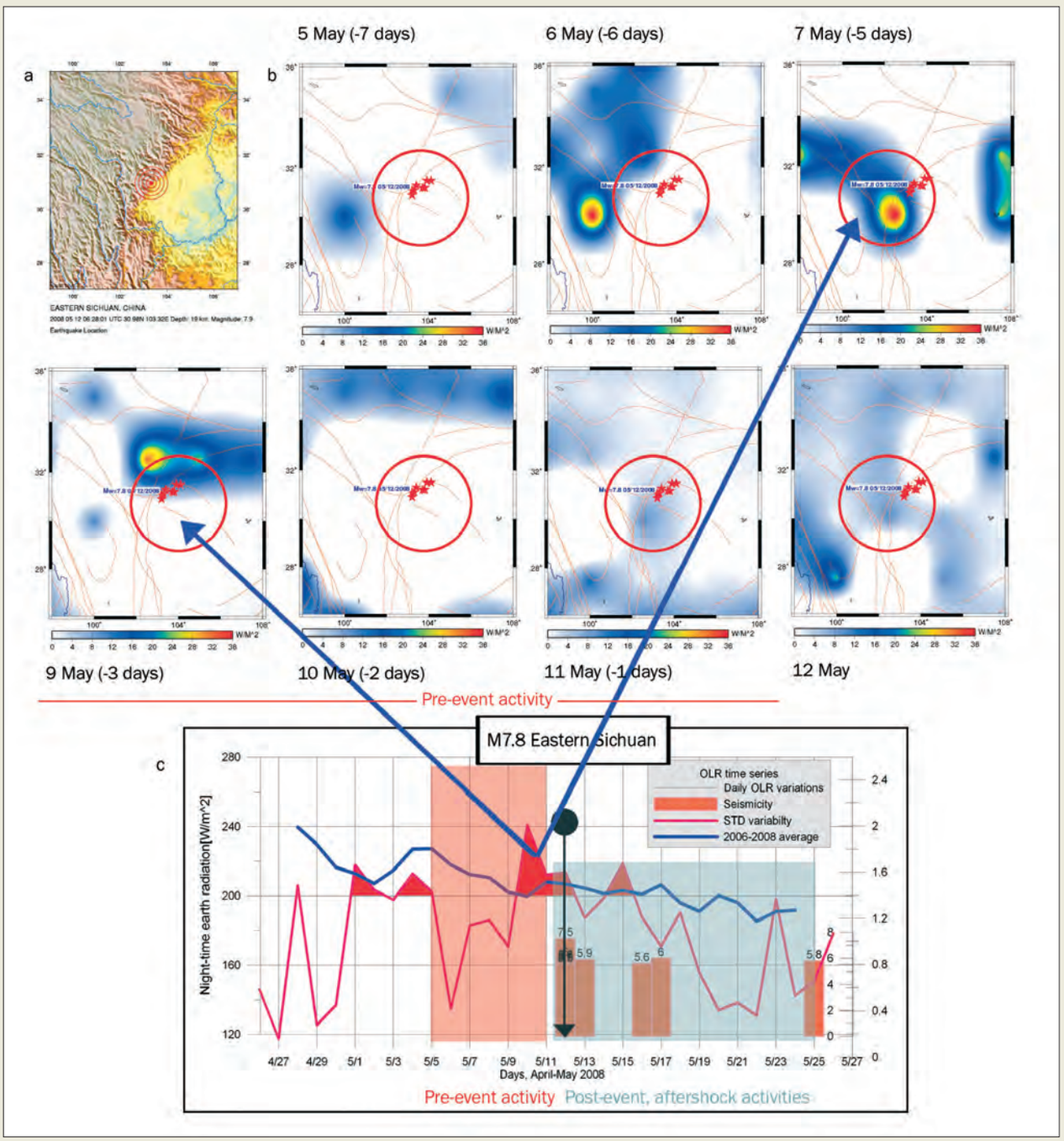
tion along faults, and mapping ground deformation after earthquakes. Currently their impact on early warning signals remains to be further studied.

The Moderate Resolution Imaging Spectroradiometer (MODIS), the key instrument of the NASA Earth Observing System (EOS), and the Atmospheric Infrared Sounder (AIRS), a high-resolution infrared sounder, were launched aboard the Aqua satellite in 2002. The suite of Aqua instruments, together with those on the Terra satellite (launched on 18 December 1999), enable global monitoring of the atmosphere and lithosphere and are developing long-term data sets for climate research. Additionally, the multi-channel (2378) AIRS on board Aqua, constitute an innovative atmospheric sounding group of visible, infrared and microwave sensors that measure temperature to better understand the vertical atmospheric structure. We have been exploring the potential benefits of combined use of the MODIS, AIRS and NOAA/AVHRR historical database under the Sensor Web framework, and obtaining an unprecedented volume of information on the Earth's atmosphere and land surface properties. This configuration is a key factor in understanding the nature of earthquake-related atmospheric signals.

In 2004 France launched the first dedicated satellite, DEMETER, to study the electromagnetic effects related to earthquakes in the ionosphere. For the last four years in orbit, multiple examples of electromagnetic emissions associated with major seismicity have been collected.[5] After the Sumatra mega-quake in 2004, several countries with high seismic risk such as Russia, China, Mexico, USA, Japan, Taiwan and Ukraine started to plan new space observations in support of earthquake hazard risk reduction. This is significant news to support a solid earth-atmospheric relationship.

Earlier studies have shown that there were some EM effects in the atmosphere/ionosphere caused by major earthquakes, and several theories have been formulated to explain their causes.[6] Some of the major events are accompanied by intensified vertical transport of charged aerosols in the lower atmosphere. These processes lead to generation of external electric current in the perturbed region of the atmosphere and in the ionosphere-atmosphere electric circuit. The Lithosphere-Atmosphere-Ionosphere Coupling

**Variations of night-time outgoing earth radiation during the time of M7.8 Sichuan earthquake of 12 May, 2008**



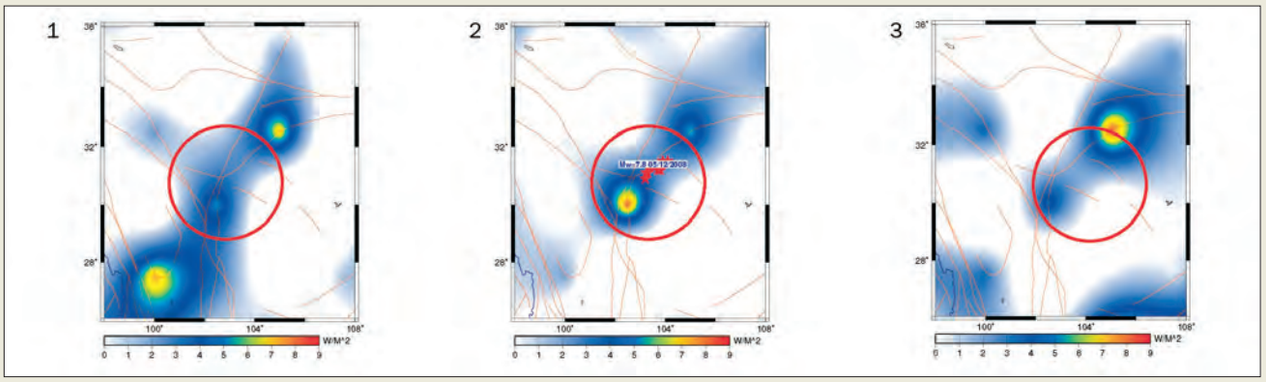

(a) USGS M7.8 location map, 12 May 2008; (b) Maps of daily night-time OLR over Eastern Sichuan, China, for 5-12 May 2008, (NOAA/AVHRR);
(c) Time-series of daily night-time OLR variability for 25 April-25 May 2008 over the epicentral area

Source: Ouzounov D., S.Pulinets, M.Parrot, P.Taylor, S.Habib, H.C. Wu, J. Ma, C.I-Wan Atmospheric and ionospheric signals associated with the Eastern Sichuan, China M7.8 earthquake of 12 May 2008 revealed by multi sensor space and ground observations, 2008, (in preparation)

(LAIC) model due to seismicity is one of the most promising technical concepts and is developed in a novel but integrated process that takes into account multiple natural activities.[7]

Several days prior to major events multiple activities occur, that involve gas emanation, change of air conductivity, enhancement of Earth's surface temperature rise and local generation of electro-static field. Ground-based or remote-sensing satellite sensors can detect such signals before or during tectonic faults activation. As part of the LAIC concept it has been proposed that the increased gas emanations start

**Monthly maps of OLR around the time of M7.8 Sichuan earthquake of 12 May, 2008**




(1) a month before (1-30 April), (2) during (1-31 May) and (3) after (1-30 June) the M7.8 12 May, 2008 earthquake (reference field for 1980-2008), (tectonic plate boundaries with red line, and major faults with brown color, red stars — earthquake epicentres, red circle — 0.5 pixel area)

Source: Ouzounov D., S.Pulinets, M.Parrot, P.Taylor, S.Habib, H.C. Wu, J. Ma, C.I-Wan Atmospheric and ionospheric signals associated with the Eastern Sichuan, China M7.8 earthquake of 12 May 2008 revealed by multi sensor space and ground observations, 2008, (in preparation)

a chain of physical processes of ionization of air molecules. This primary sequence leads to two major consequences: change of the air conductivity and, consequently, change in the near ground atmospheric electric field, which includes latent heat release. A second phenomenon, known as the 'thermal branch', has been established by the scientific community only recently with the increase in measurements of surface temperature in different bands of infrared emissions detected by NASA and NOAA satellites.[8]

One of the important components of utilizing thermal remote-sensing data (NASA's Terra and Aqua, NOAA's GOES and POES) is analysis of the continuous outgoing long wave earth radiation (OLR), which indicates anomalous variations prior to a number of medium to large earthquakes.[9] OLR energy has been measured at the top of the atmosphere by NASA and NOAA satellites and includes emissions from the ground, atmosphere and cloud formation. We have been using NOAA/AVHRR IR daily and monthly (two and half degree) gridded data to differentiate between global and seasonal variability and the transient local anomalies.

This phenomenon has been linked theoretically as part of a relationship between tectonic stresses, electrochemical and thermodynamic processes in the atmosphere and increasing Earth radiation emission, all part of a family of EM phenomena related to earthquake activity. The timescale of the observed variations is a few days, seen a week or more before the onset of the seismic event. In comparison with several years of data, the observed time series preceding the earthquake had unusually high OLR. The OLR anomaly corresponds to a large area of ground coverage and coincides with the main epicentral zone. We explored the significance of these observations for the two most devastating events on the Asian continent, the M7.6 Kashmir earthquake of 8 October 2005, and most recently the Mw 7.8 earthquake in Eastern Sichuan, China on 12 May 2008.

In the case of the Kashmir earthquake, compared to the reference fields for the months of December 2005, 2006 and 2007, we found OLR anomalous fluxes of the order of >32 W/m$^2$, with an absolute value of 282 W/m$^2$ along the epicentral area beginning 4 October, four days before the event. Maps of daily night-time thermal infrared (TIR) anomalous (mean field defined for three years 2005-2007) of Earth outgoing radiation (NOAA18/AVHRR, 1:38 a.m. mean local time) over Kashmir/Pakistan region for 5-8 October are presented below. Tectonic plate boundaries are shown with a red line, with major faults in brown. Red stars are earthquake epicentres, red circles — 0.5 pixel area. A monthly time-series graph for the daily night-time OLR variations — for 25 September-25 October 2008 over the pixel nearest to the epicentre (35N/72.5E) area — reveals some pre-event (in red) and post-event aftershock activities (in green).

In the case of the Eastern Sichuan earthquake, the NOAA-18 OLR survey for April-May shows that the initial indication of building an atmospheric anomaly was detected on 5 May (five to six days before the main shock) and the maximum reaches the value of 20 W/m$^2$ westward from the epicentre. The OLR reference field was built for the entire period of 2005-2007. During the period of 6-9 May, strong OLR anomalies were building near to the epicentral area, over the major fault lines with the highest value of 38 W/m$^2$. These are most likely connected with the gas release enhancement and additional flux emission, and provide information about major fault activation in this area.

In summary, through our research we have found a significant relationship between solid Earth actions and atmospheric and ionospheric coupling. This relationship has been studied by a number of scientists with important results, but more work in this area needs to be done. It is not a trivial effort and will require many more years of research before such an application should become important for earthquake prediction. NASA's role in this research is clear in that the agency has a history of exploration into the unknown. We hope that this work will eventually provide significant early warning for such catastrophic events as the recent earthquake in China. It is with this in mind that NASA will continue to support this and other methods of monitoring and early detection of Earth movement, such as GPS and InSAR, to provide societal benefit to the nation and the world.

# e-Flood Map: flood damage assessment in Thailand

*Geo-Informatics and Space Technology Development Agency*

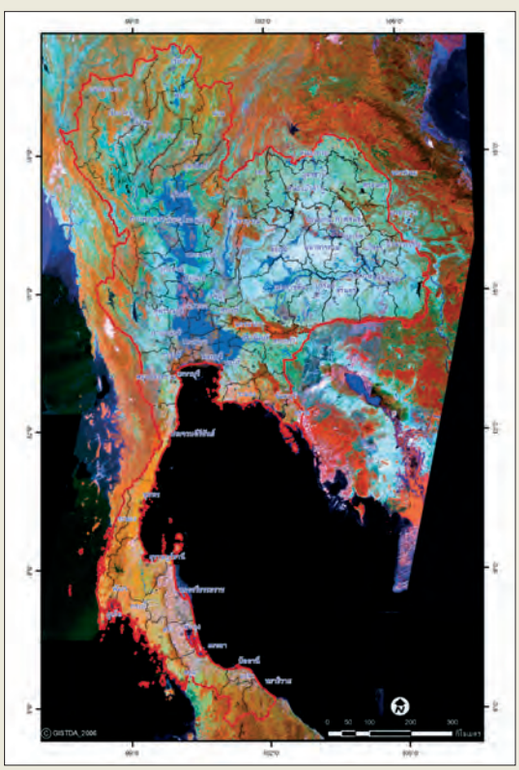
**Located in the tropical zone, Thailand has suffered from several tropical storms every year. During mid-2006, the Pra Pirun and Chang San depressions caused damages nationwide, with catastrophes in some large areas. It started with heavy rainfall which caused massive landslides in Utaradit, a province in northern Thailand, where hundreds of people were killed, thousands were physically and psychologically impacted, and their relatives and properties were lost. Subsequently, massive water mass from the north overwhelmed agricultural areas in the central part of Thailand. In order to protect the Bangkok metropolitan, a massive amount of water was drained into paddy fields in surrounding areas, which became inundated for several months. Human beings, livestock and crops all suffered from this deluge.**

The Geo-Informatics and Space Technology Development Agency (GISTDA) is a public organization that has played an active role in implementing and supporting the use of geo-informatics technologies for disaster risk management, including flood. As the main distributor of satellite imageries and a major GIS/RS application agency of Thailand, GISTDA has proved the value of Earth observation data to the field of disaster management. Throughout the long period of the 2006 flooding, GISTDA dedicated its resources to serve the needs of local governmental officers for up-to-date data which was crucial for their work. The flooded areas were interpreted from various available satellite imageries using automatic classification together with manual checking. Data was provided to end users daily in the form of paper maps, digital satellite images, and GIS (vector) data of flooded areas. This daily work lasted for over four months, and since then, GISTDA has been the main responsible supporter of ready-to-use Earth observation data for flood management.

Due to the extensive period of flooding and the burden on farmers whose farms were inundated in order to protect the City of Bangkok, it was necessary that the Government provide compensation for each farmer and for suffering people. The calculation for compensation is based on the number of days that each area was inundated. GISTDA's e-Flood Map project was then initiated to serve such a purpose, as well as to monitor the flooded area. The developed solution requires lots of work and intensive GIS analysis. The project's results are not limited to valuable information about the total amount of days each administrative region and each land use type was affected by the flood; the relevant data collected in the database can also be beneficial for many other applications. e-Flood Map DVDs containing flood statistics, study reports, summarized figures, satellite images, GIS data of the flooded area and a software application that enables users to examine the data were distributed to end users nationwide.

