Understanding Risk

Best Practices in Disaster Risk Assessment

Proceedings from the 2012 UR Forum

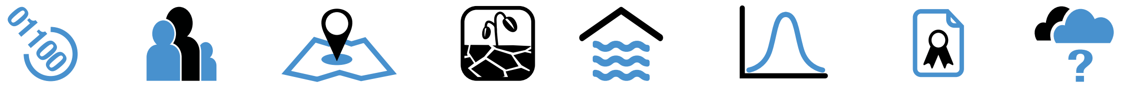
Understanding Risk (UR)

is a community of global experts in the field of disaster risk assessment. UR community members share knowledge and experience, collaborate, and discuss innovation and best practice in risk assessment. This Community convenes every two years at UR Forums.

Join the Community
www.understandrisk.org

Photo: Confluence of the Missouri and Mississippi rivers, Missouri, USA. Credit: © Digital Vision.

Key



OPEN DATA | CROWDSOURCING | COMMUNITY MAPPING | DROUGHT | FLOODS | PROBABILISTIC MODELING | INSURANCE | CHANGING CLIMATE

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THE WORLD BANK

Collaborative Partners

To the Understanding Risk (UR) Community

The spirit of collaboration leading up to the 2012 Understanding Risk (UR) Forum in Cape Town was inspiring. We cannot mention all of the organizations and individuals involved, but would like to highlight a few key partners.

First off, we would like to thank the 2012 UR partners: the Government of South Africa and the Department of Cooperative Governance and Traditional Affairs' National Disaster Management Centre (NDMC), the Global Facility for Disaster Reduction and Recovery (GFDRR), and the African Caribbean and Pacific - European Union (ACP-EU) Program.

A special thank you to all the organizations that were involved in the UR Forum: the African Development Bank (AfDB), the African Union (AU), AusAID, Australia - Indonesia Facility for Disaster Reduction (AIFDR), Cape Town Disaster Risk Management Centre (DRMC), CAPRA, Council for Geoscience, Council of Scientific and Industrial Research (CSIR), Deltares, European Space Agency (ESA), Esri, Global Earthquake Model (GEM), Humanitarian OpenStreetMap Team (HOT), IVM Institute for Environmental Studies, Intergovernmental Authority on Development (IGAD), Kenya Red Cross, Local Governments for Sustainability (ICLEI), North-West University, Open Data for Resilience Initiative (OpenDRI), Red Cross/Red Crescent Climate Centre, South African Insurance Association (SAIA), Southern African Development Community (SADC), South African National Space Agency (SANSA), Tulane University, the United Nations Development Program (UNDP), the United Nations International Strategy for Disaster Reduction (UNISDR) Willis Research Network, World Food Program (WFP) and the World Meteorological Organization (WMO).

We would also like to extend our gratitude to our opening and closing speakers: Honorable Minister Richard Baloyi, Rowan Douglas, Ebrima Faal, Hildegarde Fast, Francis Ghesquiere, Jonathan Kamkwalala, Alan Knott-Craig, Mayor Patricia de Lille, Andrew Maskrey, Ken Terry, and Richard Young. Thank you to the Mayors present at the Roundtable: Mayor Maabad Hoja, Mayor Didas Massaburi and Lord Mayor Mahmad Kodabaccus.

Thank you to our Session Leads for putting in extensive time and effort into organizing their sessions, and for writing the summaries for this publication: Philippe Bally, Kate Chapman, Derek Clarke, Trevor Dhu, Souleyman Diop, Rosauge Guale, Emmanuel Kala, James Kisia, Jaap Kwadijik, Olivier Mahul, Jean-Baptiste Migraine, Jane Olwoch, Abdishakur Othowai, Rui Pinho, Eugene Poolman, Julio Serje, Robert Soden, Maarten Van Aalst, Kenneth Verosub, and Cees van Westen. A special thanks to all of their panelists.

We would like to acknowledge the teams who were involved: the staff and volunteers from the Cape Town Disaster Risk Management Center (DRMC), the Cape Town International Convention Centre, Imfunzelelo, Multi-Image Productions, and the following individuals: Claus Astrup, Abigail Baca, Judy Baker, Trish Barrett, Laura Boudreau, Anna Burzykowska, Zelda Coetzee, Eric Dickson, Laura Dorling, Tiguist Fisseha, Marc Forni, Niels Holm-Nielsen, Sarwat Hussain, Christina Irene, Oscar Ishizawa, Henriette Mampuya, Marc Neilson, Ariel Nunez, Kristina Nwazota, Nothando Nyathi, Greg Pillay, Charlotte Powell, Fernando Ramirez, Keiko Saito, Sahar Safaie, Mmenyane Seoposengwe, Alanna Simpson, Anthea Serritslev, David Sislen, Wilfred Solomons, Zuzana Svetlosakova, Joaquin Toro, Sonam Velani, and Erika Vargas.

And last, but not least, to the core Understanding Risk team in South Africa: Ane Bruwer, Zena John, Craig Meyer, and in Washington, D.C.: Chalida Chararnsuk, Miki Fernández, Brendan McNulty, Francis Muraya, Emma Phillips, Noosha Tayebi and Doekle Wielinga; thank you for your time, dedication and creativity in making this event happen!

Cape Town, South Africa. Credit: Thinkstock.com

The Understanding Risk (UR) Community

UR is a community of more than 2,600 leading experts and practitioners in disaster risk assessment from around the world. Members of the community include representatives of government agencies, multilateral organizations, the private sector, non-governmental organizations, research institutions, academia, community-based organizations, and civil society.

Every two years, the Global Facility for Disaster Reduction and Recovery (GFDRR) convenes the UR Community at UR Forums. Forums are "state of the art" events that showcase best practices and the latest technical know-how in risk assessment. UR provides partners with the opportunity to highlight new activities and initiatives, build new partnerships, and further foster advances in the field.

Overview

The first UR Forum was held in Washington D.C. in June 2010. Since then the world has witnessed high impact disasters and extreme events that have changed the way we understand disaster risk. UR 2012, held in Cape Town, July 2-6, convened 500 risk assessment experts from more than 86 countries to address this challenge, underscoring the importance of integrating disaster risk management (DRM) and climate change adaptation (CCA) as a core element of development.

Organized in partnership with the Government of South Africa and the European Union (EU), UR 2012 showcased new tools for decision-makers, strengthened regional and global partnerships, and built technical capacity in the Africa region through a series of training events.

The UR Community of practice remains a unique platform for incubating innovation and forging partnerships and will continue to work collaboratively to build resiliency to disaster risk in the future.

Foreword

The second "Understanding Risk" (UR) Forum was held in Cape Town, South Africa from July 2-6, 2012. Organized in partnership with the Government of South Africa's National Disaster Management Center (NDMC), Department of Cooperative Governance and Traditional Affairs (COGTA), the Forum brought together 500 risk assessment experts from more than 86 countries around the world. The Forum was convened by the Global Facility for Disaster Reduction and Recovery (GFDRR) in collaboration with the World Bank's Africa Region.

These proceedings seek to convey the richness of the discussion that took place during **UR2012**. The event was a resounding success, not only because it brought together the world's leading experts in risk assessment, but also because it was a testimony to the tremendous progress achieved in understanding risk since the UR Forum series was first launched in 2010, in Washington, D.C.

Crowdsourcing, a topic that was completely new just two years ago, has now become part of the mainstream. It is noteworthy that this concept is now used to support **Risk Assessments for Financial Applications** in order to strengthen the financial resilience of governments, businesses, and households against the economic burden of disasters.

It is also clear from the discussions that there is a growing consensus about the need for more **Open Data**. Many initiatives demonstrated that this could be done for the benefit of all. The session on the use of **Satellite Earth Observation** demonstrated how much new thinking has evolved and permeated the discussion, with a renewed focus on the need to bridge the gap that still exists between image providers and actual users on the ground.