The e-Flood Map Project is considered a major and resourceful flood risk management project using Earth observation systems. Results from the project play a crucial rule not only in the process of compensation, but also in the process of rehabilitation at local level. Furthermore, distributed data from the project is useful for a vast number of user communities including researchers, students, politicians, farmers and bankers. It also offers an excellent opportunity for

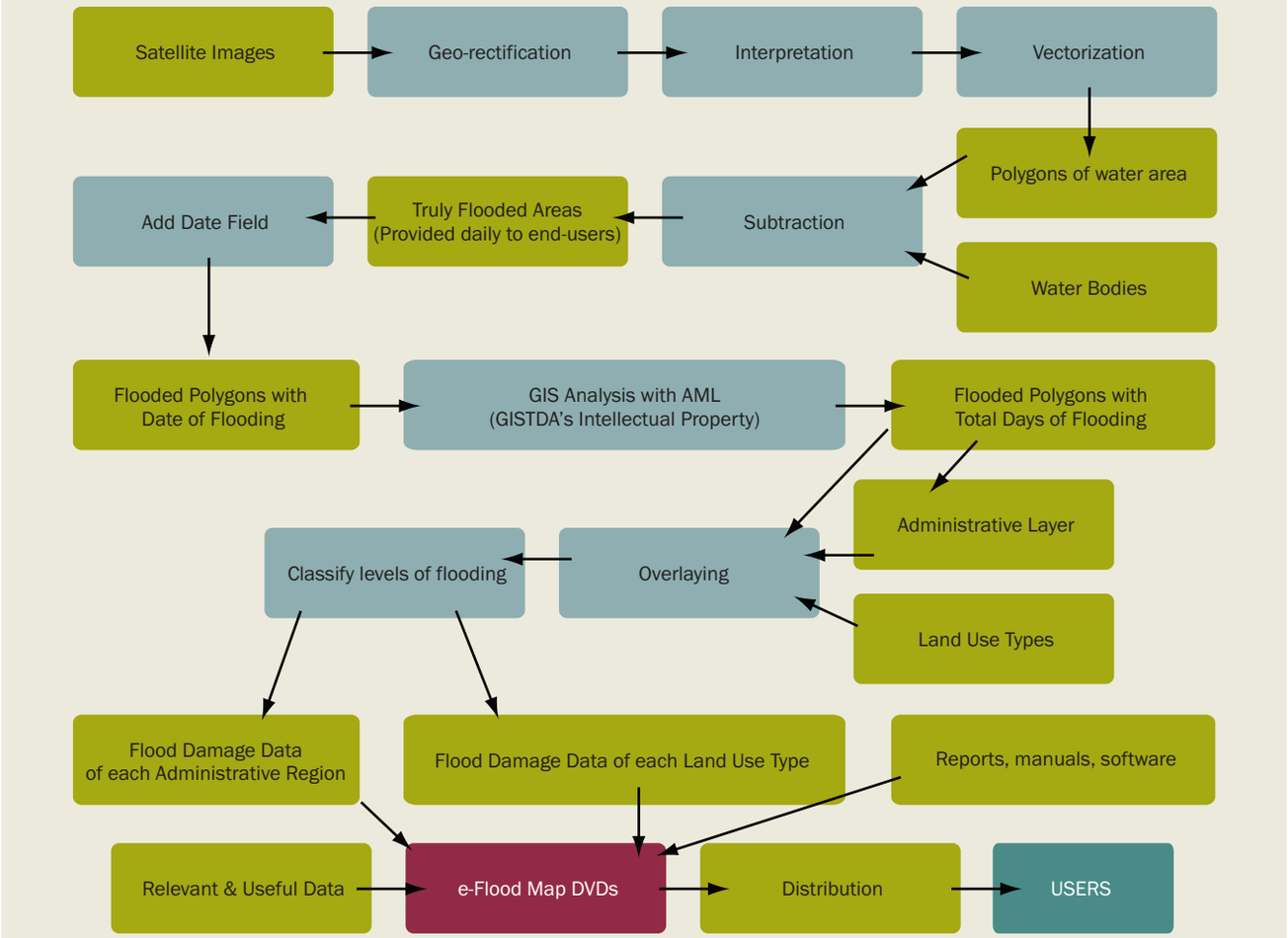
**Mosaicked False Colour Composite Landsat Imagery with Inundated Data of 2006 in Thailand**



Data from the e-Flood Map project is distributed to a number of end users

Source: GISTDA

**A step-by-step summary of the procedures followed during e-Flood Map production**




Source: GISTDA

GISTDA to create a comprehensive database for the purpose of long-term risk assessment and relief management.

**Methodology of e-Flood Map creation**

The tools used for creating the e-Flood Map were multi-date satellite data, relevant GIS data, analysis software and distributed software. The satellite data comprised microwave (SAR) data from RADARSAT and ALOS satellites, with optical data from LANDSAT-5, and SPOT 2, 4 and 5 satellites. More than 80 scenes of satellite data were acquired and used.

GIS data included administrative boundaries from the Ministry of the Interior; land use data from the Ministry of Agriculture and Cooperatives; land parcel data from the Department of Public Work and Town/Country Planning, and a topographic map from the Royal Thai Survey Department.

Image analysis and GIS software, with ArcGIS Publisher Extension, were used for data analysis and preparation, and a Visual Basic application, ArcReader (freeware), GIS data, satellite images, and summarized reports were distributed.

**Results and achievements**

The total inundated area in Thailand in 2006, as analyzed from various satellite images, was 2,658,429.28 hectares.

The levels of flooding classified by inundation periods of 1-15 days, 16-30 days and more than 30 days were found to be 1,553,309.60, 486,649.44 and 618,470.56 hectares respectively.

The e-Flood Map DVD-ROMs were produced and distributed to end users in local governments and policy makers in ministerial and departmental organizations. The e-Flood Map received high acceptance.

The results of flood damage assessment from the e-Flood Map project were reasonably accurate. The analyzed information representing levels of flooding could be used as a tool for decision-makers in compensation evaluation. The e-Flood Map DVDs were produced and completed in a short time, enabling the end users in local governments to use them for flood risk management.

The project was completed with cooperation from several partners, and the developed procedures can be applied to handle flood events in the coming years. The well-structured aggregated spatial data can be used as a historical database which will be invaluable for long-term climate change study.

# Coping with drought — the tragedy of the commons

*Joon Kim, Song-You Hong and Jhoon Kim, Department of Atmospheric Sciences and Global Environment Laboratory, Yonsei University, Seoul; Sung Kim, Sustainable Water Resource Research Center/KICT, Korea*

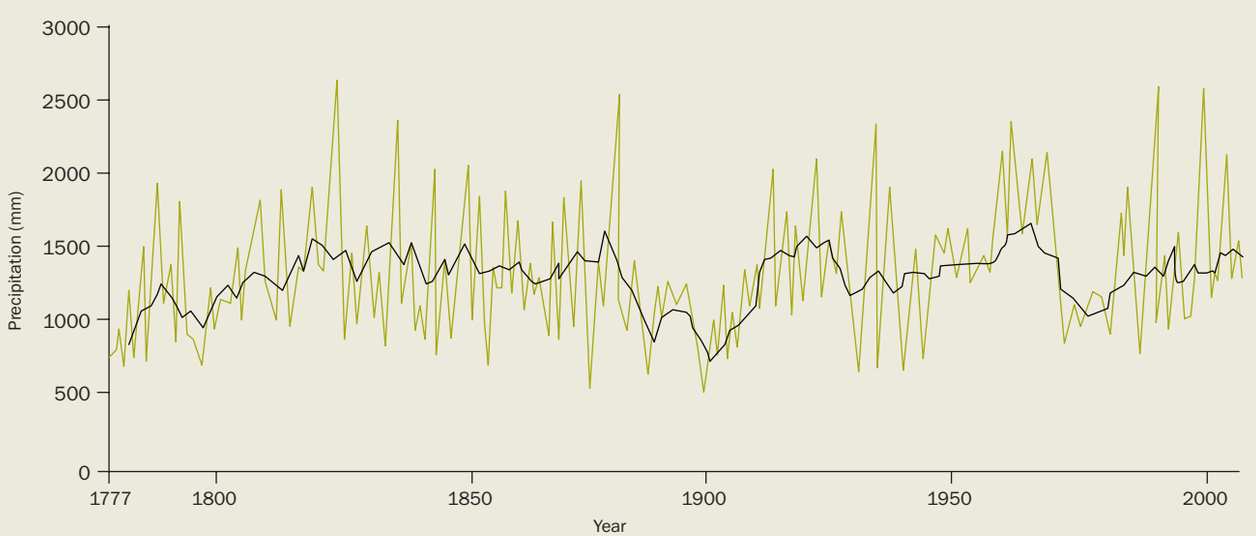
**On arriving in Korea, Horace G. Underwood wrote the following: "Oh, Lord! Now we see nothing. Nothing but the withered and deprived land. You have brought us to this barren land where not even a stump of a tree can arise refreshingly."**

This is a part of the prayer of Underwood who came to Korea with a vision in the late 19th century and founded Yonsei University in 1885 in Seoul. His prayer is intriguing, because it suggests that there may have been a severe drought in Korea in the late 1800s. In fact, British geographer Angus Hamilton[1] who visited Seoul around this time wrote: "An even more emphatic evidence of the effects of a drought, where the population live upon the rice crop, is afforded by the appalling loss of life and the grave eruption of disorder, which took place in Korea as the consequence of the famine in 1901." Contrary to our common understanding, drought is not a rare and random event but a normal, recurrent feature of climate. It is an insidious hazard of nature, originating from a deficiency of precipitation over an extended period of time, typically for a season or longer. Defining drought, however, is difficult because it depends on differences in regions and disciplinary perspectives (for example, meteorological, hydrological, agricultural and socioeconomic).[2] Drought definitions can be either conceptual or operational. The former is formulated in general terms to help people understand the concept of drought whereas the latter helps people analyze and identify the beginning, end, frequency, and degree of severity of a drought for a given historical period.

However, drought should not be viewed merely as a natural event. In fact, inadvertent human activities are exacerbating the impact of drought. Severe droughts and the resulting environmental and societal hardships in the past decades, in both developing and developed countries, may have been the results of the interplay between these natural events and *the tragedy of the commons*. With regards to the latter, American ecologist Garrett Hardin wrote: "In a crowded world of less-than-perfect human beings, mutual ruin is inevitable if there are no controls." In our case, the commons is our entire planet. Mutual ruin due to more severe and frequent droughts may result from:

- Enhanced aerosol loading through increasing air pollution
- Rapid changes in land use (e.g. deforestation) and land degradation

**Annual precipitation with five-year moving average in Seoul, Korea from 1777 to 2007**



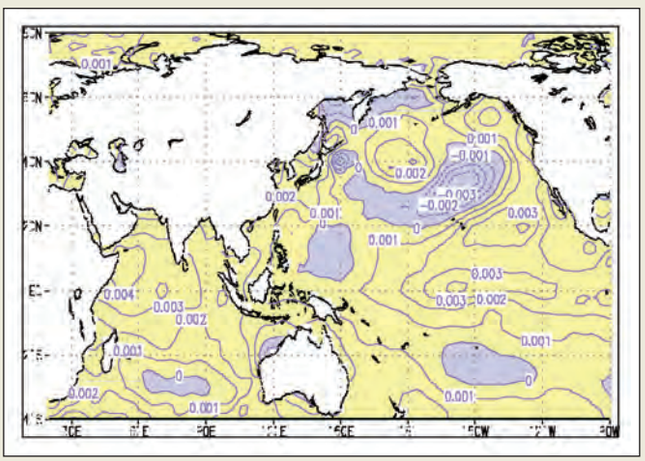

Source: Jung et al, 2001

- Positive feedback through coupling between water and carbon cycles in terrestrial ecosystems.

Indebted to the invention of the first rain gauge in 1441 and the pioneering measurement network around the Korean Peninsula by King Sejong of the Chosón dynasty, the cyclic nature of drought at a local scale can be traced through one of the longest precipitation records in Seoul. Typically, drought is considered relative to some long-term average condition such as normal. In the case of the annual precipitation from the traditional Korean rain gauge, *Chugugi* (1777-1907)[3] and the modern rain gauges (1908-2007), the recent 30-year normal precipitation is about 1,400 mm. Such a normal can change, however, by more than 30 per cent depending on the averaging intervals selected from the 230-year period, reflecting dramatic changes in climate for the last two centuries. The recurrent dry and wet periods particularly with a prolonged drought approximately from 1880 to 1910 are worth noting. Considering its cyclic nature, such a severe and extended drought, that has fortunately not occurred in the past century, may return sooner or later.

The impacts of strong and persistent drought span environmental, economic and social sectors and can be reduced through proactive mitigation and preparedness. Establishing drought climatology for a region provides a better understanding of its characteristics and probability of recurrence at different levels of severity. Such information is extremely valuable in the development of mitigation strategies and preparedness plans. On the other hand, the onset, end and severity of drought is difficult to determine, requiring better understanding of the mechanisms that originate, maintain and end an extreme drought. The potential mechanisms that can produce drought conditions are:

**ENSO-like patterns in the tropical pacific**



This image was obtained by regressing the unfiltered global Sea Surface Temperature (SST) field (upon the annually anomalous precipitation time series of Seoul for the period of 1854-1997). What we observe is an El Niño Southern Oscillation (ENSO)-like pattern over the tropical Pacific. The leading pattern of analysis for lowpass-filtered (8-yr) SST indeed reveals features similar to interdecadal variability of the tropical Pacific (not shown). These results suggest that there is a link between the long-term anomalous precipitation of Seoul and ENSO-like variability. It is also evident that precipitation in Seoul is associated with the Indian Ocean basin-wide warming. In this analysis, due to the lack of long-term soil moisture data, it is impossible to examine a physical interaction with soil moisture anomalies

- Sea surface temperature (SST) anomalies
- Soil moisture anomalies
- Atmospheric initial conditions favourable to such a climate extreme.

A drought can also be exacerbated through a regional positive feedback in which low soil moisture reduces local evaporation and in turn precipitation. For example, the strong drought of the US States of Oklahoma and Texas in 1998 was established by the SST anomalies combined with a favourable atmospheric circulation during April and May. In June-August, the regional positive feedback associated with lower evaporation and precipitation contributed significantly to the maintenance of the drought. In the autumn, the drought ended as stronger large-scale weather systems penetrated the region and overwhelmed the soil-moisture feedback.[4]

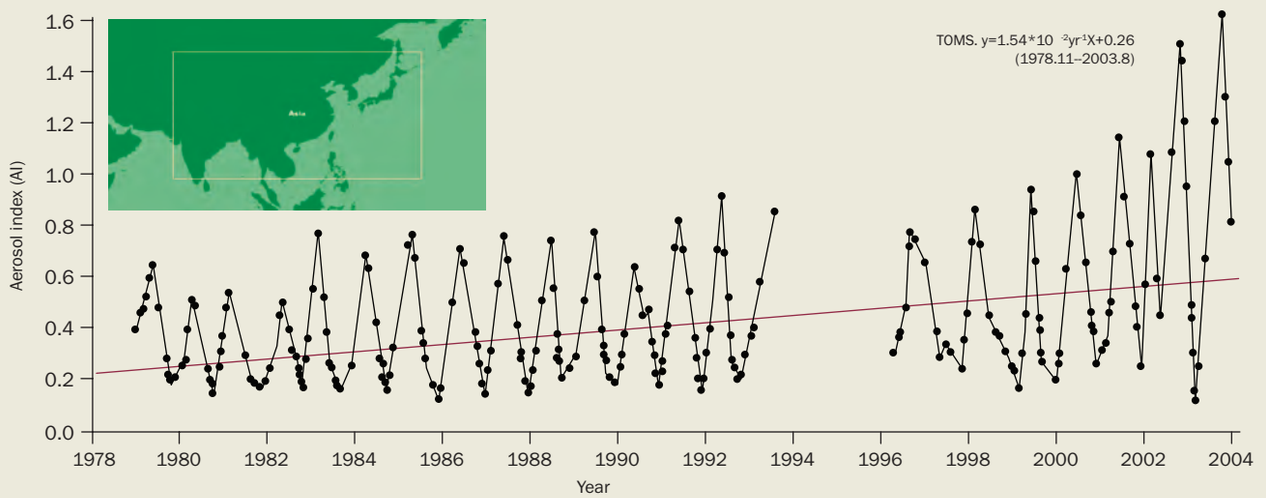
The interplay of SST anomalies and atmospheric internal forcing on local precipitation may be examined using the long-term measurement of precipitation in Seoul and the monthly SST data with a resolution of 2.5 degrees for the period of 1854-1997.[5]

Many modelling studies have shown the significant effect of soil moisture anomalies in late spring on the summer rainfall anomalies in North America. On the other hand, the role of soil moisture seems insignificant in East Asia.[6] This conflicting impact of local feedback and dynamic forcing is attributed to a weakened sensitivity of the monsoonal circulation to the initial soil moisture. Hence, drought production mechanisms in Asia are further complicated by large-scale variations in the Asian monsoon evolution, which affect more than 60 per cent of the world's population.

South and East Asia are two of the areas with the highest air pollution and aerosol concentrations due to rapid population and economic growth. In this region, air pollution emissions containing aerosol particles produce widespread layers of brownish haze, so called 'atmospheric brown clouds' (ABC). The particles in ABC (including black carbon, ash, dust and $NO_2$) result in millions of deaths annually, decreased photosynthetically active radiation and global dimming (having direct impacts on ecosystems), stabilized surface-atmosphere system during dry seasons, altered SST gradients, and altered regional rainfall patterns — thereby leading to global cooling and drying.[7]

The aerosol index (AI) is a measure of how much the wavelength dependence of backscattered ultraviolet radiation from an atmosphere containing aerosols differs from that of a pure molecular atmosphere. In South and East Asia, AI has been continuously increasing with greater interannual variability, indicating growing aerosol emissions for the past three decades. Numerous modelling studies have described the potential effects of aerosols on monsoon rainfall over the South Indian subcontinent. Recent observational studies suggest that although anomalously high aerosols are associated with deficient precipitation in South Asia in early spring,

**Aerosol index in South and East Asia from 1978 to 2004**




Source: http://disc.sci.gsfc.nasa.gov/data/datapool/TOMS

internal atmosphere-land-surface feedback actually strengthens the monsoon in subsequent summer months. Land-surface processes, once triggered by anomalous aerosol concentrations, are important mediators in monsoon evolution.[8] According to the fourth assessment report of the Intergovernmental Panel of Climate Change (IPCC), aerosol-cloud-precipitation-climate interactions remain as the largest uncertainties in our current understanding of the climate system.

The fourth report by Working Group I of IPCC notes a greater than 66 per cent probability that more areas of the world will be affected by drought. Furthermore, recent studies have reported the effect of drought and heat on the carbon cycle by using direct and long-term carbon flux measurements and yield data, as well as by inferring regional-scale fluxes from satellite-based MODIS and a carbon-cycle model. For example, the 2003 Europe drought (50 per cent below the long-term average in Europe) and heat (6°C above the long-term average since 1851) caused a Europe-wide reduction in primary productivity, resulting in an annual loss of 0.5 Gt C $m^{-2}$ $yr^{-1}$.[9]

A number of major droughts in mid-latitudes have contributed to the weakening of the growth rate of terrestrial carbon sinks in these regions. An increase in future drought events could turn temperate ecosystems into carbon sources. Also, regional droughts during El Niño events promote large biomass fires, contributing to high atmospheric $CO_2$ growth rates.[10] Over the last 50 years, the efficiency of natural carbon sinks has decreased by 10 per cent and will continue to do so in the future,[11] implying that the more vulnerable the region is to future drought, the larger the burdens needed to reduce carbon emission.

In July 2008 the G8 summit over climate change invited eight major economies to Japan to discuss a new global agreement. Developing countries, including China, India and Korea refused to sign the G8's pledge to cut carbon emission by half, by 2050. The aforementioned participant nations did, however, sign a joint statement, officially committing to play by international rules to fight pollution. The ball is now in our court and we cannot refuse to play.

At the time of writing the 2008 Beijing Olympics is just around the corner and China, which has the largest rainmaking operation in the world, is aiming for a dry opening ceremony. The chemicals used in the production of artificial rain, however, could affect climatic patterns, ecosystem, water sources, soil, and most likely the natural hydrological cycle, as well as the energy budget.

Reaching a useful and usable understanding of the sustainability, dynamics, vulnerabilities and resilience of the complex socio-ecological systems associated with drought will require a strong push to advance focused scientific research with a clear vision — foresight with insight, based on hindsight.[12,13] This will include building up classical disciplinary knowledge from the natural and social sciences, and an even stronger development of interdisciplinary and trans-disciplinary research. Bruno Latour wrote in *Science*[14] about the transition from the culture of 'science' to the culture of 'research' in the past 150 years: "Science is certainty; research is uncertainty. Science is supposed to be cold, straight, and detached; research is warm, involving, and risky. Science puts an end to the vagaries of human disputes; research creates controversies." Truly, we as informed stewards are standing at a turning point where the risks can be minimized by developing and transferring the true knowledge of contextualized science to our society.

> "Here is wisdom that has impressed me as I have watched the way our world works. There was a small town with only a few people, and a great king came with his army and besieged it. A poor, wise man knew how to save the town, and so it was rescued. But afterward no one thought to thank him. So even though wisdom is better than strength, those who are wise will be despised if they are poor. What they say will not be appreciated for long. Better to hear the quiet words of a wise person than the shouts of a foolish king."[15]
>
> King Solomon

# Assessing natural hazard risk in the Asia-Pacific region: first we must ask the right questions

*Alanna Simpson, Phil Cummins, Jonathan Griffin, Trevor Dhu and John Schneider, Geoscience Australia*

**Natural disasters are a frequent occurrence in the Asia-Pacific region due to a combination of very dense population and very hazard-prone areas. The Australian Government has recently been called upon to play a significant role in responding to natural disasters such as earthquakes in Pakistan and Indonesia, landslides in the Philippines, tsunami events in Indonesia and the Solomon Islands, cyclone related flooding in Papua New Guinea, and the regular occurrence of cyclones in the south-west Pacific and south-east Asia. There is an increasing trend in the number and size of disasters as the effects of climate change are felt, and rapid population growth and urbanization results in increasingly large and vulnerable populations in areas exposed to natural hazards.**

Natural disasters have been clearly demonstrated to disproportionately affect developing countries — more than 90 per cent of natural disaster deaths and 98 per cent of people affected by natural disasters are from developing countries.[1] This fact has considerable implications for international aid programmes. First, natural disasters significantly compromise development progress and reduce the effectiveness of aid investments. Progress toward the achievement of the Millennium Development Goals (MDGs) might be slowed or halted depending upon severity. In particular, progress on MDG1 — halving poverty and hunger by 2015 — may be halted or reversed as a consequence of a natural disas-

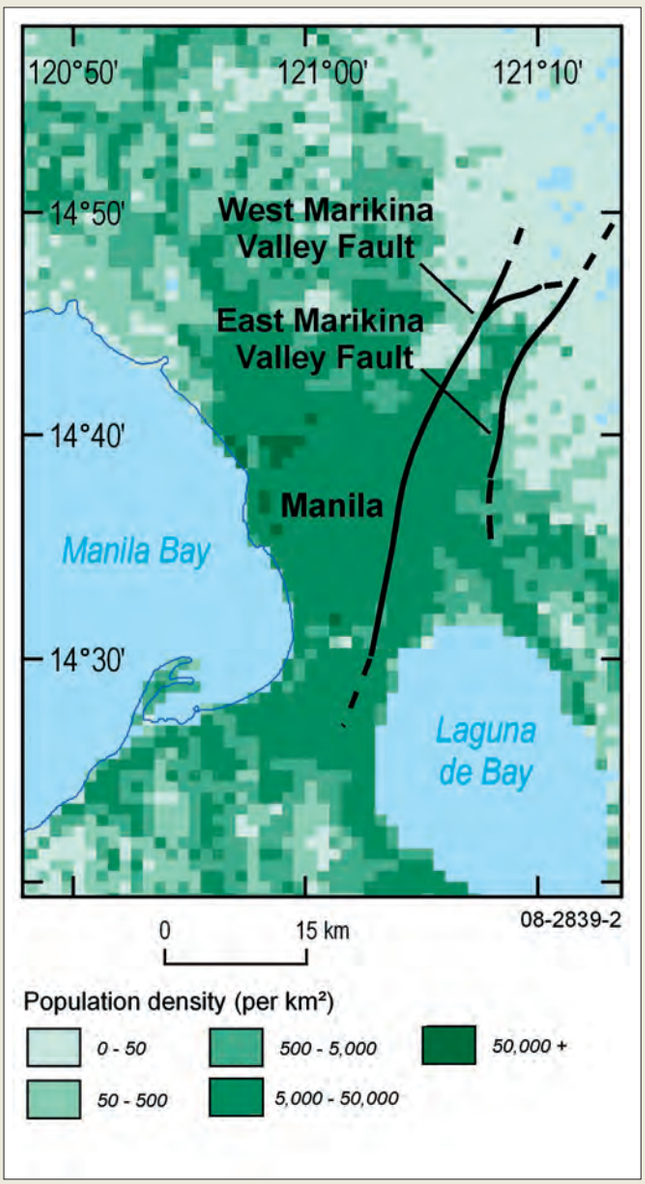
Image: J Griffin

This school in Ghanool, Pakistan, collapsed during the 2005 South-Asia earthquake killing several children. The vulnerability of non-residential structures such as schools, offices and hospitals is no less important than for residential structures

ter. Second, natural disasters, particularly relatively infrequent, high-magnitude natural disasters (for example, the 2004 Indian Ocean tsunami), require a significant disaster relief and humanitarian response from aid agencies, which may shift resources away from other development objectives. For this reason the Australian Agency for International Development's (AusAID) strategic direction affirms that managing and responding to natural disasters should be central to development planning.

A recent activity undertaken by Geoscience Australia for AusAID made a preliminary assessment of natural hazard risk across all Asia-Pacific partner countries.[2] The objective was to gain a better understanding of disaster risks across the AusAID portfolio and support AusAID to better target disaster risk reduction and humanitarian response activities. This project sought to broadly identify the characteristics, frequency, location and potential consequences of rapid-onset natural hazards including earthquake, tsunami, landslide, flood, cyclone, wildfire and volcanic eruptions.

**The convergence of high population density and active faults in Manila, Philippines**




Movement on the Marikina Valley fault could have a devastating impact on Manila, of a scale determined by the earthquake magnitude and epicentre

Source: Population data from Landscan; fault location from Nelson et al. 2000

**Toward an understanding of risk and impact**

Disasters are not the inevitable consequence of natural hazards. A volcanic eruption on an uninhabited Alaskan island is unlikely to be a disaster whereas the same eruption in the densely populated Asia-Pacific region may be catastrophic. In order to transform a natural hazard into a natural disaster, populations need to be exposed to the hazard. Furthermore, if we dissect the anatomy of disasters, we find that the impact of the hazard is typically determined by inherent vulnerabilities within populations. For example, a magnitude 6 earthquake in New Zealand is unlikely to cause mass fatalities due to strict building codes. Yet the same magnitude earthquake may lead to many fatalities in the developing countries of the Asia-Pacific region as building codes, if available, may not be enforced. To rewrite a familiar adage, 'earthquakes don't kill people, buildings do'.

Thus the ultimate aim of a natural hazard risk assessment is to move beyond an understanding of the hazard to a more comprehensive understanding of the risks and potential impacts of hazards on communities. For example, rather than simply identifying which provinces have the highest chance of an earthquake or flood, risk analysis provides information on how many people would be left homeless by a 1-in-100-year flood or a magnitude 6.5 earthquake.

A crucial aspect in the assessment of natural disaster risk is the metric used to define a past disaster and therefore the risk of future disasters. Typically, the number of fatalities is used to classify a disaster. However, this simplistic metric ignores the number of injured, homeless and displaced, the requirement for international humanitarian assistance and the economic impact of a disaster. In recognition of this we used 'significantly impacted population' as the risk metric in our study. This deliberately vague term covers death, injury and displacement, prolonged loss of access to essential services and/or shelter, and significant damage to agriculture, horticulture and industry. Future work to improve our understanding of natural hazard risk in the Asia-Pacific region will need to test more specific risk metrics, particularly those most useful in an international development and humanitarian context. For example, it may be useful to calculate risk in terms of the number of fatalities and injured, the extent of building destruction, the period of compromised access to essential services (water, electricity, communication, health), the impact on food supply (would the annual harvest be destroyed?) and/or the effect on the economy.

A particularly useful risk metric, and one touched on in our study, is the risk of a government's disaster

**The current population density of Indonesia is overlaid by the ash-dispersal pattern from the 1815 Tambora eruption**


The area 100km from the volcano received between 50 and 100cm of ash, and pyroclastic flows are thought to have extended about 30km from the volcano. More than 1cm of ash covered over 500,000km² of the Java sea and surrounding islands

Source: Population data from Landscan

response capabilities being overwhelmed and thus requiring significant external aid assistance. Such an event may be termed 'catastrophic'. The potential for a government being overwhelmed in a disaster is proportional to the percentage of the population seriously impacted and the country's level of development. Typically in developed countries, if a very low proportion of the population is affected by a disaster, internal resources can be readily mobilized for response and recovery. For example, when Cyclone Larry hit northern Queensland in 2006 it seriously affected less than one per cent of Australia's population; thus, Australia was well equipped to support those affected by the disaster without external assistance. In contrast, a similar percentage of Papua New Guinea's population was directly affected by Cyclone Guba in 2007, yet this disaster required significant foreign support in the post-disaster phase.

### Natural Hazard Risk Assessment of the Asia-Pacific region — preliminary results

Here we present some key findings from our preliminary natural hazard assessment of the Asia-Pacific region, followed by two case studies that illustrate some of the findings.

1. Our broad assessment suggests that it is inevitable that the Asia Pacific will suffer one or more 'mega-disasters' in the 21st Century that significantly impact millions of people. Previously it has been argued that a million-fatality earthquake in the Himalayan belt of south Asia is likely, and we would argue that megacities (cities with more than 8 million people) in China, Indonesia and the Philippines are also candidates for this type of event (Case Study 1). As far as we are aware, the case for volcanic disasters of this scale has not been argued, but our analysis suggests that millions could be seriously affected by a volcanic disaster in the Philippines or Indonesia (Case Study 2). Finally, the current population explosion in the mega-deltas of Asia (e.g. Bangladesh, Burma), combined with increasing vulnerability as a result of climate change, indicates that a flood or cyclone event affecting tens of millions is also likely.
2. Of this study's primary focus countries, Indonesia and the Philippines stand out as having very large populations exposed to multiple hazards, with a high potential for massive single-event impacts.
3. Pacific countries have a high potential for catastrophic disasters that may affect large proportions of their populations, overwhelming their national capacity to respond.
4. The gaps in natural hazard information available for developing countries are vast, especially when compared to developed countries. These gaps are often large enough to preclude any meaningful hazard/risk assessment.

**Case study 1: Manila — a megacity with a very high earthquake risk**

The 18 million residents of Manila in the Philippines dwell in an area particularly vulnerable to earthquakes, with the city sustaining heavy damage from earthquakes at least six times in the last 400 years.[3] In part this results from movement on the Marikina Valley fault system which cuts through the north-eastern part of the city. Studies suggest that magnitude 6-7 earthquakes are generated on this fault every 200-400 years.[4]

A combination of rapid urbanization, its location on a floodplain prone to amplified ground motion and liquefaction, and frequent large earthquakes lead to a high potential for an earthquake to impact a large proportion of Manila's population. Indeed, our analysis suggests that Manila is the Asia-Pacific megacity most at risk to earthquakes, with magnitude 5 earthquakes occurring on average once every 37 years. A magnitude 5 earthquake centred near Manila is predicted to significantly impact several hundreds of thousands of people, and a larger earthquake striking at Manila's centre may be catastrophic.

Across the Asia-Pacific region, the countries with the largest total populations exposed to very high earthquake hazard are China, India, Nepal, Philippines and Burma; while megacities with a particularly high risk from earthquakes include Dhaka, Bangladesh and Beijing, China. Countries with a high percentage of their populations exposed to very high earthquake hazard are Vanuatu, Solomon Islands, Nepal, Burma and Philippines.

**Case study 2: The danger of dormant volcanoes in heavily populated areas**

"The most dangerous situation of all is that of a large, unexpected explosive eruption from a long-dormant volcano in a densely populated area."[5]

Our analysis suggests that 180 million people in the Asia-Pacific region live within 50 kilometres of a volcano that has not been active in at least the last 40 years; thus this 'dangerous situation' is prevalent in the Asia-Pacific region.