The Honorable Minister of Cooperative Governance and Traditional Affairs of South Africa, Mr. Richard Baloyi opened the Forum with a keynote address that highlighted the importance of the disaster risk management (DRM) and climate change adaptation (CCA) agendas to the African continent. Extensive participation by African delegates confirmed that identifying risk is particularly relevant for Africa and that progress has been made in the developing world to make better use of risk assessments.

Holding the Forum in South Africa enabled the UR community and practitioners to focus on **Drought Response and Resilience**. Drought is a challenge that affects the region on a regular basis, and as the ongoing crises in the Horn of Africa and the Sahel demonstrate, the economic and social impacts are far-reaching. It is heartening that the 2013 **Global Assessment Report** will have a particular focus on developing methodological approaches to measure drought hazards and drought intensity to better address this challenge.

Other sessions highlighted the advances in hazard assessments, including **Flood Risk across Spatial Scales, Landslides Risk Assessments,** and **Earthquake Risk Assessments,** also relevant to the African context. **New Tools and Methodologies for Building Resilience** were highlighted, focusing on the extensive progress being achieved in making these tools available to non-specialists for the analysis and communication of risk, as well as the importance of **Community-Based Risk Assessments** that engage local and impacted communities in the risk reduction process.

Finally, the last two years confirmed the need for the world to continue **Thinking about the Unthinkable.** The Great Japanese Earthquake and Tsunami of March 2011 and the floods in Thailand come as a stark reminder that we face a future of increasing uncertainty about extreme events. The cascading impacts and far-reaching consequences disrupted energy policies and value chains all around the world. The release of the Intergovernmental Panel on Climate Change (IPCC) Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) Report was at the core of discussions on **Meteorological, Hydrological, and Climate Services** and the need to **Assess Risk in a Changing Climate**.

We are pleased that all these topics are included in this volume, summarizing the stimulating discussions that took place in Cape Town. Since the 2010 Forum the UR Community has been growing from strength-to-strength, tackling issues of economic, social, and environmental vulnerability with renewed commitment to helping communities build resilience.

We are confident that the UR Forum series will lead to new partnerships and innovative advances in risk assessment, so essential for achieving sustainable development in Africa and beyond. We look forward to the next UR Forum in 2014, and to continuing the excellent spirit of cooperation that took root in Cape Town, South Africa.

Francis Ghesquiere
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Risk in the 21st Century

Rowan Douglas
Chief Executive Officer, Global Analytics, Willis Re

At the 2010 Understanding Risk (UR) Forum we described this community of four hundred risk experts and practitioners as a ship that was setting sail. We were aware that not all the key institutions we wanted were there at the time, but those who were there needed to be on that ship. Two years on, what has happened? The ship is now a flotilla of ships that have set sail and have remarkably entered the main shipping lanes. Why is that?

Last year saw the most remarkable and shocking stream of natural catastrophes to befall our communities in many years, from floods in Thailand to the earthquake and tsunami in Japan. Theses catastrophes affected all communities, even those that were considered to be the most prepared and able to confront those challenges. They also had a global effect because of the increasingly interconnectedness of modern society and supply chains.

The first ten years of this century have been an overture of the 21st century. The shocks coming from the financial markets, natural catastrophes, and security have changed the tempo of the post World War II period of growth to a period of uncertainty. We do not know what the rest of the century will look like, but as we look at the perfect storm of further climate concern, population growth, and concerns around finance and others, we have an interesting time ahead of us.

Over the last few years we have seen that disasters have moved to the top levels of public policy. We see it here in Cape Town, at the local level through the work of the United Nations International Strategy for Disaster Reduction (UNISDR); with the national programs, for example in the United States or the United Kingdom, where natural catastrophe is considered a key concern in building resilience and security as a platform for growth; and we see it in our multi-national institutions, where natural catastrophe is at the top of the agenda for the European Union (EU) and the Asia-Pacific Economic Cooperation (APEC). But perhaps most critically, at the G20 meeting in Los Cabos, Mexico, natural disasters were on the agenda for the first time.

In the UR world, much has happened too. What we previously talked about in theory is now happening in practice. Two years ago the Global Earthquake Model (GEM) Foundation was being talked about in theory. Today you can attend a training session in the *Openquake* modeling platform. As a result, a number of communities have been connected.

Looking ahead, we need to think about how this flotilla is going to navigate the "seven seas". We have to understand how to navigate the climate, the crust, catastrophe, capital, communications (both understanding and conveying

information), culture (public policy and decision-making within public and private spheres), and community (at local, national, and global scales).

During the Romantic Period in the 18th century, artists and intellectuals tried to connect an increasingly industrialized society with nature through the arts, music, and literature. We are now entering, not least through the work of the UR community, a new Romantic period. But today we are connected back to nature through the pervasive power of the modeled and networked world. We are connected not just through our emotions, but also through our balance sheets, financial decision-making, and fiscal processes. This marriage of technology, data, finance, and policy is at the heart of confronting the challenges we face around natural disasters.

As such, there is tremendous opportunity for science, technology, and academy to cross boundaries and show impact and relevance. Whether through the power of super-computing or models, or the ability of us all to contribute and receive information at micro scales, there is an opportunity for international institutions to develop a framework together to confront this challenge.

There is also a huge challenge and opportunity for emerging economies. South Africa, Mexico, and others are taking a lead in this space. Through the need to confront the challenges of natural catastrophe other public policy benefits and mindsets have been created.

An exciting opportunity exists for business and the world of insurance. Insurance has receded in peoples' consciousness until quite recently. But now in an increasingly uncertain world, the principals of applying math and science to socio-economic challenges as they did 200 hundred years are being re-expressed today through technology. It is also recognized that countries and individuals need to come together to mutualize and share their risk at both local and global scales.

What are the challenges moving forward? To some degree the supply side is taken care of: we have the technology, we can usually find the information to the level we need, and we can usually find the financing we require.

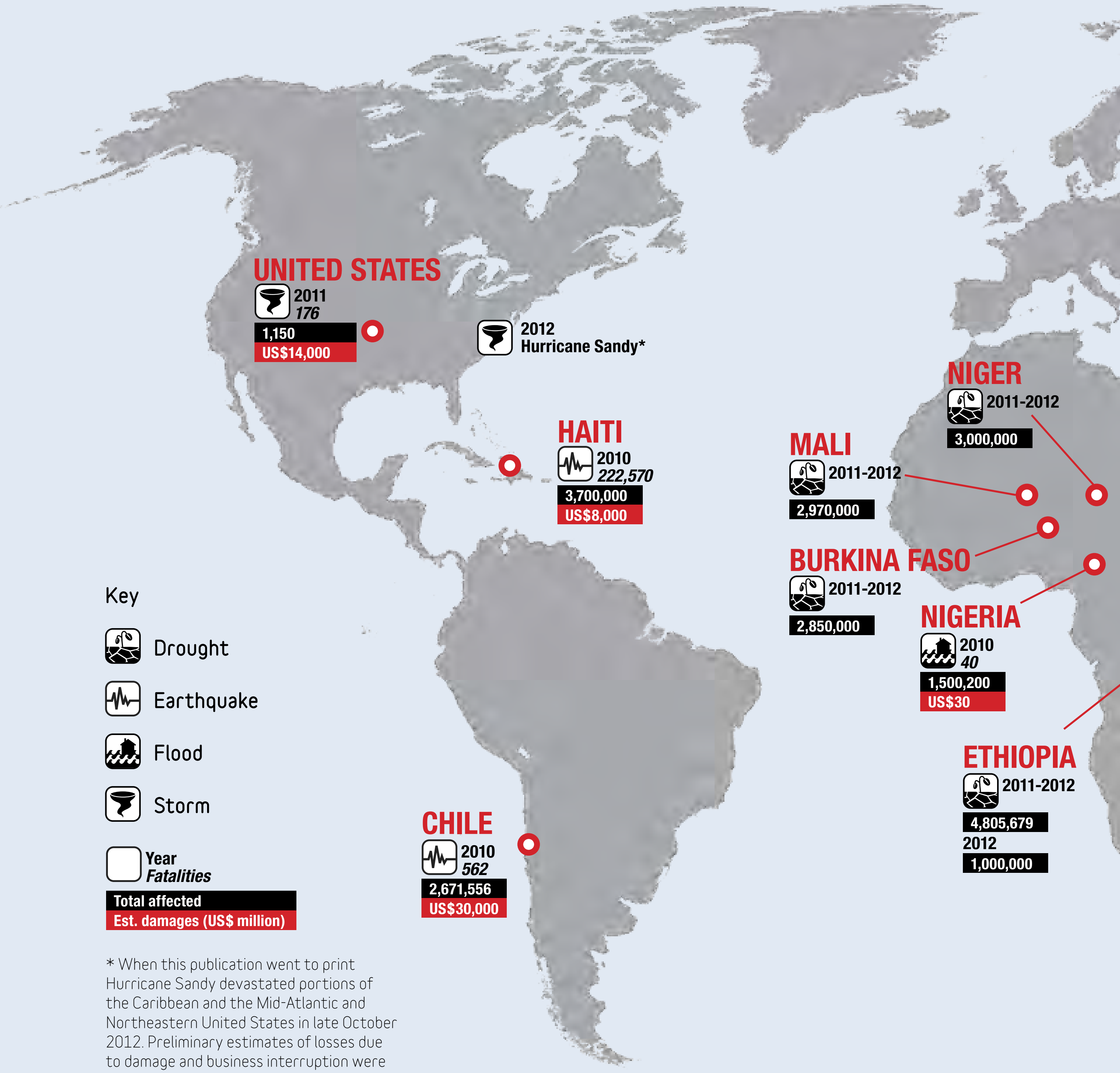
The real challenge is to create the generation of demand. We need to be able to incentivize and ensure those who need to take decisions about securing their future and understanding their risks obtain the right information; and that we deliver it to them effectively.

Seemingly 'local' disasters have much broader impacts. As businesses become more interconnected and supply chains become more international, seemingly local events have increasing global impact. The 2010 eruption of the volcano Eyjafjallajökull had negligible impact in Iceland, but affected international air travel in Europe for over two weeks, leading to major economic losses in travel, tourism and trade. A study by Oxford Economics found that the total impact on global Gross Domestic Product (GDP) in just the first week of disruption from the ash cloud amounted to approximately $4.7 billion[1]. Similarly the 2011 floods in Thailand reduced Japan's industrial output by 2.6% between October and November of that year, due to disruptions in electronics and automotive "just-in-time" supply chains[2].

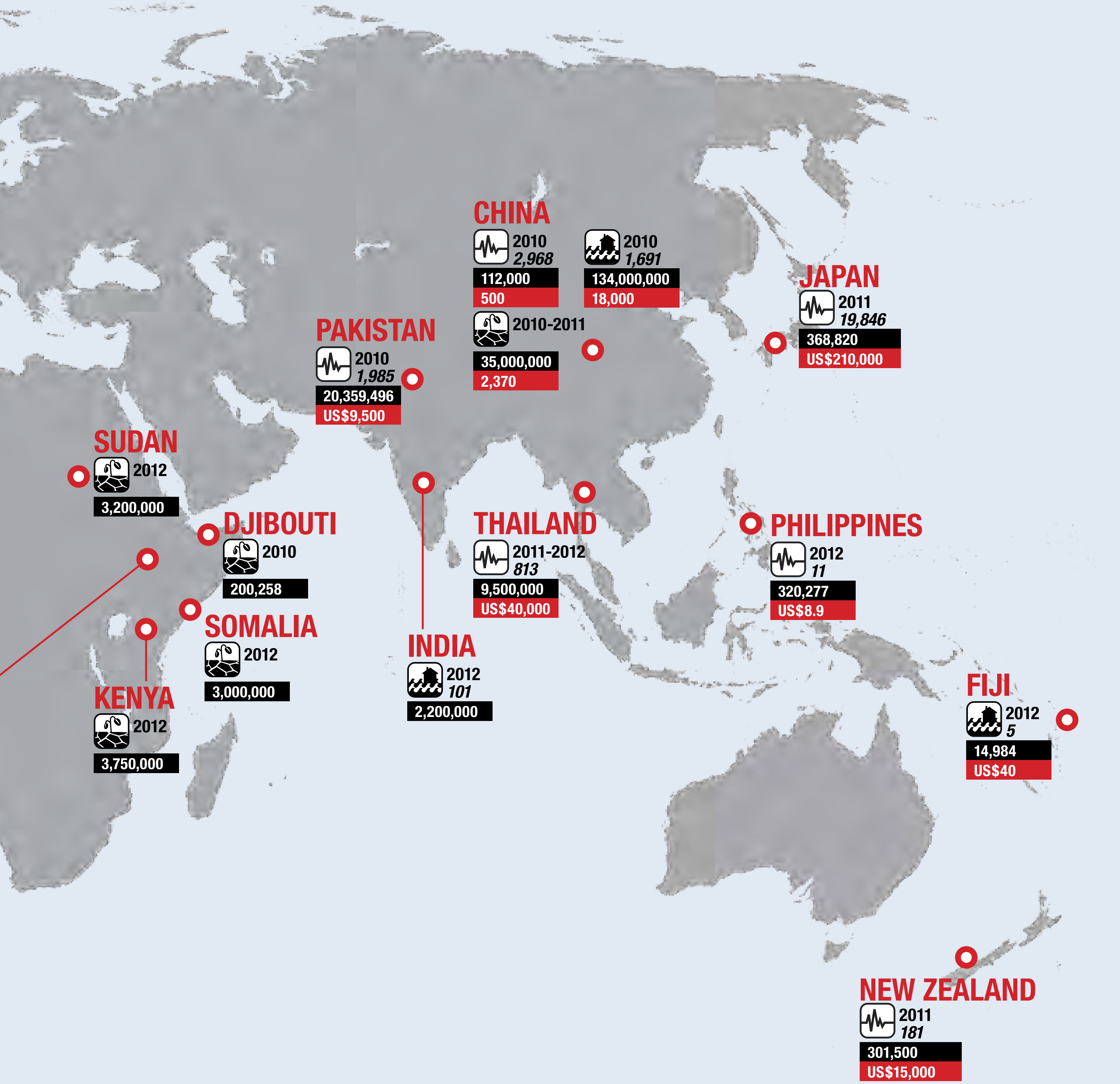
[1] Oxford Economics, (2010).
[2] Mitchell, Mechler, and Harris, (2012).

Major Disasters since UR2010

Since the first meeting of the Understanding Risk (UR) Community in Washington, D.C. in June 2010, the world has seen hundreds of natural disasters that have caused more than US$1 trillion in losses, the vast majority of them uninsured, and affected thousands of lives. Below are some of largest disasters in terms of economic losses and human impact.



* When this publication went to print Hurricane Sandy devastated portions of the Caribbean and the Mid-Atlantic and Northeastern United States in late October 2012. Preliminary estimates of losses due to damage and business interruption were estimated at US$65.5 billion.


CHINA
2010
2,968
112,000
500
2010
1,691
134,000,000
18,000
2010-2011
35,000,000
2,370
JAPAN
2011
19,846
368,820
US$210,000
PAKISTAN
2010
1,985
20,359,496
US$9,500
SUDAN
2012
3,200,000
DJIBOUTI
2010
200,258
THAILAND
2011-2012
813
9,500,000
US$40,000
PHILIPPINES
2012
11
320,277
US$8.9
SOMALIA
2012
3,000,000
INDIA
2012
101
2,200,000
KENYA
2012
3,750,000
FIJI
2012
5
14,984
US$40
NEW ZEALAND
2011
181
301,500
US$15,000

Assessing Risk in a Changing Climate

Dr. Maarten Van Aalst,
Director, Red Cross / Red Crescent Climate Center

Science, policy, and practice all demonstrate that disaster risk management (DRM) and climate change adaptation (CCA) are intimately connected. Evidence suggests that weather and climate extremes are changing and new risks are emerging. We need to think about how to manage not only the reoccurring risks of the past, but also those of the future. Policy and practice also need to bridge short and longer timescales relevant for decision-making.