To illustrate the potential impact of one of these long-dormant volcanoes erupting in the densely populated Asia-Pacific region we have created a simple simulation of the impact of Indonesia's Tambora eruption on today's population. The 1815 eruption of the Tambora volcano, 300 kilometres east of Bali, killed around 92,000 people. With the 20th century population explosion, the impact of the same eruption today would be catastrophic, as illustrated by the following scenario.[6]

Assuming that warning signs of an impending eruption were recognized, and appropriate and timely action taken, more than 200,000 people would require evacuation from within 50 kilometres of the volcano. This evacuation would provide protection from the most life-threatening of the volcanic hazards. If wind patterns similar to those in 1815 prevailed, around 8 million people would receive at least 20 centimetres of ash during the eruption, potentially collapsing around one-third of roofs. Roughly one-third of Indonesia's population would receive one centimetre of ash. This relatively thin layer of ash may damage electrical equipment, disrupt power supplies, contaminate water sources, cause health problems and significantly interrupt food production, industry and tourism. Finally, at least one tsunami was triggered by the 1815 eruption, with a wave height of four metres observed near the volcano and wave heights of 1-2 metres in East Java[7] – such a tsunami today could cause extensive coastal damage.

A similar eruption scenario could be played out in many Asia-Pacific countries, with Indonesia and the Philippines having the greatest populations exposed to very high volcanic hazard. Our analysis suggests that volcanic disasters seriously affecting more than 100,000 people can be expected around once a decade in Indonesia and once every few decades in the Philippines. Volcanic disasters impacting tens of thousands of people in Papua New Guinea are expected around once a century, and Vanuatu has the potential for a catastrophic volcanic disaster at a rate of around twice a century.

**Conclusions**

Our preliminary assessment of natural hazard risk in the Asia-Pacific region highlights the potential for this region to experience a mega-disaster affecting millions of people in the coming century. While the scale of such a disaster may seem greater than what has been experienced historically, this conclusion is reached not only because the Asia-Pacific is home to intense geological and meteorological activity, but also because of the 20th century population explosion. The population has grown by more than five-fold during the 20th century, and is increasingly vulnerable as the result of rapid poorly regulated urbanization and the tendency of populations to concentrate in areas especially prone to natural hazards. Because of the threat that natural disasters pose to development progress, natural hazard risk management will continue to increase in importance in international development policy in the Asia-Pacific region.

# The first tsunami early warning centre in the Indian Ocean

*Shailesh Nayak and T. Srinivasa Kumar, Indian National Centre for Ocean Information Services*

**The oceans are a cornerstone of the life support system for all creatures on the planet Earth, and the source of several natural phenomena that are beneficial to humankind. However, oceans are also associated with disastrous events such as tsunami, cyclones and associated storm surges. Tsunami is a system of ocean gravity waves formed as a result of large-scale disturbance in the sea that occurs in a relatively short duration of time. A series of oscillations both above and below sea level take place during the process of the water returning to an equilibrium position by the force of gravity. Thus tsunami waves are generated, propagating outwards from the source region.**

Most tsunamis are caused by earthquakes (of the magnitude of more than 7 on the Richter Scale), with a vertical disruption of the water column generally caused by a vertical tectonic displacement of the seabed along a zone of fracture in the Earth's crust which underlies or borders the ocean floor. Tsunamis are also generated by volcanic eruptions and submarine landslides. The speed of tsunami waves depends on the depth of the water, typically varying from 500 to 1,000 kilometres per hour in the deep ocean and a few tens of kilometres per hour near shore. The time period of the tsunami wave ranges from a few minutes to an hour or even more.

The Indian Ocean tsunami (26 December 2004) was one of the strongest in the world and the deadliest of all time by an order of magnitude. The Pacific Rim countries are affected frequently by tsunamis (about 900

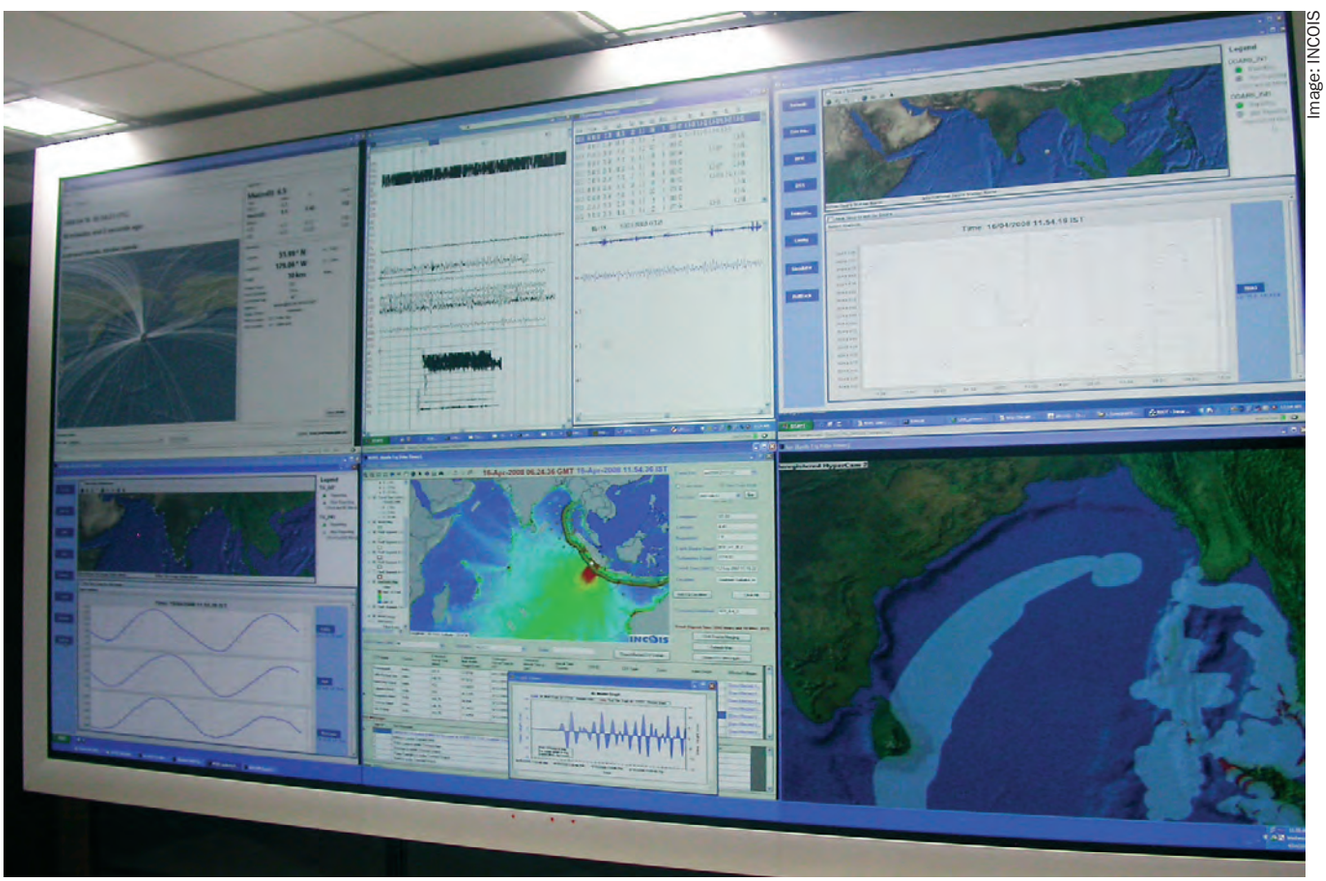



Image: INCOIS

The tsunami early warning centre at INCOIS

**Estimates from the model scenario for 12 September 2007**

| Location | Estimated Arrival Time (IST) | Estimated water level (cm) | Observed Arrival Time (IST) | Observed water level (cm) |
|---|---|---|---|---|
| Padang | 1751 | 80 | 1754 | 60 |
| Coco's Island | 1748 | 40 | 1748 | 50 |
| Sabang | 1903 | 20 | 1903 | 30 |
| TB3 | 1903 | 2 | 1913 | 1 |
| TB10A | 1931 | 1 | 1941 | 2 |
| TB10 | 1930 | 2 | 1945 | 1 |
| Port Blair | 2010 | 10 | 2013 | 8 |
| Chennai | 2105 | 20 | 2110 | 18 |
| Male | 2054 | 12 | 2058 | 13 |

Source: INCOIS

events in the 20th century) due to the high seismic activity (75 per cent of global activity) in the circum-Pacific belt. The Indian Ocean Rim countries are likely to be affected by tsunamis generated in the two known tsunamigenic zones, the Andaman-Nicobar-Sumatra island arc and the Makran subduction zone north of the Arabian Sea (about five per cent or less). These zones have been identified by considering the historical tsunamis, earthquakes, their magnitudes, location of the area relative to a fault, and tsunami modelling. In spite of the infrequent occurrence of tsunamis (about six events reported in the 20th century) in the Indian Ocean, they could occur at any time and may be very devastating. The east and west coasts of the Indian Ocean and the island regions are likely to be affected by tsunamis generated mainly by subduction zone-related earthquakes from the two potential source regions.

Identification and forecasting of tsunamis requires the detection of a tsunamigenic earthquake and its parameters, generation of model scenarios to estimate travel time and run-up height, monitoring of sea level, a decision support system, a standard operating procedure and mechanisms for timely delivery of information. India has successfully set up the first tsunami warning centre in the Indian Ocean in record time, and it has been operational from 15 October 2007.

### Components of the Indian Tsunami Warning System

*Sensor networks* — The Indian Tsunami Early Warning System comprises a real-time network of seismic stations, bottom pressure recorders (BPR) and tide gauges to detect tsunamigenic earthquakes and to monitor tsunamis. The seismic subsystem receives real-time seismic data from the national seismic network of the Indian Meteorological Department (IMD) and other international seismic networks, and is capable of detecting all earthquake events in the Indian Ocean in less than 15 minutes of occurrence. BPRs installed in the deep ocean are the key sensors to confirm the triggering of a tsunami. Four BPRs in the Bay of Bengal and two in the Arabian Sea have already been installed by the National Institute of Ocean Technology (NIOT). Thirty coastal tidal stations have been installed by the Survey of India (SOI) to monitor the progress of tsunami waves.

*Tsunami modelling* — One of the most important requirement for a tsunami warning system is to generate simulations of expected travel time (i.e. time taken by the tsunami wave to reach the particular coast) and run-up height for the tsunamigenic earthquakes. The TUNAMI-N2 model has been used for the purpose of predicting surges for different earthquake scenarios. This model uses available earthquake parameters and assumes worst slip rate. As the model takes about 40 minutes to provide output on travel time and run-up, a database of pre-scenarios has been created for the entire Indian Ocean. For operational early warning, a large spatial database (about eight terabytes) of pre-run numerical simulations has been created that can be accessed at the time of an earthquake event to generate a forecast of tsunami travel time and run-up estimates for different parts of the coastline of the Indian Ocean. The model scenarios provide information on 1,800 forecast points which are generally towns, cities and settlements as well as location of BPRs and tidal stations.

*Tsunami early warning centre* — A state-of-the-art early warning centre has been established at the Indian National Centre for Ocean Information Services (INCOIS) with the necessary computational and communication infrastructure that enables reception of real-time data from all the sensors, analysis of the data and generation and dissemination of tsunami advisories following a standard operating procedure. A host of communication methods have been employed for timely dissemination of advisories. Seismic and sea-level data are continuously monitored in the early warning centre using a custom-built software application that generates alarms/alerts whenever a preset threshold is crossed. The data is organized in a central database on a storage server and affords analysis and retrieval.

A display wall facilitates visualization of various data streaming in, pre-run model outputs and vulnerability maps. Tsunami warnings/alerts/watches are generated based on preset decision support rules and disseminated to the authorities concerned for action, following a standard operating procedure. The database is also linked to the dedicated tsunami website through which data/information/advisories are made available to users. The efficiency of the end-to-end system was proved during the large under-sea earthquake of 8.4 metres that occurred on 12 September 2007 in the Indian Ocean.

**Estimated errors for the initial estimate of earthquake parameters and run-up, 12 September 2007**

| Parameters | Performance Target | Performance Achieved |
|---|---|---|
| Elapsed time from earthquake information issuance (distant) | 15 min. | 13 min. |
| Accuracy of earthquake hypocentre location | 30 km | 20 km |
| Accuracy of earthquake hypocentre depth | 25 km | 5 km |
| Accuracy Earthquake Mw magnitude | 0.2 | 0.1 |
| Accuracy of the tsunami forecast amplitude/height | Factor of 2 | ~ 25 % |

Source: INCOIS

*Standard operating procedure at the early warning centre* — The criteria for generation of different types of advisories (warning/alert/watch) for a particular region of the coast are based on travel time. The warning criteria are based on the premise that coastal areas falling within 60 minutes travel time from a tsunamigenic earthquake source need to be warned based solely on earthquake information, since enough time will not be available for confirmation of water levels from BPRs and tide gauges.

Those coastal areas falling outside the 60 minutes travel time from a tsunamigenic earthquake source have been put under a watch status and upgraded to a warning only upon confirmation of water-level data. For example, if a tsunamigenic earthquake happens on the coast of northern Indonesia, parts of the Andaman and Nicober Islands falling within 60 minutes travel time of a tsunami wave will be put under warning status. Other areas will be put under watch status and upgraded to a warning only if the BPRs or tide gauges reveal significant change in water level. This implies that the possibility of false alarms is higher for areas close to the earthquake source; however, the issue of false alarms does not arise for other regions since the warnings are issued only after confirmation of water-level data.

To reduce the rate of false alarms even in the near source regions, alerts are generated by analysing the pre-run model scenarios, so that warnings are issued only to those coastal locations that are at risk. Within the tsunami warning areas, based on the estimated water levels and directivity maps, the coastal areas will be categorized under different risk zones, as Major Tsunami, Medium Tsunami and Minor Tsunami.

*Vulnerability maps* — Tsunamis and cyclonic storms result in generation of waves of different period and height that are termed 'surges'. These wave parameters depend on earthquake source parameters, (in the case of tsunami), bathymetry, beach profile, coastal land topography and presence of coastal structures. These surges cause flooding of seawater into the land as much as one kilometre or more, resulting in loss of human life and damage to property. To minimize such losses, it is imperative to prepare coastal vulnerability maps indicating the areas likely to be affected due to flooding and rending damage.

The TUNAMI-N2 model has been used for the purpose of predicting surges for different scenarios of earthquakes and to indicate the extent of inundation of seawater into the land. This information has been used for taking precautionary and mitigation measures such as the evacuation of people, avoiding human settlements and large investment, and designing appropriate structures in risk-prone areas. Information from remote sensing and field investigations is being integrated into GIS for modelling and mapping of inundation of seawater for determination of setback lines, planning coastal defences, and so on.

**Case study: 12 September 2007**

INCOIS generated a database of model scenarios considering various earthquake parameters. The pre-run scenario for the 12 September 2007 event was used to calculate the estimated travel time and run-up heights at various coastal locations and water level sensors (tide gauges and BPRs). The directivity map generated from the selected scenarios showed that the south-east and south-west Indian coast was likely to be affected by a minor tsunami (~20cm), as were the Andaman and Nicober Islands (~10cm) which is evident from the observations of tidal stations at Chennai and Portblair.

The estimates from the model scenario matched well with the observations from BPRs and tidal stations. The end-to-end system performed extremely well enabling reception, display and analysis of the real-time and model data sets as well as generation and dissemination of timely and accurate advisories following the standard operating procedure. An estimate of the errors for the initial estimate of earthquake parameters and the run-up was used to provide necessary advisories to the authorities concerned, thus avoiding unnecessary public evacuation for this event.

**Contribution to the Indian Ocean region**

The Indian tsunami early warning centre is equipped with world-class computational, communication and technical support facilities and is considered the most modern tsunami warning centre in the world at the time of writing. The instrumentation of the Indian system is established in such a way that it is capable of detecting tsunamis originating from both known tsunamigenic sources in the Indian Ocean. It has robust application software based on geospatial technologies to generate and disseminate timely tsunami advisories to the Indian Ocean countries. INCOIS has also set up the warning centre infrastructure so as to have the capabilities of a regional tsunami watch provider. India has begun providing regional tsunami watch services from its national system for the Indian Ocean region. At present, it provides earthquake source information to give potential tsunami threat and travel times. Shortly, earthquake parameters, travel time, run-up height and potential threat zones will be provided. The warning centre can also support the generation of inundation maps and risk and hazard assessments.

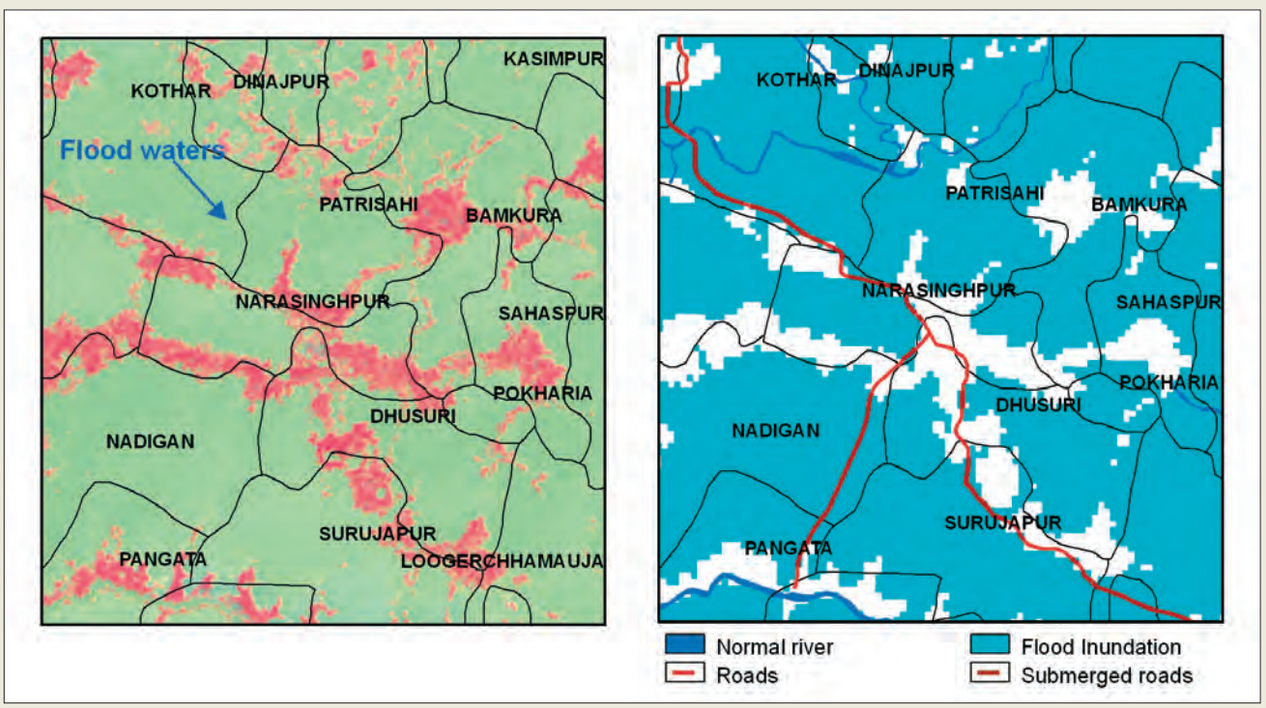
# Decision support for disaster risk reduction in India: remote sensing and GIS-based operational approach

*P.S. Roy, C.S. Murthy, P. Manjusree and M.S.R. Murthy, Remote Sensing and GIS Applications Area, National Remote Sensing Agency, India*

**The global risks due to disasters seem to be increasing. Billions of people living in more than 100 countries are periodically exposed to at least one natural disaster, causing more than 184 deaths per day.[1] Diverse geo-climatic conditions, increasing population and its expansion to vulnerable areas, unplanned urbanization, inadequate carrying capacity of river systems, poor drainage characteristics, uncertain monsoon conditions and large areas of dry deciduous forests all contribute to make India one of the world's most disaster-prone countries.**

The recurring impacts of these disasters on human life, agriculture, livestock and the environment triggered the momentum for adopting disaster risk reduction strategies in a holistic manner. There has been a paradigm shift in the disaster management approach in recent years, from relief/crisis-centricity to a focus on prevention, mitigation and preparedness. Recognizing the importance of disaster management as a national priority, in 1999 the Government of India set up a

**An example of near real-time flood mapping - part of Bhadrak district, Orissa state**




Left: IRS-P6 LISS-III FCC 08-July-2007; Right: Flood Map showing submerged villages

Source: Annual flood report, 2007, NRSA, India

high-powered committee — as well as a national committee after the Gujarat earthquake in 2002 — for making recommendations on effective management of disasters in the country.

In December 2005 the Government enacted a Disaster Management Act, which envisaged the creation of the National Disaster Management Authority (NDMA) and the State Disaster Management Authorities to develop and implement holistic approaches for disaster management. The NDMA is responsible for evolving policies, plans and guidelines for disaster management, as well as coordinating the enforcement and implementation of said policies. There are a number of organizations in the country such as the Indian Space Research Organization (ISRO), the India Meteorological Department, the Geological Survey of India and the National Geophysical Research Institute, which are closely associated with the NDMA and regularly contribute to disaster management activity in a significant way.

Having more than two decades' experience in the application of remote sensing technology for operational disaster monitoring and risk assessment, the Indian Government's Department of Space (DOS) has embarked upon the Disaster Management Support Programme (DMSP), to take the benefits of aerospace technology and apply them to disaster risk reduction in the country.

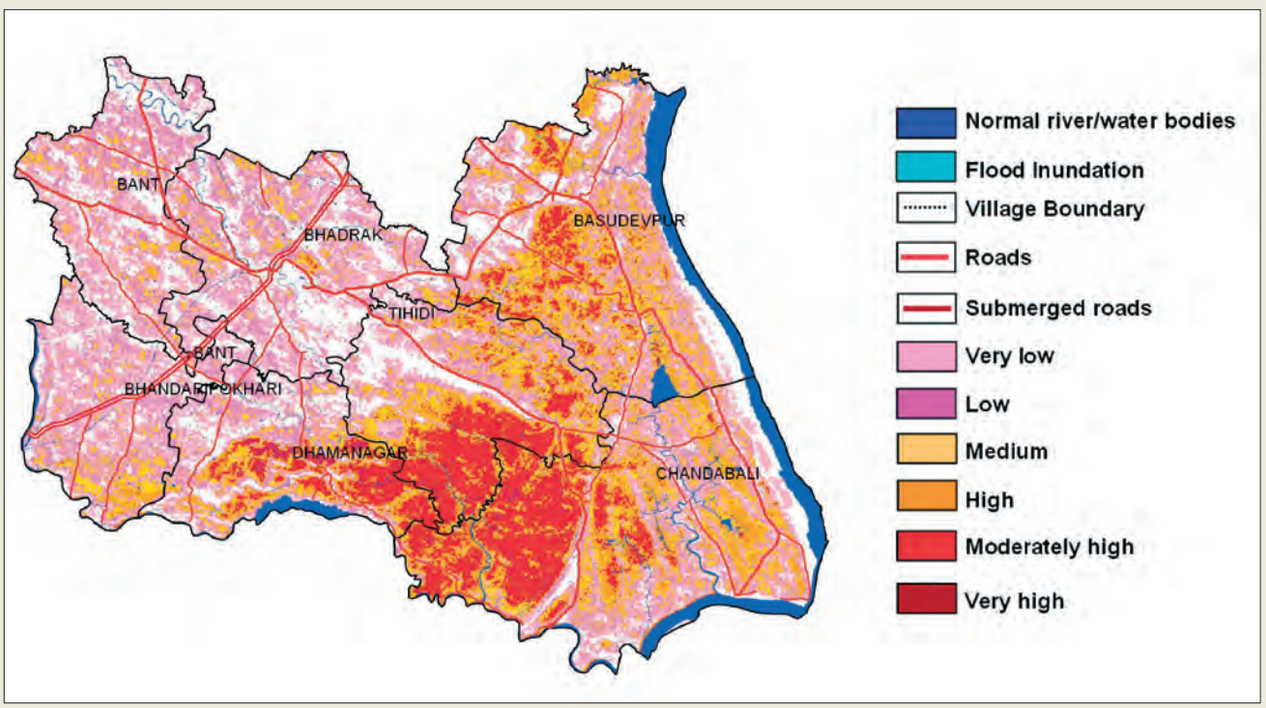
The Decision Support Centre (DSC) has also been established at National Remote Sensing Agency (NRSA) to serve as a single-window delivery point for disseminating value-added information on five types of natural disaster. The DSC keeps a constant watch on the prevailing disasters in the country by gathering information from different sources. Analysis of space/airborne images, integration with ground data, generation of user-friendly information products, timely dissemination of information and constant interaction with decision makers are just some of the priority tasks of the DSC. Furthermore, the DSC also provides support to the International Charter on Space and Major Disasters.

### Floods and cyclones

Since a flood is a dynamic disaster, monitoring them and the timely dissemination of flood information plays a crucial role in the management task. During monsoon season, floods and cyclones are continuously monitored and mapped in near-real time through aerial and satellite data.[2] All weather space images from microwave sensors are also of immense help to map flood events.[3] Using hydro-meteorological data, a constant watch is kept on the flood/cyclone situation in the country. Accordingly, optical and microwave synthetic aperture radar (SAR) data is planned and acquired from Indian and foreign satellite missions respectively. Currently, images from Resourcesat 1, Radarsat and are being used extensively. Indigenously developed SAR instruments mounted on an aircraft can also be flown over the affected areas, depending on the requirement.

Automated procedures have been developed to delineate flood inundation layers from satellite images. Flood maps are composed at various scales from 1:500,000 to 1:25,000 showing administrative boundaries, settlements, roads and rails and the extent of inundation.

**Flood hazard zonation map**




Map showing the flood hazards for the Bhadrak district, Orissa state

Source: Flood reports of NRSA, India

Flood damage statistics — such as the length of rail, roads, or extent of crop area under submergence — are also transmitted to the decision makers. The spatial inundation map, along with estimates on submergence, is generated within eight to ten hours of receiving satellite data and disseminated to the Ministry of Home Affairs, the Central Water Commission and State Relief Commissioners through electronic means for further use in relief and rescue operations. There is also a systematic feedback mechanism, through which decision makers are able to interact with the DSC to get the required value addition to the information.

Through the analysis of historic satellite images, a flood frequency map is prepared showing the frequency of flooding and the extent of inundation. Based on these maps, flood hazard zones are delineated and updated under each river system. Flood hazard zones indicate vulnerability and risk, and hence are useful in evolving long-term structural and management measures for risk reduction. The information on river configuration changes, riverbank erosion/deposition, and the status of flood control structures is generated periodically using multi-temporal and multi-resolution satellite data.[4] This information plays a vital role in designing structural flood mitigation measures.

Timely dissemination of information to user departments is achieved through a dedicated satellite-based communication network. This network operates on an extended C-band onboard INSAT system and has facilities like video conferencing, voice over Internet protocol and large-volume data transfer. It is connected with state disaster emergency operation centres and key government offices across the country that are engaged in disaster management and knowledge institutions.

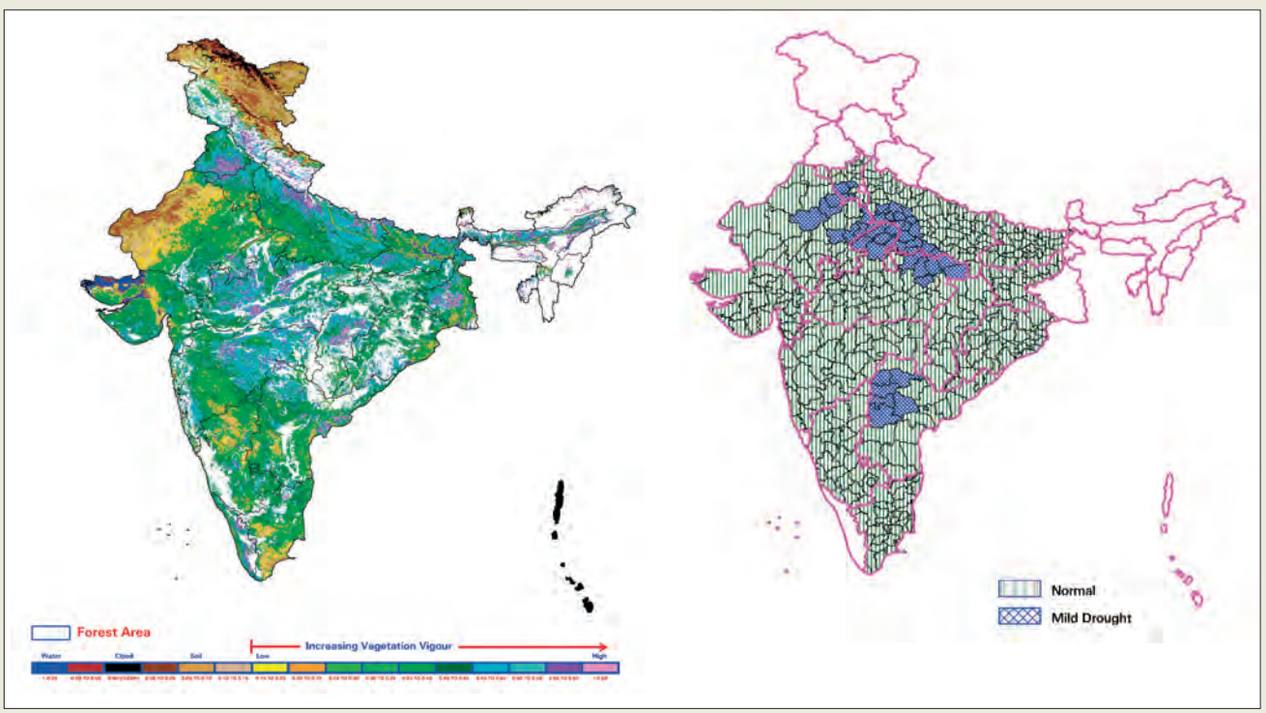
There are also plans to generate finer resolution digital elevation maps from Airborne Laser Terrain Mapper (ALTM) instruments, which are useful for accurately assessing the depth of flooding — a crucial input for flood risk assessment. The proposed launch of state-of-the-art indigenous microwave satellite RISAT, in the year 2009, will further boost the use of space images for disaster management.

### Agricultural drought

Agricultural drought assessment using space technology has been operational in India since 1989 through the project National Agricultural Drought Assessment and Monitoring System (NADAMS). NADAMS provides near-real-time information on prevalence, severity level and persistence of agricultural drought at state/district/sub-district level. Currently, the project covers 13 states of India. Coarse resolution data from AVHRR is being used for drought assessment at regional and district level. Moderate resolution data from Advanced Wide Field Sensor (AWiFS) and Wide Field Sensor (WiFS) from Indian remote sensing satellites is used for detailed assessment of agricultural drought at sub-district level in four states.[5]

The satellite-derived Normalized Difference Vegetation Index (NDVI) and other biophysical parameters are integrated with ground data on soils, irrigation, rainfall and crop areas for assessing the agricultural drought situation. During June to August,

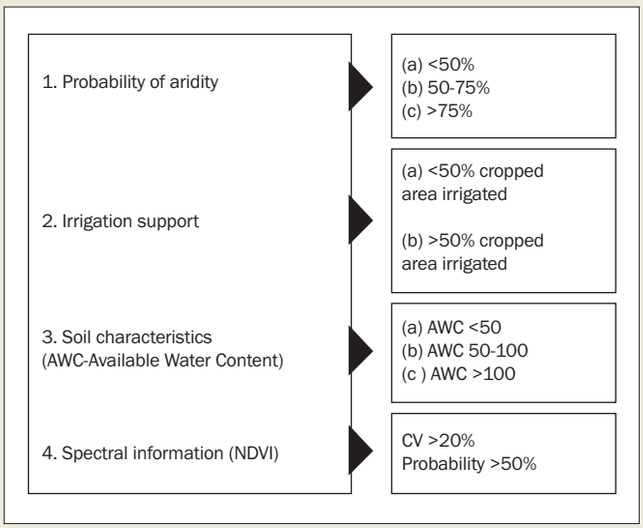
**Agricultural drought assessment**




Left: NOAA AVHRR NDVI September 2007; Right: Drought intensity

Source: NADAMS drought reports of 2007, NRSA, India

**Identification of drought proneness**




Multi-criteria approach for delineation of drought prone blocks

Source: Murthy, C.S., Sesha Sai, M.V.R., Dwivedi, R.S., Roy, P.S., Rao, G.G.S.N. and Rama Krishna, Y.S., 2008, An integrated approach for characterization and delineation of drought prone areas, Proc. International Symposium on Agromet and Food Security, Hyderabad, India.

drought warning information is issued in terms of 'Watch, Alert and Normal' categories. The 'Alert' warning calls for immediate external intervention, in terms of crop contingency plans. During September and October, drought declaration is done in terms of 'Mild, Moderate and Severe' drought. Monthly/fortnightly drought reports are disseminated to the decision makers in drought management during the monsoon season (June to November), by electronic and traditional mail. The feedback received from the user community on drought reports is encouraging. The drought information is being used by the Indian Government's Ministry of Agriculture and by state agriculture and relief departments in agricultural situation review meetings, as well as for the development of relief management measures.