New Risks

The Intergovernmental Panel on Climate Change (IPCC) recently released a Special Report on Managing the Risk of Extremes and Disasters to advance Climate Change Adaptation (SREX). Signed off by all governments, this report presents the best scientific knowledge on how extremes are changing, but also how changing risks can best be managed.
Key findings from the report indicate that disaster risk will continue to increase in many countries as more vulnerable people and assets are exposed to weather extremes. Climate change has altered the magnitude and frequency of some extreme weather and climate events ('climate extremes') in some regions already. For the coming two or three decades, the expected increase in climate extremes will probably be relatively small compared to the normal year-to-year variations in such extremes. However, as climate change becomes more dramatic, its effect on a range of climate extremes will become increasingly important and will play a more significant role in disaster impacts.

There is better information on what is expected in terms of changes in extremes in various regions and sub-regions; though for some regions and some extremes uncertainty remains high. Climate extremes are essentially becoming more unpredictable. High levels of vulnerability, combined with more severe and frequent weather and climate extremes, may result in some places, such as atolls, being increasingly difficult places in which to live and work[3].

New Measures

A new balance needs to be struck between measures to reduce risk, transfer risk, and effectively prepare for and manage disaster impact in a changing climate. This balance will require a stronger emphasis on anticipation and risk reduction.

[3] Mitchell and van Aalst (2012).

Photo courtesy of the IPCC Special Report

In this context, existing risk management measures need to be improved as many countries are poorly adapted to current extremes and risks, let alone those projected for the future. This would include, for example, a wide range of measures such as early warning systems, land use planning, development and enforcement of building codes, improvements to health surveillance, or ecosystem management and restoration.

A country's capacity to meet the challenges of observed and projected trends in disaster risk is determined by the effectiveness of their national risk management system. Such systems include national and sub-national governments, the private sector, research bodies, and civil society, including community-based organizations.

In a situation where vulnerability and exposure are high, capacity is low, and weather and climate extremes are changing, fundamental adjustments are required to avoid the disaster losses and tipping points. Any delay in greenhouse gas mitigation is likely to lead to more severe and frequent climate extremes in the future (Tables 1 and 2).

There is exciting work underway that demonstrates how integrated climate risk management is being implemented. Based on its

Table 1: Observed changes in temperature and precipitation extremes since the 1950s

Table 1 shows observed changes in temperature and precipitation extremes, including dryness in regions of Asia since 1950, with the period 1961-1990 used as a baseline (see box 3.1 in Chapter 3 of SREX for more information)

Region and Sub-region	Trends in maximum temperature (warm and cold days)	Trends in minimum temperature (warm and cold nights)	Trends in heat waves/ warm spells	Trends in heavy precipitation (rain, snow)	Trends in dryness and drought
North Asia	Likely increase in warm days (decrease cold days)	Likely increase in warm nights (decrease cold nights)	Spatially varying trends	Increase in some regions, but spatial variation	Spatially varying trends
Central Asia	Likely increase in warm days (decrease cold days)	Likely increase in warm nights (decrease cold nights)	Increase in warm spells in a few areas Insufficient evidence in others	Spatially varying trends	Spatially varying trends
East Asia	Likely increase in warm days (decrease cold days)	Increase in warm nights (decrease cold nights)	Increase heat wave in China Increase in warm spells in northern China, decrease in southern China	Spatially varying trends	Tendency for increased dryness
Southeast Asia	Likely increase in warm days (decrease cold days) for northern areas Insufficient evidence for Malay Archipelago	Likely increase in warm nights (decrease cold nights) for northern areas Insufficient evidence for Malay Archipelago	Insufficient evidence	Spatially varying trends, partial lack of evidence	Spatially varying trends
South Asia	Increase in warm days (decrease warm days)	Increase in warm nights (decrease in cold nights)	Insufficient evidence	Mixed signal in India	Inconsistent signal for different studies and indices
Western Asia	Very likely increase in warm days (decrease in cold days more likely than not)	Likely increase in warm nights (decrease in cold nights)	Increase in warm spells	Decrease in heavy precipitation events	Lack of studies, mixed results
Tibetan Plateau	Likely increase in warm days (decrease cold days)	Likely increase in warm nights (decrease cold nights)	Spatially varying trends	Insufficient evidence	Insufficient evidence

Climate Risk Management and Adaptation Strategy, the African Development Bank (AfDB) has developed a Climate Safeguards System to screen projects for climate risk. It targets the early stages of the project cycle, so that the risks can be integrated during project preparation. Projects are categorized as Category 1: Very vulnerable; Category 2: Potentially vulnerable; or Category 3: Not vulnerable. This classification determines next steps included in the Project Concept Note.

An online tool is currently being piloted before intended roll-out across all Bank operations. Alongside the online tool, there will be country Adaptation Profiles and a knowledge base to guide investment planning and project preparation. Other institutions are taking similar initiatives, including a range of knowledge portals to support risk assessment and investment screening.

In practice, implementation of such intentions will not always be straightforward. Experience from a range of integrated climate and DRM programs implemented over the past ten years suggest that the key is a combination of promoting the right instruments, addressing incentives and setting up the right institutions.

Table 1: Projected changes in temperature and precipitation extremes, including dryness, in Asia

Table 1 shows projected changes in temperature and precipitation extremes, including dryness in Asia. The projections are for the period 2071-2100 (compared with 1961-1990) or 2080-2100 (compared with 1980-2000) and are based on GCM and RCM outputs run under the A2/A1B emissions scenario.

Region and Sub-region	Trends in maximum temperature (the frequency of warm and cold days)	Trends in minimum temperature (the frequency of warm and cold nights)	Trends in heat waves/ warm spells	Trends in heavy precipitation (rain, snow)	Trends in dryness and drought
North Asia	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells	Likely increase in heavy precipitation for most regions	Inconsistent change
Central Asia	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells	Inconsistent signal in models	Inconsistent change
East Asia	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells	Increase in heavy precipitation across the region	Inconsistent change
Southeast Asia	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells Low confidence in changes for some areas	Inconsistent signal of change across most models (more frequent and intense heavy precipitation suggested over most regions)	Inconsistent change
South Asia	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells	Slight or no increase in %DP10 index More frequent and intense heavy precipitation days over parts of S. Asia	Inconsistent change
West Asia	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells	Inconsistent signal of change	Inconsistent change
Tibetan Plateau	Likely increase in warm days (decrease in cold days)	Likely increase in warm nights (decrease in cold nights)	Likely more frequent and/or longer heat waves and warm spells	Increase in heavy precipitation	Inconsistent change

Key **Symbols** Increasing trend Decreasing trend Varying trend Inconsistent trend/insufficient evidence No or only slight change

Level of confidence in findings Low confidence Medium confidence High confidence

Overlapping mandates and institutional turf battles, for instance, between the ministry of environment (often responsible for climate change), and ministries of civil defense/home affairs (often responsible for DRM) are still wasting scarce capacity. Adaptation and DRM should preferably be handled by the same government institutions. Overall responsibility for risk management should be placed at a high level institution, close to economic planning. Implementation should fall to the respective sectoral ministries, as well as other relevant actors at different levels.

In that context, risk assessments need to be actionable for decision-makers, from politicians, policy-makers, and donor agencies to traditional leaders and individuals in vulnerable areas. Besides simpler and more tailored forecasts, key tools to communicate the message should include providing economic analyses and risk maps.

Panels of trusted national experts can play a key role in convincing policy-makers at the national level. At the local level, it requires engagement with trusted intermediaries, such as community leaders. A strong focus should be on awareness raising and communication. An exciting example is the use of games for decision-makers. These games confront decision-makers, from local farmers to high-level policy-makers with the costs and benefits of action or inaction with regards climate information (see article on Climate Games, p. 44).