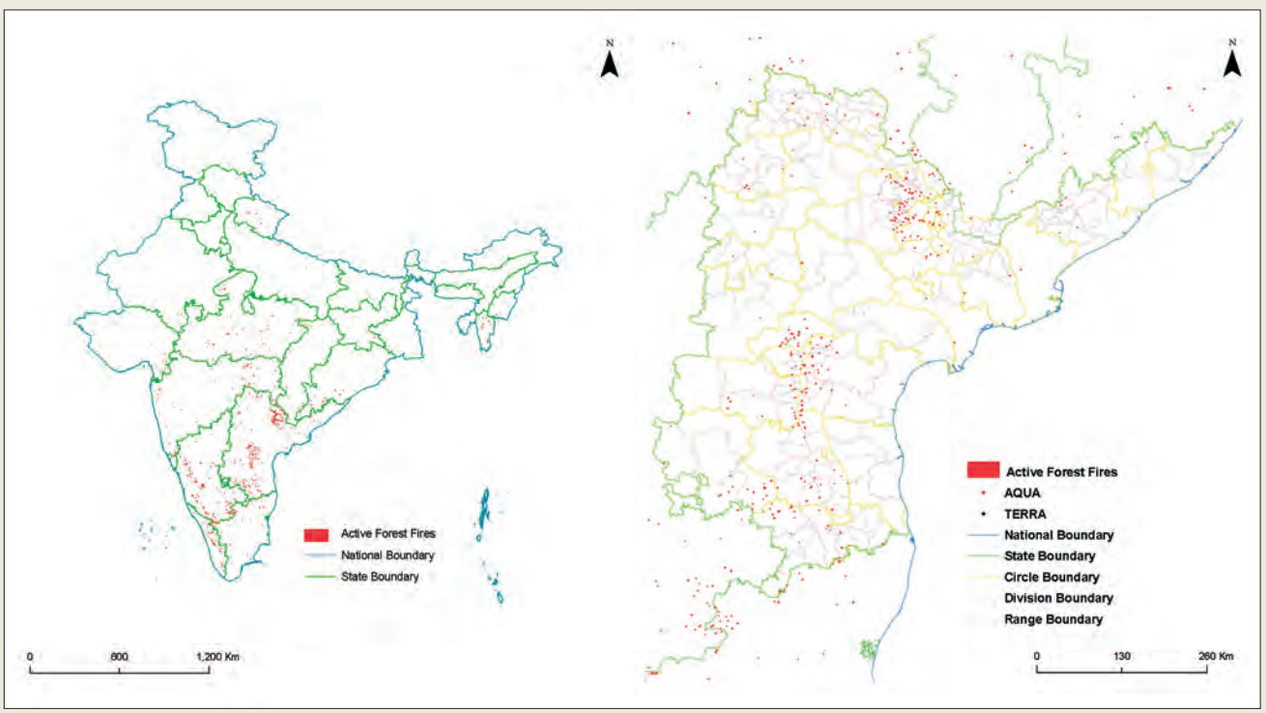
Time series data on agricultural area NDVI, aridity, rainfall, irrigation support, cropping pattern and soils is integrated in a spatial information system to define the criteria and limits for assessing drought proneness. Prepared based on multiple criteria, the drought vulnerability status of the district is useful in developing long-term drought management measures with locale-specific action plans.

The establishment of automatic weather stations, soil moisture estimation, quantitative assessment of drought impact and drought early warnings are just some of the research initiatives that can strengthen drought risk assessment capabilities.

## Forest fire

In the context of India, a conventional fire control system is limited in terms of area under coverage, due

**Daily fire alert products (daytime data)**




Left: All India level; Right: State level value added product

Source: Perspectives of Geoinformatics in forest fire management, 2006, Technical Report of NRSA, India

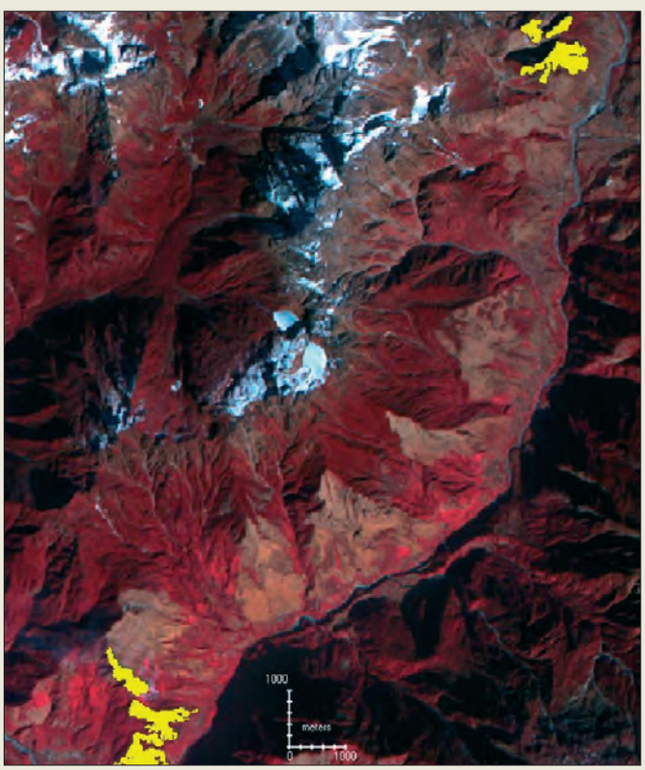
to the vastness of forested regions and the inaccessibility of fire affected areas. Besides, remote sensing data — with its multi-sensor, multi-temporal and synoptic potential — in conjunction with the Geographic Information System (GIS) and ground data is one of the most powerful mechanisms in the development of fire management tools. By relating actual fire patterns, a better understanding of fire ecology can guide management decisions that facilitate the restoration and conservation of fire-prone ecosystems in the Indian region.

Because of the need to develop a national database of spatial information on forest fires, the Indian Forest Fire Response and Assessment System (INFFRAS) was established under the DSC, as part of the Disaster Management Support Programme, to facilitate forest fire monitoring and management.[6] As part of INFFRAS, multi-resolution, multi-temporal and multi-spectral satellite, remote sensing data-based inputs are utilised in:

- Identification of daily active fire locations using MODIS and DMSP-OLS satellite data and dissemination of active fire location information to the concerned state forest departments[7]
- Forest fire burnt area assessment
- Fire burnt area progression monitoring
- Ecological damage assessment due to forest fires.

Daily fire alerts are disseminated through e-mail and a website. Based on specific requirements, value-added products in terms of vegetation type, forest management boundaries, settlements and roads, overlays are also provided to the user departments. Damage assessment in terms of burnt area is also taken up for critical areas based on the daily fire alerts. Furthermore, studies are in progress to develop a National Fire Danger Index, as well as an ecological damage assessment system designed to facilitate effective fire management. Efforts are also underway to develop spatial decision support systems for web-enabled decision making, in order to improve turn-around time and spatially explicit planning.

**Forest burnt area mapping**




Fire Burnt Area (yellow patches) Assessment for Chungthang District, Sikkim

Source: Perspectives of Geoinformatics in forest fire management, 2006, Technical Report of NRSA, India

### National Database for Emergency Management

A recent initiative called the National Database for Emergency Management (NDEM) aims to develop an organized database at different scales related to various themes on natural and man-made disasters. The NDEM serves as a national repository of geospatial databases for emergency/disaster management, as well as to assist stakeholders at various levels in hazard/risk zonation, damage assessment, preparedness and emergency response. The emergency trends, demographic patterns, economic profiles, infrastructure status, communication networks and public utilities will be analysed and shared in coupling disaster reduction and economic development, especially in vulnerable areas. NDEM will also be crucial in the development of well-connected early warning systems enabling knowledge warehouses, developing spatial decision support systems for disasters, and catalysing the process of preparedness, response and mitigation.

### Looking forward

The remote sensing and GIS community in India is closely associated with the NDMA, an apex body for disaster management in the country seriously engaged in utilizing the benefits of aerospace technology in reducing risk and hardship. Data from various satellite sensor systems and aerial sensors is continuously analysed to generate disaster-related information. Integration of multiple data sets in a GIS environment is being done for objective assessment of the prevalence and progress of disasters — flood, drought and forest fires — at different spatial and temporal dimensions. The near-real-time, objective information on the intensity of disasters that is disseminated to decision makers through an exclusive communication network is of immense help when evolving risk reduction strategies. Disaster vulnerability maps generated using a multi-criteria approach are useful when developing long-term management strategies.

New initiatives utilizing technology such as airborne laser terrain mapping to generate finer elevation data for flood depth assessment, the establishment of automatic weather stations and the quantitative assessment of disaster impact further strengthen risk assessment capabilities. The proposed launch of the state-of-the-art indigenous microwave satellite RISAT in the year 2009 would further augment the use of space images for disaster management.

# Sentinel Asia — the next step

*Kazuya Kaku, Japan Aerospace Exploration Agency*

**The Sentinel Asia (SA) initiative is a collaboration between space agencies and disaster management agencies, applying remote sensing and Web-GIS technologies to assist disaster management in the Asia-Pacific region. It aims to:**

- Improve safety in society by ICT and space technology
- Improve speed and accuracy of disaster preparedness and early warning
- Minimize the number of victims and social/economic losses.

SA is a voluntary initiative led by the Asia-Pacific Regional Space Agency Forum (APRSAF) to share disaster information in near-real time across the Asia-Pacific region, using primarily the Digital Asia (Web-GIS) platform. Its architecture is designed to operate initially as an Internet-based, node-distributed information distribution backbone, eventually distributing relevant satellite and in situ spatial information on multiple hazards in the Asia-Pacific region.

A step-by-step approach for implementation of this dissemination system was adopted as follows:

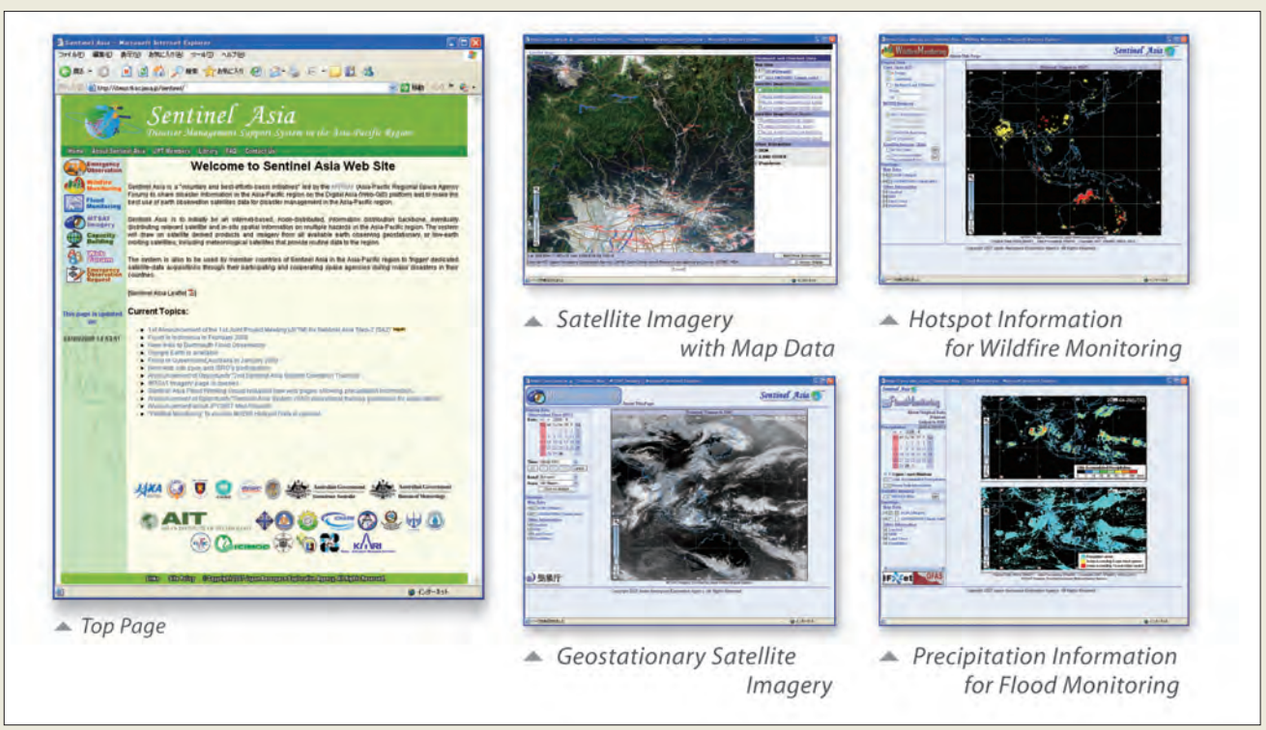
Step 1 — Implementation of the backbone Sentinel Asia data dissemination system as a pilot project, to showcase the value and impact of the technology using standard Internet dissemination systems (2006-2007)

Step 2 — Expansion of the dissemination backbone with new satellite communication systems (2008-2012)

Step 3 — Establishment of a comprehensive disaster management support system (2013 onwards).

SA Step 1 has achieved its overall goals. The Sentinel Asia website has operated since October 2006. It has served as a good demonstrator project, to share disaster-related information obtained by several Earth observation satellites such as Advanced Land Observing Satellite (ALOS), Indian Remote Sensing satellites (IRS), Multi-functional Transport Satellite 1R (MTSAT-1R), Terra and Aqua. It also demonstrates recent advances in web-mapping technologies and ICT systems.

**Sentinel Asia website**




Sentinel Asia provides disaster-related information such as satellite imagery and satellite data products through its website

Source: http://dmss.tksc.jaxa.jp/sentinel

SA Step 2 has recently been initiated with the following principles and objectives:

- A contribution from the space community (APRSAF) to disaster management in the Asia-Pacific region
- To promote utilization of disaster-related information obtained by space and remote sensing technology in order to mitigate and prevent damage caused by natural disasters
- To strengthen and succeed Step 1, considering the findings and achievements of Step 1 and users' needs
- A voluntary initiative through the new Joint Project Team.

**Background**

According to statistics, the Asia region has been seriously damaged by natural disasters over the last 30 years.[1] This is compounded by its high levels of population (close to 3 billion). Disasters occurring in Asia comprise 37 per cent of the worldwide total, whereas the region has 57 per cent of the global fatalities and 89 per cent of the total victims associated with such disasters.

In view of these circumstances, APRSAF proposed Sentinel Asia in 2005, to showcase the value and impact of Earth observation technologies, combined with near-real-time Internet dissemination methods and Web-GIS mapping tools for disaster management support in the Asia-Pacific region. APRSAF was established in 1993, in response to the declaration adopted by the Asia-Pacific International Space Year Conference (APIC) in 1992, to enhance the development of each country's space programme and to exchange views toward future cooperation in space activities in the Asia-Pacific region. It was originally designed to provide opportunities for regional space agencies and associated governmental bodies to exchange technical views, opinions and information on national space programmes and space resources.

**Framework**

Sentinel Asia is promoted with cooperation amongst the space community (APRSAF), the international community (UN ESCAP, UN OOSA, ASEAN, Asian Institute of Technology etc), the disaster reduction community (Asian Disaster Reduction Center (ADRC) and its member countries), and the Digital Asia community (Keio University etc).