Conclusion

Climate science, which has made great progress, is just one piece of the puzzle. It is highly relevant but often difficult to apply off-the-shelf. An essential change of mindset, particularly for the climate science community is to think about *actionable* information, more directly linked to decision-making, and to produce the relevant guidance for interpretation, jointly with users.

One key lesson is to look at the climate science products relevant to the timescales for decision-making, including not just long-term climate projections, but also seasonal forecasts, historical climate information, and proper characterization of historical variability.

Long-term trends may be relevant for longer-term infrastructure investments. For many other decisions, for instance in agriculture, information about the coming season, or the envelope of possible conditions (including uncertainties) for the coming 5-10 years may be much more relevant, and offer pragmatic ways to address the rising risks in a changing climate.

Contributors to the session

Co-Session Lead: Ebrima Faal, Regional Director, African Development Bank

Panelists

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Tony Nyong, Head, Gender, Climate Change and Sustainable Development Unit, African Development Bank

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Alhassane Diallo, Director General African Centre of Meteorological Application for Development

James Kisia,Deputy Secretary General, Kenya Red Cross

Youcef Ait-Chellouche, Deputy Regional Coordinator, United Nations International Strategy for Disaster Reduction

Further Resources

- IPCC SREX: http://ipcc-wg2.gov/srex
- Useful SREX interpretation, including regional summaries: www.cdkn.org/srex
- AfDB climate safeguards system: http://72.26.119.91:8080/GCAP-CSS/afdbhomepage.html;jsessionid=E3E362D500C7567533667683896C9795
- Red Cross and Red Crescent Climate Center: http://www.climatecentre.org/

Interview with

HONORABLE PATRICIA DE LILLE

Mayor of Cape Town, South Africa

How do we make disaster risk assessment as attractive to decision-makers and donors as disaster response?

The benefit of a disaster risk assessment is that it provides one with a risk profile of the hazards that could impact your City. It allows one to take remedial action and be pro-active so that the impact of the hazard can be mitigated and reduced. Very often the funds allocated to remedial risk reduction action will be less than the funds that will be allocated for dealing with the aftermath of a disaster, e.g. ensuring appropriate drainage systems are installed in preparation for the rainy season, versus dealing with flood damage and relocations of communities.

What is the most effective way to engage a Minister of Finance to start thinking about and allocating resources for risk assessment?

It will be helpful to point out that the risk assessment is a diagnostic tool that enables one to gauge what the risk profile of your City is. The risk assessment is useful in that it provides one with a strategic risk profile of the hazards that could impact the City. Therefore funds spent on this risk assessment initiative amounts to money well spent, as it identifies the hazards that could impact the City, and allows one the opportunity to undertake remedial risk reduction action, i.e. how to lessen the impact of the hazard by formulating a disaster management plan, preparedness measures, and technical and engineering interventions, etc.

In your career, what event (large or small) have you been most proud to have been involved with?

In the City of Cape Town there is a high incidence rate of fires in informal settlements. In an effort to reduce the risk of fires in these informal settlements, I donated funds from my office for the purchase of 1000 fire extinguishers that were provided to households in the Joe Slovo Informal Settlement, Langa. A day was set aside where I visited the community in December 2011, and with the assistance of the Fire Service and Disaster Management, a demonstration was provided how the fire extinguishers should be used. A fire was lit as part of the demonstration, and I used the fire extinguisher to supress the fire, indicating to the community how easy it could be done to avoid fire spread. The media was also invited to this event.

Photo: Aerial view of the Japanese ground self-defense force and disaster relief crews. Credit: Thinkstock.com

Thinking about the Unthinkable

Dr. Kenneth L. Verosub,
Distinguished Professor,
University of California (UC) Davis

For the 2012 Understanding Risk (UR) Forum a distinction was made between Black Swans and White Whales. Black Swans were events that no one ever expected would happen; White Whales were events that we knew were out there but were thought to be extremely rare.

In the two years since then, the distinction between Black Swans and White Whales has become less distinct because, more often than not, it turns out that at least someone somewhere has predicted any given Black Swan event. Even the archetypal Black Swan event, the bringing down of the Twin Towers in New York City, was on the radar of some security analysts.

Thus for the 2012 UR Forum, we chose to label all extreme events with the simple generic term of "unthinkable" and to address the deeper question of how we could help decision-makers think about the unthinkable.

The Challenge of Thinking about the Unthinkable

Why is it so difficult for officials, administrators, planners and people, in general, to think about the unthinkable? Part of the answer is that no one wants to hear about how bad things could be. However, a larger problem is that many people, including disaster risk management (DRM) practitioners, find it difficult to appreciate how the interconnected complexities of modern society are amplified under extreme conditions. In the language of structural engineering, under such conditions, the response of the system becomes non-linear, and when that happens, models based on a linear response simply fail.

Hurricane Katrina, for example, pushed New Orleans to the point that the existing dysfunctionalities of the city (in the areas of governance, planning, poverty levels, emergency response, law enforcement, etc.) combined with a devastating hurricane, had an overwhelming impact on the city. Barry Commoner's First Law of Ecology ("Everything is connected to everything else)" applies here. The difficulties that the United States military had in providing ready-to-eat meals (MREs) to the population of New Orleans was directly related to America's involvement in a war in Iraq, to which most of the available MREs had already been sent.

Even when we try to grasp the enormity of the impact of an unthinkable event, we run the risk of overconfidence. We assume we can extrapolate from what we know and what we've already seen to what we think will happen. This overconfidence can manifest itself in different ways: we do not think more research is required; we believe our existing tools will be adequate for the job; we select the wrong people (risk and insurance managers) to do the analysis; we base our decisions on the wrong factors (profits); and/or we are motivated by the wrong reasons (liability and public relations).

Another part of the answer is that too often we think only in terms of top-down responses. The first responders in any disaster or emergency are the people who are directly affected by it. Part of what prepares them to respond is the ability to draw upon traditional wisdom as well as immediate situational awareness. For example, several communities affected by the Indian Ocean tsunami of 2004 had relatively few fatalities because they had an oral tradition that told them to flee inland when the waters receded.

The final part of the answer is that we need a new perspective for dealing with unthinkable events. A careful reading of historical records provides clues as to what kinds of unthinkable events might be lurking out there.

We also need to develop a vocabulary or "bestiary" to describe unthinkable events. There are aspects of certain unthinkable events that are similar, and having a better way to describe those similarities could help in understanding the risks and planning for them.

Lessons Learned from Recent Unthinkable Events

Since the UR Forum in 2010, the world has experienced several unthinkable events. Perhaps the most impressive was the 2011 Tohoku earthquake and tsunami in Japan and the subsequent nuclear emergency at the Fukushima Daiishi nuclear facility. In the language of the bestiary, this would be classified as a *cascade event* since the earthquake triggered the tsunami and the tsunami in turn triggered the nuclear meltdown.

In terms of the tectonics, the initial earthquake was caused by simultaneous rupture on six adjacent segments of an oceanic fault, which generated an earthquake with a magnitude of 8.9. Prior to this, the maximum that anyone had expected was that at most three segments of the fault could rupture simultaneously.

Analysis of the historical record indicates that in 869 A.D. the same region was hit by a large tsunami, generated by what is estimated to have been a magnitude 8.6 earthquake with a return period of about 1000 years. Therefore, the information was out there, but insufficiently incorporated into the thinking of those trying to assess the risk.

Another unthinkable event was the flooding in Pakistan in 2010, which began with very intense rainfall in the northwest of the country and eventually led to inundation along the entire length of the Indus River. The flooding directly affected 20 million people and caused economic losses of almost $50 billion. In terms of the bestiary, this would be a *domino event*. As the flood wave moved downstream, it affected different areas in different ways, but the net result was a cumulative humanitarian and economic disaster.

An example of a *compound event* is the 1991 eruption of Mount Pinatubo, Philippines, that coincided with a typhoon passing by the volcano, resulting in a lethal mix of ash and rain. Tens of thousands of people were evacuated and the surrounding areas were severely damaged by pyroclastic flows, ash deposits, and subsequently, by the lahars caused by the rain, destroying infrastructures and altering the river systems.

Another example would be the heat wave that affected Washington, D.C. earlier this summer. The heat wave itself would probably have been manageable, but it coincided with a regional outbreak of severe thunderstorms that caused massive

1. **Domino event:** An initial set of impacts leads to another set of impacts, which leads to another set, and so on.
2. **Cascade event:** The impact of an initial event is exacerbated by the impact of a second, and/or even a third event.
3. **Compound event:** Two separate phenomena, neither of which is inherently out of the ordinary, combine to produce an extraordinary event.
4. **Perfect storm event:** A series of elements come together in just the right way to produce an unthinkable event.

2010 Eruption of the Eyjafjallajokull volcano in Iceland. Photo: Thinkstock.com.

power outages. The pairing of these two phenomena did not quite cause an unthinkable event, but it is not hard to imagine that a slightly longer heat wave and a slightly more severe power disruption could well have had a much greater impact. Moreover, one could also view this event as a precursor for future unthinkable events in which severe heat as a manifestation of global climate change combines with widespread power outages caused by the recognized vulnerabilities of the electrical grid system.

A *perfect storm event* would be the shutdown of European air traffic in 2010 as a result of the eruption of the Eyjafjallajokull volcano in Iceland. In that case, the volcano erupted through a glacier in just the right way to produce large amounts of unusually fine ash. The force of the eruption was just enough to carry the ash to altitudes that were crossed by the flight paths of commercial aircraft. And the ash was injected into a stagnant weather pattern that held the ash over northern and central Western Europe for weeks.

If any one of these conditions had not occurred, there would have been no significant impact on aviation or the global/regional economy at large. In fact, a year later Grimsvotn volcano erupted in Iceland under similar circumstances, except that it missed a stagnant weather pattern by three days and had no significant impact on aviation.

Scenario for an Unthinkable Event: Global Food Crisis

It is clear that different factors can come together to create a particular unthinkable event. One such scenario could be a massive global food crisis. In one sense, this is not such an "unthinkable" event; there are warnings that continued warming due to global climate change could lead to a global food crisis. But it is "unthinkable" in the sense that most decision-makers are confident that the global agricultural economy, and its complex network for growing and distributing food, has the resilience to weather any shock to the system.

Our thesis is that this represents gross overconfidence that the system will respond linearly to large events and that because it has been able to cope with previous smaller events it will also be able to cope with a larger one.

This summer the most severe threat to global agriculture has been the massive drought in the

United States and Eastern Europe, the failed monsoon in India, and severe rains in Brazil. As a result of these factors, prices on the global grain market have risen significantly. Climate change also indicates that the combined challenges to agriculture from weather-related phenomena are likely to be more frequent and severe. Even if this year does not produce a global food crisis, it certainly demonstrates the potential for several weather-related events to come together to create a *compound event* resulting in a global food crisis.

A rise in grain prices also produces a rise in meat prices and could translate into frustrated expectations about the cost and availability of food in general. This could lead to political unrest, which could, in turn, affect the system that gathers and distributes food in a given country. This *cascade* of events, if repeated simultaneously in many countries, as occurred during the Arab Spring, could also trigger a global food crisis.

Natural hazards could also contribute to the disruption of the global agricultural system. A massive volcanic eruption, especially one near a major rice-producing region on the Pacific Rim, could blanket a region with a heavy layer of volcanic ash, shutting down agriculture production completely.

A more global impact could result from an eruption like the one in 1815 from Mount Tambora in Indonesia. That eruption injected sulfur dioxide into the upper atmosphere, and the sulfur combined with water vapor to form droplets of sulfuric acid that created a veil, blocking sunlight and reducing surface temperatures causing food shortages. In 1816 Europe and North America experienced a "year without summer," resulting in massive food shortages and subsequent disease outbreaks. Just as the Eyjafjalljokull eruption disrupted passenger transportation, an eruption could impact the food distribution network.

Thus, there are many pathways to a global food crisis, some of them are more likely to occur, others are less likely, but it's not hard to imagine some combination of them coming together in a *perfect storm* to create a situation where not enough food is being produced and/or what is produced is not being collected and distributed properly.

We may be closer to the second condition than we realize: recent studies indicate that 30-50% of the food produced globally is wasted for one reason or another. The multiplicity of pathways shows that picking one particular pathway and preparing for it is not likely to be a worthwhile exercise.

Our thesis is that this represents gross overconfidence that the system will respond linearly to large events and that because it has been able to cope with previous smaller events it will also be able to cope with a larger one.

What is needed instead is a flexible and resilient response structure that is capable of dealing with all of the ways that a given crisis or set of crises might manifest itself. That is how we need to start thinking about the unthinkable.

Contributors to the session

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Gavin Macgregor-Skinner, Assistant Professor, Department of Public Health Sciences, College of Medicine, Pennsylvania State University

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& Laura Boudreau,
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Advancing Risk Assessment for Financial Applications

We all have our talents. For the disaster risk management (DRM) community, evidence suggests that reducing mortality risk from disasters is one of them: Mortality risk associated with weather-related hazards is declining globally, despite the rapid increase in population exposure to such hazards[4].

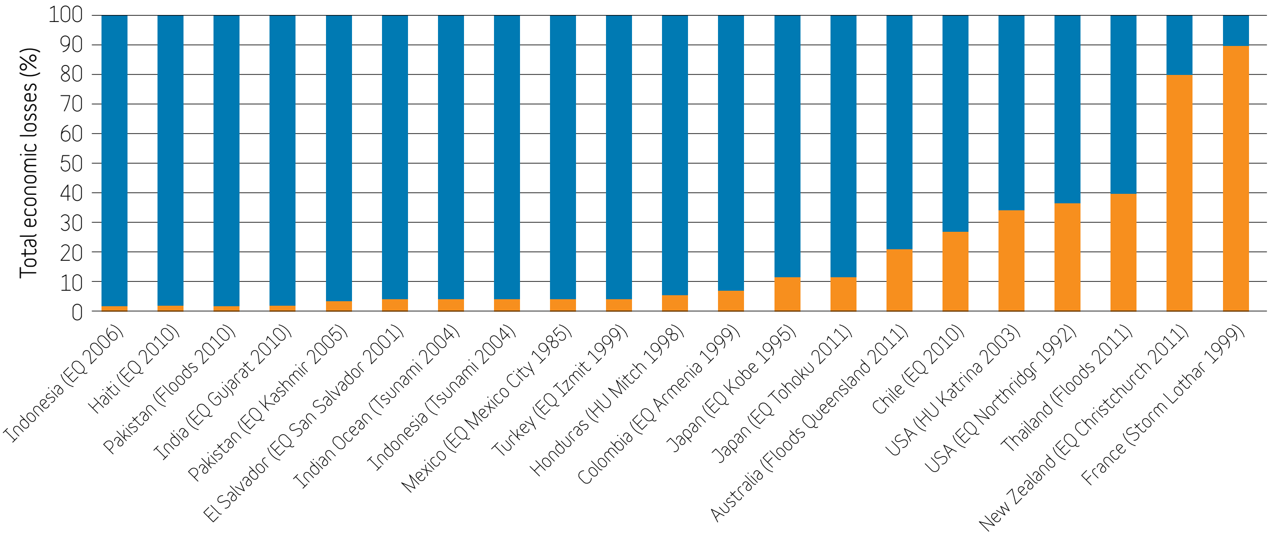
Likewise, we all have our weaknesses. And although DRM practitioners may shine at saving lives, we have fared much worse with reducing economic losses: Globally, the risk of losing wealth in a disaster is increasing at a faster pace than wealth is being created[5]. Increasing economic strength around the world is failing to translate into lower economic loss risk.

In absolute terms, post disaster losses in countries forming the Organization for Economic Co-operation and Development (OECD) are much greater than those in low- and middle-income countries. As a percentage of Gross Domestic Product (GDP), however, they are significantly higher in the latter[6].