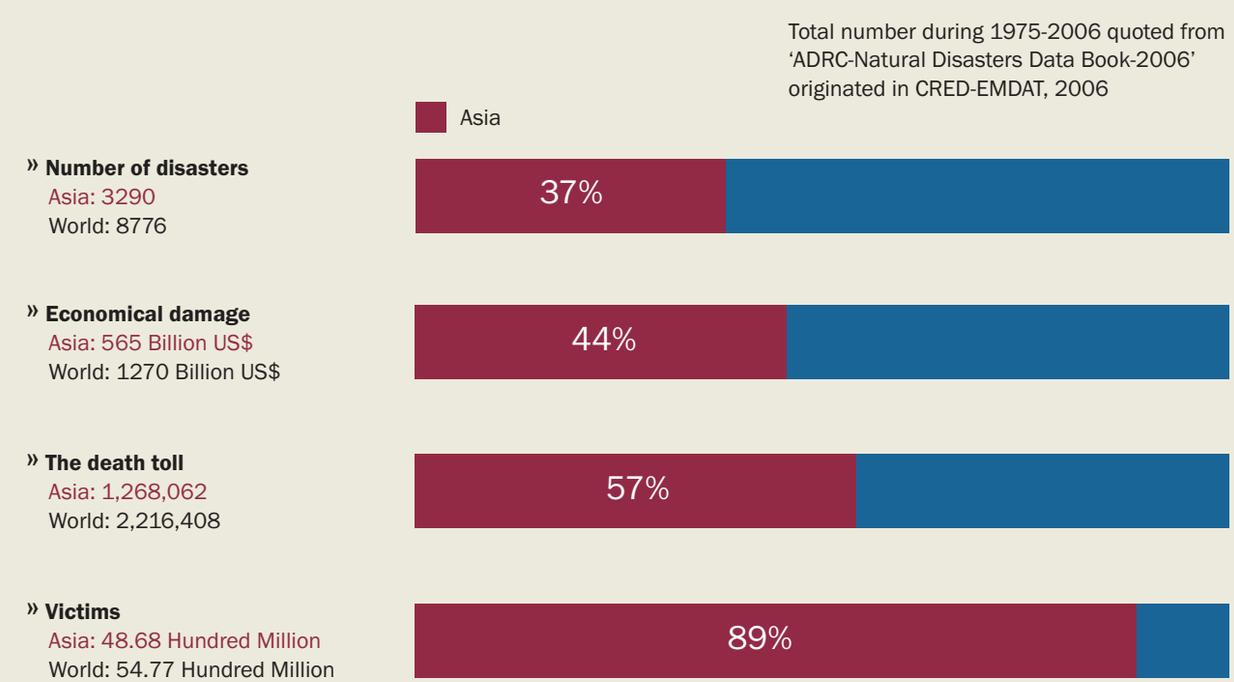
To support the implementation of the SA project, a Joint Project Team (JPT) was organized. Membership of the JPT is open to all the APRSAF member countries, disaster prevention organizations and regional/international organizations that are prepared to contribute their experience and technical capabilities, and that wish to participate in technical aspects of disaster information sharing activities.

**Activities**

Sentinel Asia has two main responsibilities:

1. Providing disaster-related information in the Asia-Pacific region, such as satellite imagery and satellite data products through the website
2. Capacity building to develop human resources and a human network to utilize the information provided by the website.

**Natural disaster damages in Asia, 1975-2006**




Source: CRED-EMDAT, 2006

The main activities of Sentinel Asia are as follows:

- Emergency observation in case of major disasters by Earth observation satellites via observation requests of JPT and ADRC members
- Wildfire monitoring and flood monitoring
- Capacity building for utilization of satellite images for disaster management.

SA Step 1 operations have been running since October 2006 with the opening of its website.[2] JPT consists of 51 organizations from 20 countries and eight international organizations at the time of writing. The Japan Aerospace Exploration Agency (JAXA) is a secretariat of the JPT.

Currently, a website dedicated to SA is open to the public providing the following content:

- Recent disasters and emergency observation
- Hotspots data for wildfire monitoring
- Accumulated precipitation data for flood monitoring in cooperation with the Global Flood Alert System (GFAS)
- MTSAT imagery in cooperation with Japan Meteorological Agency (JMA)
- Capacity building.

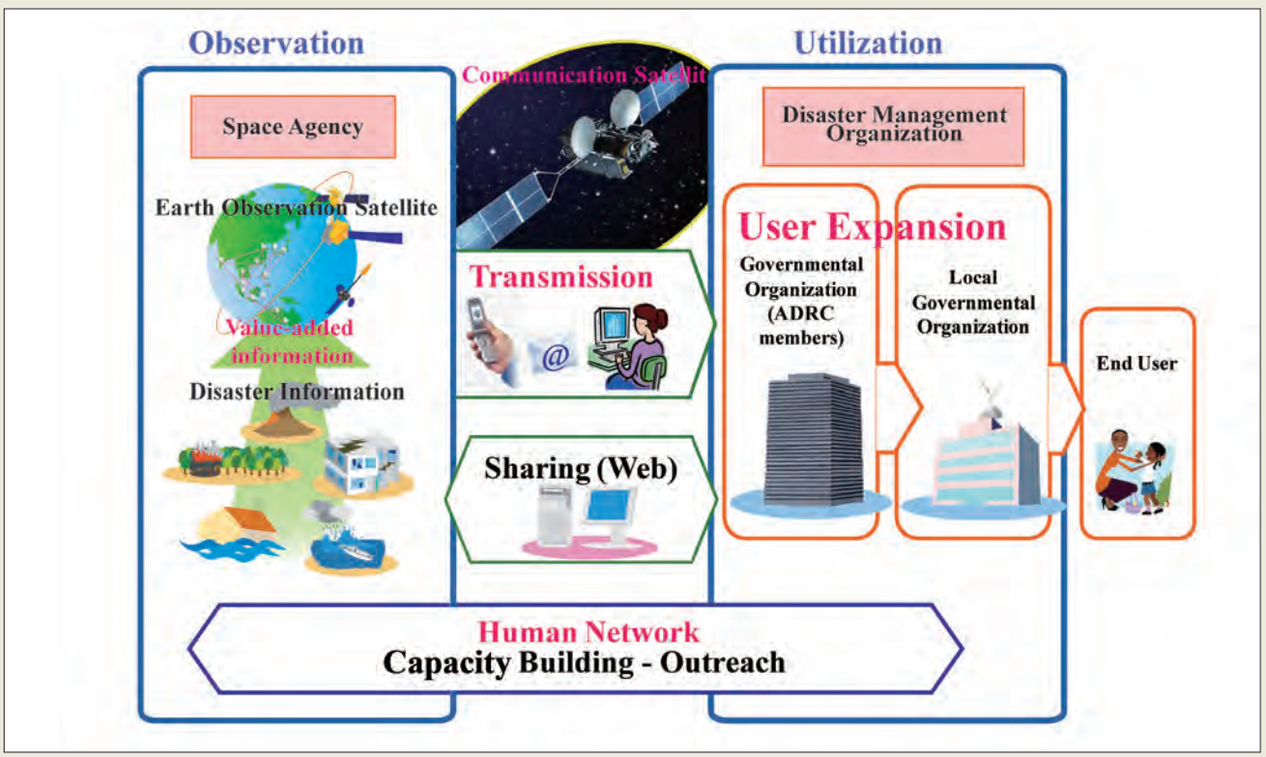
JAXA's ALOS satellite and the IRS satellite of the Indian Space Research Organization (ISRO) have carried out emergency observations in the case of major disasters in the Asia-Pacific region.

Wildfire is a major and recurring phenomenon that has a serious impact on property and human health, affecting many countries in the region. Compared to other disasters in the area, it does not necessarily cause many immediate fatalities. However, it causes serious impact on property and human health due to smoke. Responding to requirements from Asian countries, wildfire monitoring has been chosen as one of SA's activities. Having accurate information on the location and intensity of the fires, and subsequent control of wildfire, are therefore very important and urgent tasks across the region. SA primarily addresses the issue of near-real-time information distribution on wildfires in the region. Furthermore, its effects are of great relevance both at a regional and global level, and accordingly bear substantial influence on global warming.

Flood is also a major and recurring phenomenon affecting many countries in the Asia-Pacific region, and flood monitoring has been chosen as one of SA's activities. At the moment, SA is providing accumulated precipitation data from GFAS, MTSAT imagery on Web-GIS and inundated area information observed by satellite.

A good human network has been constructed between the space and disaster reduction communities since operations began in October 2006. At the same time, some difficulties have appeared which need greater attention and more work to resolve, such as narrowband areas in Asia, where it is very hard to see information via the Internet.

**Sentinel Asia Step 2 aims to broaden the reach of Step 1**




The point of SA Step 2 is shown in red: to make value-added information from satellite imagery, to transmit the information to users using communication satellites in addition to information-sharing by Internet in Step 1, and to expand users. Finally, these activities are supported by a human network

Source: Kazuya Kaku

Image: JAXA

The first Joint Project Team Meeting for SA Step 2 was held in Kobe, Japan on 5-6 June 2008 with participants from 18 Asian countries and severn international organizations, which initiated the SA Step 2 project

**Sentinel Asia Step 2**

At APRSAF-14 held in Bangalore, India in November 2007, the following recommendations on SA were adopted:

1. A declaration that the efforts of the current JPT have led to the successful completion of the Sentinel Asia pilot project. This pilot project has successfully shared disaster-related information obtained by several Earth observation satellites, especially those of JAXA and ISRO, along with training and technical support.

2. A declaration of the launch of the next phase of Sentinel Asia, running from 2008 to 2012, with the goal of expanding utilization of disaster-related information, including environmental changes together with its member countries and international organizations. Increasing the number of Earth observation satellites from the Korea Aerospace Research Institute (KARI), the Geo-Informatics and Space Technology Development Agency (GISTDA) of Thailand, and some other entities, as well as satellite communication.

3. An agreement to establish the new JPT for implementation of the second phase of Sentinel Asia early next year, where JAXA will serve as a secretariat.

In response to the APRSAF-14 recommendation, the new JPT meeting was held in Kobe, Japan in June 2008, and the Sentinel Asia Step 2 project was initiated.

The main objectives of 'Sentinel Asia Step 2' are as follows:

*Participation of various satellites* — In addition to Step 1's Earth observation satellites such as ALOS (JAXA), MTSAT-1R (JMA) and IRS (ISRO), new Earth observation satellites such as the Korean Multipurpose Satellite (KOMPSAT, KARI), Thai Earth Observation System (THEOS, GISTDA), and communications satellites such as the Wideband Internetworking Engineering Test and Demonstration Satellite (WINDS, JAXA) are expected to join.

*Improvement of accessibility to information* — In addition to data sharing via the Internet in Step 1, information transmission to facilitate access to disaster-related information through various means including demonstration of the use of new-generation communication satellites will be introduced.

*Value-added data* — A new framework of satellite data analysis is organized to provide analysed images and easily comprehensible interpretations from images. AIT, ADRC, the Center for Remote Imaging, Sensing and Processing (CRISP, National University of Singapore), the National Institute of Aeronautics and Space (LAPAN, Indonesia), and the Ministry of Natural Resources and Environment (MONRE, Vietnam), among others, are expected to join the framework.

*Expansion of disaster scope* — SA is expected to contribute to the mitigation of global warming through strengthening its contribution to wildfire management, which has a substantial influence on global warming.

*User expansion* — A planned expansion of the user-base to include local disaster authorities in cooperation with organizations such as UN ESCAP.

*Enrichment of outreach and capacity building* — A new framework to promote outreach and capacity building will be organized. JAXA, ISRO, AIT and ADRC are expected to be among the organizations that join the framework.

**Beyond Sentinel Asia**

We propose a new grand concept: 'Sentinel Earth' — a kind of universal expansion from existing initiatives — beyond Sentinel Asia. Using all present space-based disaster management initiatives as a component of Sentinel Earth, we will be able not only to cooperate and create synergy among existing initiatives, but also to initiate new activities for areas not covered by them.

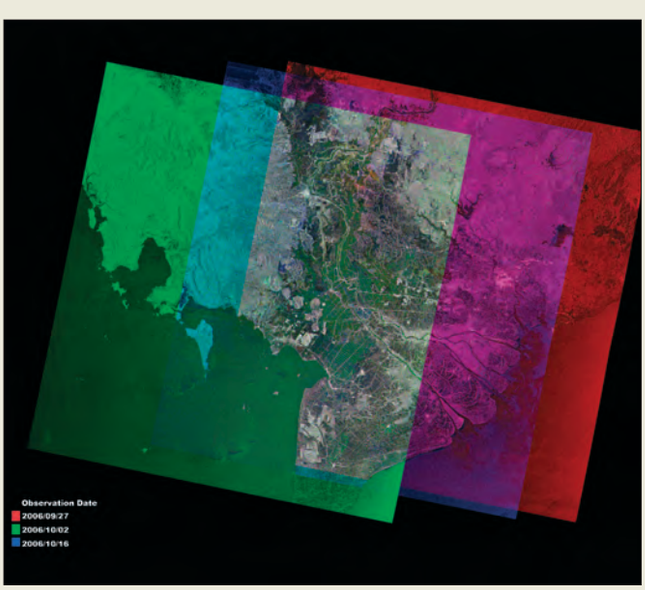
# An approach to disaster management from space

*Ryo-ichi Furuta, Tsutomu Yamanokuchi, Riiko Ueno, Nobuhiro Tomiyama, Tamotsu Igarashi, and Yukio Haruyama, Remote Sensing Technology Center of Japan*

**The technology of satellite remote sensing has the capacity to monitor natural disasters as well as other objectives with the advantages of wide-area and frequent observation capability, a multi-sensor utilization environment, economic efficiency, and objectivity. The Remote Sensing Technology Center of Japan (RESTEC) is providing technology for the operation of Earth observation satellites, Earth observation data distribution and applications, and training for the utilization of Earth observation data. Currently, the Japan Aerospace Exploration Agency (JAXA) has been operating the Advanced Land Observing Satellite (ALOS) which is the latest Japanese Earth observation satellite launched in early 2006. RESTEC supports this operation under the agreement of JAXA.**

The mission objectives of ALOS are cartography, disaster monitoring, regional observation, natural resource monitoring and technology development for future satellites. Disaster monitoring is currently drawing attention as an important mission. RESTEC has been applying the ALOS data to monitor all kinds of natural disasters, as well as supporting system development for disaster prevention and mitigation in the Asian and Andean region. We have also held training courses for remote sensing data users, on a variety of applications including disaster management. In this paper, we present the latest RESTEC activities and discuss the effective utilization of Earth observation data to disaster management.

**Colour composite image of ALOS PALSAR ScanSAR**




Greenery area at the centre of image shows flooded area from 27 September 2006 to 16 October 2006

Source: Remote Sensing Technology Center of Japan

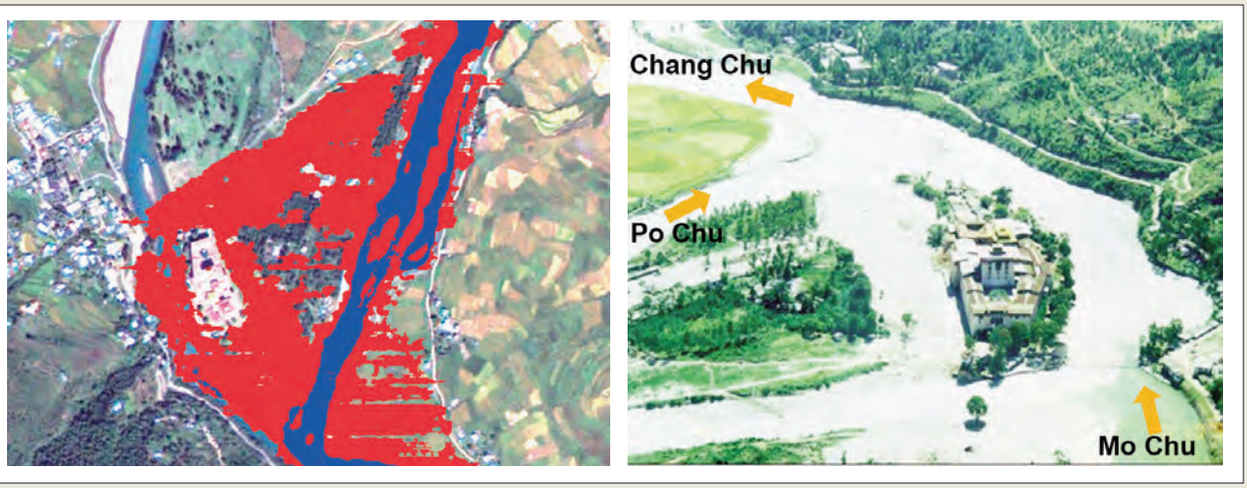
## Example of flood risk management for the Mekong delta

In the Mekong delta, a large river delta in Vietnam, flood disasters occur regularly every year. For the mitigation and reduction of flood disasters, it is important to manage the river basin. As a tool for river basin monitoring, remote sensing data is effective from a wide area monitoring capacity. The utilization of ScanSAR mode (an observation mode of SAR) is the best solution to monitor a wide river basin in the Southeast Asian region for three reasons.