Moreover, a significantly smaller share of the losses incurred in developing countries is typically insured; thus, the economic burden of these events is borne almost entirely by the households and the governments of these countries (Figure 1). Often, households and governments do not fully understand their exposure and may not secure adequate resources and/or purchase insurance to prepare for disasters.

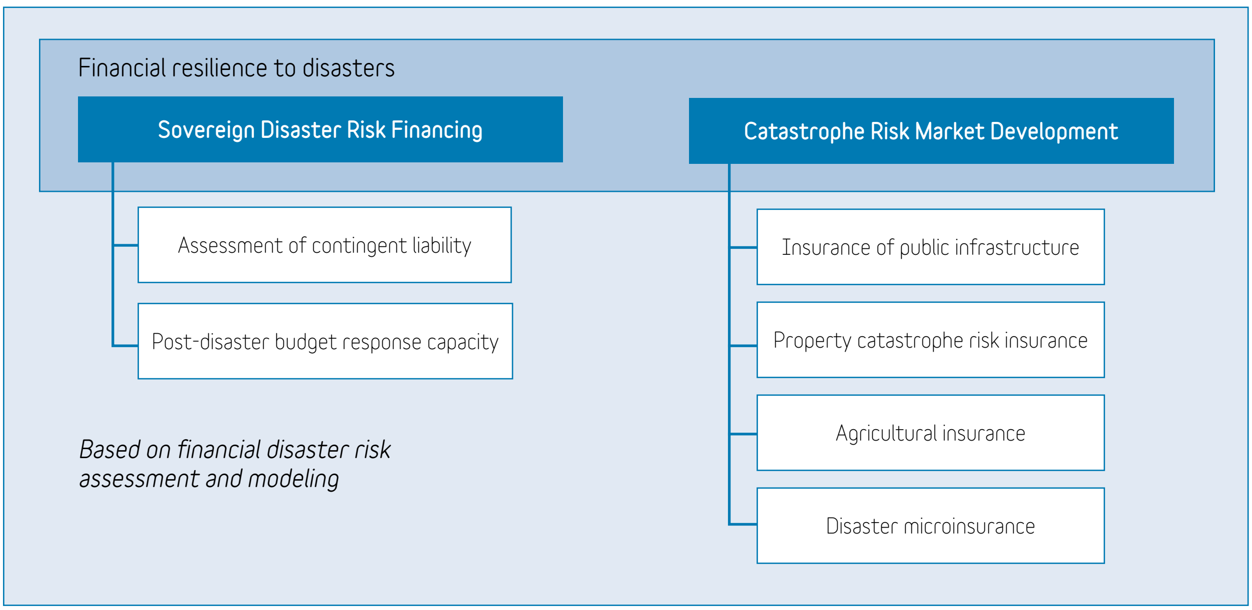
4 UNISDR (2011).
5 *Ibid.*
6 Cummins and Mahul (2010).

FIGURE 1: Insured versus uninsured losses from recent disaster events



Source: World Bank Disaster Risk Financing and Insurance Program (2012).

FIGURE 2: World Bank framework for improving financial resilience to disasters events



Source: World Bank Disaster Risk Financing and Insurance Program (2012).

Financial disaster risk assessment elucidates economic risk from disasters, enables the development of appropriate disaster risk financing and insurance (DRFI) strategies, and allows for risk transfer to the private sector.

A financial risk assessment forms the basis of taking a proactive approach to managing financial risk from disasters and improving financial resilience (Figure 2). In the World Bank framework, financial risk assessment and modeling can be applied at the sovereign level to assess the government's contingent liability to disasters, and to devise strategies to improve the government's post-disaster budget response capacity while protecting its long-term fiscal balance.

It can also be applied to inform the design and pricing of catastrophe insurance products, facilitating the development of catastrophe risk insurance markets.

Macro-level Risk Information, Assessment, and Financing

Developing a Sovereign Disaster Risk Financing Strategy - Mexico

At the sovereign level, a financial risk assessment is a primary input into a fiscal risk assessment of disaster risk. It entails an assessment of expected losses to the government's fiscal portfolio (for example, public buildings, infrastructure, low-income housing, etc.), an analysis of historical spending on emergency and other response and recovery costs, and an understanding of macroeconomic conditions.

Based on an understanding of its fiscal disaster risk profile, the government can then develop a DRFI strategy that combines *ex ante* and *ex post* instruments.

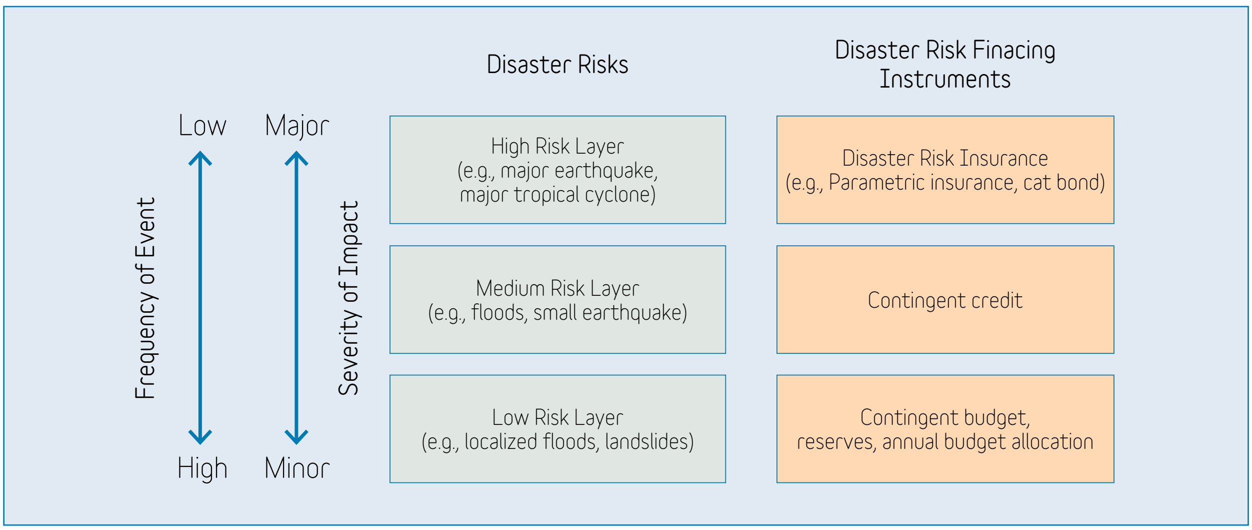
Developing *ex ante* instruments addresses multiple issues posed by complete or overreliance on *ex post* sources of financing (a common problem in developing countries), such as limited borrowing capacity, narrow tax bases for internal resource mobilization, and slow pace of external support.

The development of an *ex ante* disaster risk financing strategy relying on a combination of risk retention and transfer brings important benefits. This approach improves economic management of disasters, allows for an improved, targeted approach to post-disaster response, and can contribute to the development of the private insurance sector (Figure 3).

Developing a sovereign disaster risk financing strategy is a long-term effort and an iterative process, as illustrated by the experience of Mexico. By the mid-2000s, the Government of Mexico (GoM) had some elements of a disaster risk financing strategy in place: a national disaster fund (FONDEN), insurance policies for some infrastructure, and starting in 2006, a parametric catastrophe bond covering specific zones of the country for earthquake risk[7].

The GoM realized, though, that to understand how well it was protected relative to its exposure and to move toward a stronger,

FIGURE 3: Disaster risk financing strategy combining risk retention and transfer tools



Source: Ghesquiere and Mahul (2010).

[7] A parametric catastrophe bond or insurance product makes indemnity payments based not on an assessment of the policyholder's losses, but rather on measures of a parametric index (e.g., wind speed, earthquake intensity) that is assumed to proxy actual losses.

ex ante DRM approach required an essential element: Information.