First, SAR has the capacity to observe Earth's surface under all weather conditions. In Southeast Asia cloud cover ratio is usually high. Vietnam is an example. Unfortunately, under the bad weather conditions optical sensors cannot observe the earth's surface. Second, ScanSAR mode is a wide area observation mode and its observation swath width is normally 100-400 kilometres. Therefore, it is possible to cover almost every area of interest within one observation timing. Third, it is possible to observe the target area more frequently than the normal observation mode without the pointing function. To reduce the effects of disasters, frequent observation is important. Many Earth observation Satellites adopt the 10-50 days revisit orbit. In the case of ALOS, a 46 days revisit orbit was adopted. However, utilizing the ScanSAR mode of PALSAR, it can observe almost the same area every five days.

The included figure shows a colour composite image that is made up from three images at different observation dates. Data was acquired on 27 September 2006, 2 October 2006, and 16 October 2006 by ALOS PALSAR ScanSAR mode. The green colour area at the centre of the image shows that the flooded area was detected from the change of surface backscattering. We confirmed that the detected area corresponded to the historical inundation area. The result was drawn using a simple analysis but we can quickly pass flood disaster information to the end user. In a practical test, we sent the image of the flooded area through

**Estimated GLOF damaged area**




Left: The simulated GLOF area. Red painted area shows the simulated GLOF damaged area using ALOS/PRISM DSM data; Right: The actual photo of the damaged area acquired on 10 October 1994

Source: Remote Sensing Technology Center of Japan; Photo: Phuntso Norbu

facsimile, and the estimated water level through the short message service (SMS) of a cell phone. The information passed from Japan to collaborators in Vietnam, and the practical test was successful.

**Feasibility study of GLOF using ALOS data**

Recent global environmental change might have a relationship with the retreat and melting of alpine glaciers. The Himalaya is the highest mountainous region in the world and there are many glaciers and glacial lakes. In recent years, many studies have reported the retreat of these glaciers and the expansion of glacial lakes. Several disasters have happened due to flooding by melt water from glacial lakes, termed a Glacier Lake Outburst Flood (GLOF). Therefore, it is necessary to investigate the potential danger of each glacial lake for the prediction and mitigation of GLOF. Satellite data is one of the promising methods of solving the above problem.

Bhutan is a small Tantric Buddhist country at the southeastern side of the Himalaya. Its population is around 600,000 and almost all people live in a natural Himalayan environment. The Po Chu River has its source in the Himalayan mountains and flows down to Punakha and Wangdue Phodrang, an ancient and honourable city in Bhutan. In 1994, a serious GLOF event hit this river basin and 21 human lives were lost.

We introduce here the application of ALOS data for the estimation of a GLOF flooded area, using a PRISM Digital Surface Model (DSM) generated from a triplet image. It is known from our field survey results that the flooding height caused by the 1994 GLOF reached approximately 1.8 metres above the river surface at Chang Chu River basin. We simulated the GLOF damaged area using PRISM DSM and evaluated the result in comparison with photos acquired at that time. The analysis method is to first extract river water by supervised classification. Then, the area with a topography two metres higher than the river water surface on DSM was considered a damaged area by GLOF and was masked.

An enclosed figure shows the result of this analysis and actual photos taken just after the GLOF around Punakha Dzong. The function of Dzong is a castle and governmental office. Our analysis results almost perfectly coincided with the actual photo. The northern part of Punakha Dzong was an old riverbed and low topographic area. DSM by PRISM data can clearly detect this area.

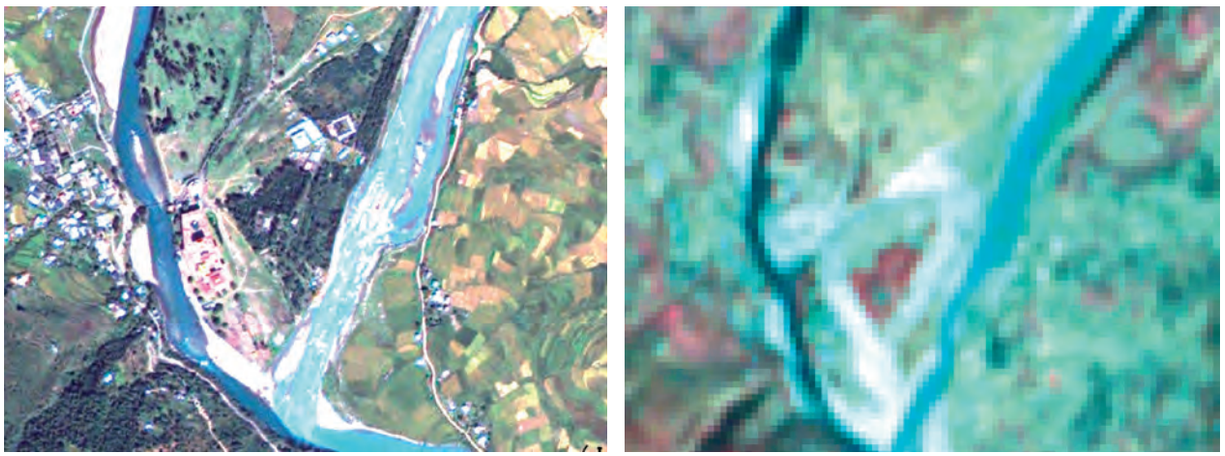
It is difficult to perceive this low topographic area from the pan-sharpened image of ALOS data on the left-hand side image of the enclosed figure, because this area is already covered with vegetation and it is impossible to interpret riverbed features. The right-hand side image is an OPS sensor image from the JERS-1 satellite observed on 6 February 1995, and it was able to interpret the white-coloured river bed spreading to the northern side of Punakha Dzong due to sand sedimentation from the Po Chu River caused by the GLOF event.

**Activities for the latest great earthquake in the northern part of Japan**

On 14 June 2008, an earthquake of magnitude 7.2 occurred in the northern part of Japan. This earthquake was named the 'Iwate-Miyagi Nairiku Earthquake of 2008'. Several people were killed. Furthermore, huge numbers of landslides occurred in the mountainous area. The landslide near the Aratozawa Dam is the largest class of landslide caused by seismic wave in the history of Japan.

The enclosed figure shows this landslide captured by ALOS PRISM which is a medium resolution (2.5 metre spatial resolution) optical sensor. In the figure there are two images showing pre and post-disaster. From the figure, landslide mass is estimated at an area of approximately 1,400 metres by 800 metres. PRISM observed the Earth's surface using between one and three optics. Therefore, we can analyse the topography from stereo and/or triplet data. If we use the data of pre- and post-earthquake, we can obtain the mass of the landslide, and

**Temporal change of GLOF damaged area**



Comparison of the GLOF damaged area acquired in 2006 by ALOS (Left) and in 1995 by JERS-1/OPS (Right)

Source: Remote Sensing Technology Center of Japan

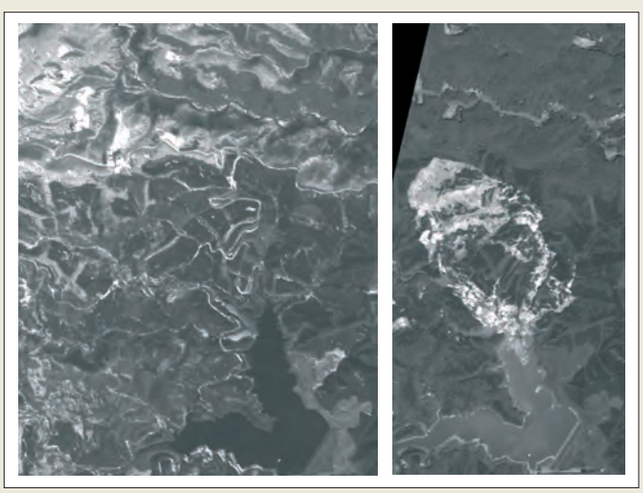
also the latest topography. Currently, we are continuing the analysis to understand the mechanism of this landslide and mitigate the effects of similar disasters in the future.

### Capacity building for monitoring disasters using Earth observation data

RESTEC has organized the remote sensing group training course for more than 30 years, ever since its establishment in 1975. Over 1,200 researchers or scientists from about 50 countries have been trained through this course. Recently we arranged the following two types of training on remote sensing for disaster/environmental monitoring.

Technical assistance and capacity building on satellite-based monitoring of ground cover in Andean glacier regions — We collaborated with the World Bank on the Adaptation to Rapid Glacier Retreat in the Tropical Andes project. The objective of RESTEC is to provide training using ALOS data to the scientists of the participating four countries (Bolivia, Columbia, Ecuador and Peru), on a state-of-the-art remote observing system to be used for interpreting climate change impact on high mountain ecosystems (including glacier basins) in the Andes. The training took place at the Hydraulic and Hydrologic Institute (IHH) in Bolivia from 5 November to 6 December 2007, with a total number of 15 participants. The results of these activities are a scientific and technical monitoring system for the analysis of the dynamics of glacier retreat.

**A large scale landslide which occurred at the north side of Aratozawa Dam was captured by ALOS PRISM**



Source: Remote Sensing Technology Center of Japan

JICA group training programme, satellite remote sensing data analysis technology for disaster/environmental monitoring — We implemented this training programme under the contract with JICA. The programme aims to allow remote sensing experts from disaster/environment-related agencies of Asian and other developing countries to improve synthetic aperture radar (SAR) and other data analysis capability.

In areas where clouds tend to cover the land surfaces throughout the year, an optical sensor merely acquires land surface images. However, by utilizing SAR, land surface data can be acquired regardless of weather and sunlight conditions. By analysing SAR data, disaster/environment damage can be understood widely and the results will supply important information for planning measures. In this programme, the participants will acquire the necessary skills of SAR data analysis and learn to provide precious information for disaster management and the problems of environment-related organizations. The training is held at RESTEC in Japan from 11 August to 12 September 2008. Nine participants from six countries (Argentina, Bhutan, Brazil, Indonesia, Malaysia, and Sri Lanka) will join the training.

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**About the author:**

David Applegate is chair of the National Science and Technology Council's Subcommittee on Disaster Reduction, and is the senior science advisor for earthquake and geologic hazards at the US Geological Survey. The Grand Challenges For Disaster Reduction and accompanying implementation plans are available at http://www.sdr.gov. Applegate can be reached at applegate@usgs.gov. The text is modified from a column that first appeared in *Science News*.

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**Author contact details:**
Yugraj Singh Yadava, Director, Bay of Bengal Programme Inter-Governmental Organisation, 91 St Mary's Road, Abhiramapuram, Chennai – 600 018, Tamil Nadu, India.

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   Dr Christina Kamlage – Senior Project Coordinator, InWEnt – Capacity Building International - Dept. 5.03, Environmental Policy and Environmental Management, Lützowufer 6-9, 10785 Berlin, Germany Email: christina.kamlage@inwent.org, www.inwent.org
   Dr Jürgen Bischoff – Director, ASEM, GTZ-ASEM and TMU-ASEM (Training Management Unit) Indo-German Environment Programme, A-33 Gulmohar Park, New Delhi 110049 Email: info@asemindia.com
   Mr Florian Bemmerlein-Lux, ifanos concept&planning, Vordere Cramergasse 11, 90478 Nürnberg, Germany, Email: flo@ifanos-concpet.eu

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1. Simeulue was close to the epicentre of the 9.3 magnitude earthquake on 26 December 2004, but loss of life was surprisingly low, mainly because the people are familiar with earthquakes and tsunamis in this seismically active region and so knew to leave the coast after the earthquake. Local folklore has it that a huge earthquake and tsunami hit Simeulue in 1907, killing many of its inhabitants. Many died when people rushed to the beach when they saw the water recede, exposing the coral and fish. They went to collect the fish not realizing that the water would come back with a vengeance. Those who survived told the story of the 1907 semong, the local word for tsunami, to their children. It is largely because of this oral history that many in Simeulue say they instinctively knew what to do when the 2004 earthquake and tsunami struck. The island's official death toll in the tsunami was seven – the low figure was almost a miracle considering Simeulue's population of 78,000, the strength of the earthquake and the fact that the epicentre was just 25 miles away.
   BBC News online: Saved by tsunami folklore, 10 March 2007:
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2. Intergovernmental organizations should recognize non-governmental humanitarian agencies (NGHAs), local and foreign, as valuable partners: NGHAs are willing to work with UN and other intergovernmental agencies to effect better disaster response. They do so in a spirit of partnership that respects the integrity and independence of all partners. Intergovernmental agencies must respect the independence and impartiality of the NGHAs. NGHAs should be consulted by UN agencies in the preparation of relief plans.

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Author e-mail:mcnaught@climatecentre.org

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1. AKDN implements a similar multi-input programme on the Indian side of the Line of Control in the Uri Block of Baramullah District. A school construction and teacher training programme is also being implemented in Ghari Habibulah in the North West Frontier Province of Pakistan.
2. Each house typically consists of two multi-purpose rooms, a kitchen and a bathroom.
3. These were defined as poor widows, orphans too old to live with other families, poor disabled people and poor elderly people who had no families. These people were identified by the village organizations and confirmed by a team from AKDN.
4. Many of the valley's deaths and injuries had happened in the schools, and both students and teachers were very reluctant and frightened to go back to school. Yet, going back was one of the most important ways for dealing with the psychological effects of the trauma. Getting teachers and students to feel good about being back at school was a slow but rewarding process for all concerned.

**Iran earthquake risk reduction strategy and the International Institute of Earthquake Engineering and Seismology**

Author contact details: Tel: +9821-22294050, Fax: +9821-22299479, e-mail: ashtiany@iiees.ac.ir

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2. International initiatives in support of early warning systems include (i) three International Early Warning Conferences sponsored and hosted by Government of Germany, (ii) the International Early Warning Programme (IEWP) launched at the Second International Early Warning Conference and supported by the Platform for the Promotion of the Early Warning Systems (PPEW) Secretariat, (iii) Recognition of early warning systems as an integral part of disaster risk reduction within the G8 summit (2005) and UN General Assembly Resolutions, (iv) Report of the Global Survey of Early Warning Systems requested by former UNSG, Kofi Annan, and (v) First Multi-Agency International Symposium on Multi-Hazard Early Warning Systems, convened by the World Meteorological Organization (WMO) in May 2006.
   Further details about the outcomes of the MHEWS-I are available at http://www.wmo.int/pages/prog/dpm/ews_symposium_2006/index_en.html

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**About the authors:**

Francesco Pisano is an expert in international affairs and geopolitics with a background in humanitarian affairs and disaster prevention. He joined the United Nations in 1993. He serves in the UN Institute for Training and Research (UNITAR) where he is a senior officer with UNOSAT.
Einar Bjorgo has a doctoral degree in geophysics, focusing on humanitarian applications of satellite data. He joined the UN in 1999 and currently serves as a senior officer with UNITAR-UNOSAT focusing on humanitarian affairs and new solutions for satellite-based applications.

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**Author details**
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J. Miglarese, FedSolve, Inc., Bethesda, MD
S. Cross, NOAA NCDDC, Charleston, SC
K. Kirkwood, University of South Carolina (USC) School of Public Health, Columbia, SC
L. Brock, SC Department of Natural Resources, Marine Resource research Institute, Charleston, SC
J. Burdine, J. Richter, USC, Center for Public Health Preparedness, Columbia, SC
A. Caver, SC State Veterinarian and Director, Clemson University Livestock & Poultry Health Programs, Columbia, SC
E. Covington, S. Finklea, P. Lee, J. Rice, SC Department of Health and Environmental Control, Columbia, SC
J. Davis, T. Murphy, SC Emergency Management Division, Fish Hatchery Road, Columbia, SC
M. Martin, Clemson University Livestock & Poultry Health Programs
J. Shelton, E. Strom, US Geological Survey, SC Water Science Center, Columbia, SC

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Author details: Nathalie Valette-Silver, Quay Dortch, Richard P. Stumpf, Marc E. Suddleson, Gary C. Matlock
National Ocean Service, NOAA, 1305 East-West Highway, Silver Spring, MD 20910 USA
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**Author contact details:**
NASA Goddard Space Flight Center/SSAI, Greenbelt, MD, 20071, USA, Dimitar.P.Ouzounov@nasa.gov
NASA Goddard Space Flight Center, Greenbelt, MD, 20771, USA, Shahid.Habib@nasa.gov
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INCOIS contact details: e-mail: director@incois.gov.in

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Tudor Rose