Starting in 2007, the Ministry of Finance, in collaboration with the *Universidad Nacional Autónoma de México and Agrosemex*, the state-owned insurance company, began to improve its information on hazards in Mexico (starting with earthquake and hurricane), and on the exposure of public assets and low-income housing to these hazards.

The partners developed a multi-hazard probabilistic risk model to estimate losses from disasters to Mexico's portfolio of public assets. A probabilistic approach to catastrophe risk assessment is essential for disaster risk financing as historical records typically lack the impacts of potential major losses from low probability, high impact events. Probabilistic catastrophe risk modeling techniques estimate these losses, allowing for the quantification of expected losses from devastating events.

Based on its improved understanding of its catastrophe risk profile, the GoM began to update its risk financing approach, starting with the top risk layers (Figure 4). In 2009, the GoM issued a second parametric catastrophe bond, and starting in 2011, an excess-of-loss insurance contract was placed to protect FONDEN from major losses (the contract uses FONDEN's damage evaluations for the adjustment procedure).

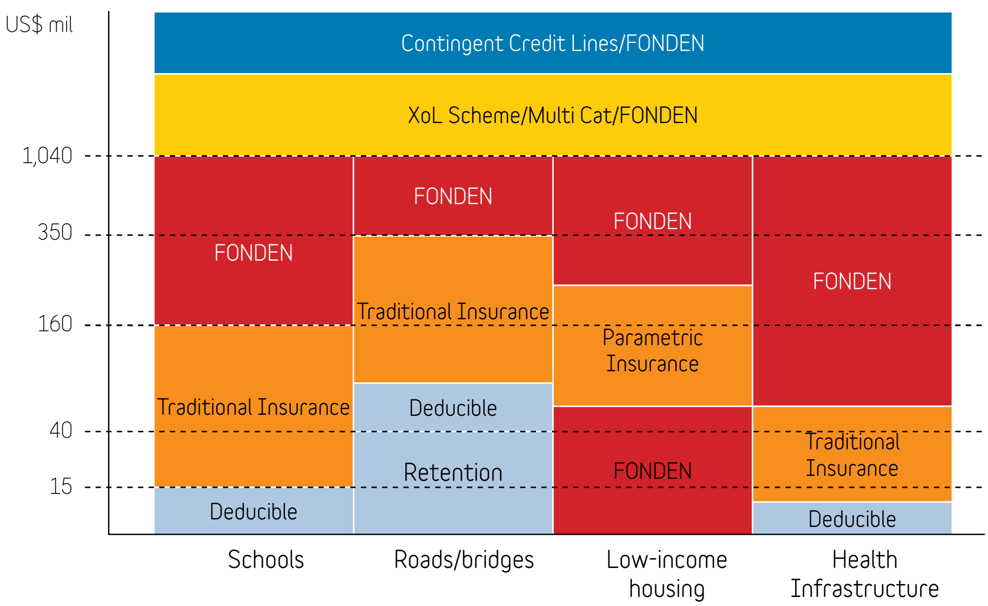
More recently, the GoM has started working through lower risk layers and is conducting additional risk analysis to improve the effectiveness and efficiency of FONDEN.

Developing Financial Products - Malawi

Beyond informing the design of a disaster risk financing strategy, improved risk information and assessment is used to develop and implement the products comprising the strategy.

In Malawi, for example, the government has implemented a weather derivative program relying on an index that relates rainfall data with a maize production model (Figure 5). The weather derivative program is part of the country's broader agricultural risk management strategy; one of the primary objectives of the program is to improve drought risk assessment and early warning tools. The macro-

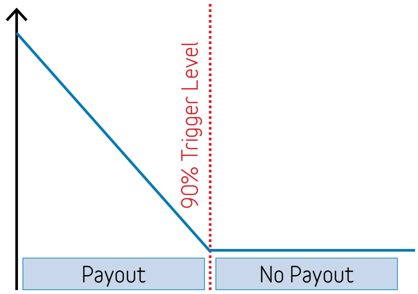
FIGURE 4: Mexico's evolving disaster risk financing strategy

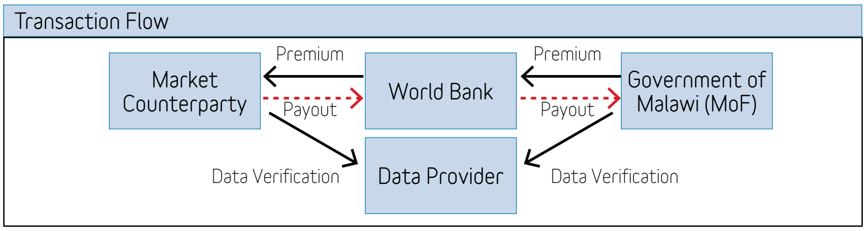


Source: Lobato (2012).

FIGURE 5: Structure of the 2011-12 Malawi weather derivative

Type of Contract	Put Option
Premium	$US 499,950
Maximum Payout	$US 4.41 million
Payout per commodity index unit	$US 147,000
Start Date	October 1, 2011
Final Date	April 30, 2012
Strike	105 below average index value (90)





Source: Kachingwe (2012).

level weather derivative provides financial protection against severe drought impacting the country's maize harvest.

The parametric nature of the product means that it eliminates the need for on-site assessment of maize yields. When the modeled maize production (based on actual rainfall data) falls below 90 % of the long-term average, the contract will begin to payout to the government. The maximum amount that the government could receive under the contract is US$4.41 million.

The derivative has been transacted four times starting in 2008 but has not yet been triggered, although it came especially close during the past year. In this context, the government is reviewing its modeling approach and assessing alternative approaches, as well as confronting broader policy questions on the continuation of the program.

Regional Risk Pooling Initiatives - Africa Risk Capacity

One risk financing option available to Malawi and other African countries is the African Risk Capacity (ARC) project being advanced by the African Union (AU). The ARC will be a regional risk pooling facility owned by the AU that will provide participating countries with quick-disbursing funds in case of drought.

Participation in a regional approach as part of a country's disaster risk financing strategy can provide numerous benefits and address the trans-boundary nature of many hazards. Significant economies of scale may be created when risk financing solutions are developed at the regional level. These include both potential risk pooling benefits and reduced operating costs. These vehicles can also efficiently leverage the international reinsurance and capital markets.

In the case of the ARC, part of the goal of the Facility is to transfer ownership of DRM from the international community to African governments by reducing dependence on *ex post* donor assistance. One of the primary ways that the ARC will help governments to take ownership of their risk is by providing them with improved information based on the *AfricaRiskView* software tool. *AfricaRiskView* generates modeled drought response costs based on satellite weather data and the model's internal parameters. It allows governments to quantify the expected annual costs of drought response as well as expected response costs for extreme droughts.

With this information, a government can improve its contingency planning to quickly execute funds to enact an early response, and it can take a proactive approach to financial management of droughts.

Risk Assessment for Catastrophe Risk Insurance Market Development

Risk assessment is also an essential input to the design of catastrophe insurance products at the micro-level. Insurance companies rely on analysis of expected losses from disasters to form the base of catastrophe insurance policy pricing.

However, the design and pricing of catastrophe insurance products is technically complex and insurers in developing countries may lack technical capacity to underwrite catastrophe risk. The significant upfront financial investment required for catastrophe risk assessment can also be a deterrent.

In this context, one way that the government can help catalyze insurance market growth is through the provision of basic risk market infrastructure as public goods, such as catastrophe risk assessment and pricing, product development, underwriting and loss adjustment procedures, and distribution channels. This support can promote market growth, building domestic insurers' capacity while supporting the sale of reliable, cost-efficient insurance products.

Public-private partnerships (PPPs) are an effective approach to establish sustainable and affordable catastrophe risk insurance markets. In South Africa, the South Africa Insurance Association (SAIA) and the National Disaster Management Center (NDMC) are engaged in a PPP to address the increasing level of systemic risk from disasters in the country.

The SAIA and the NDMC signed a Memorandum of Agreement for activities including risk mitigation, sharing data and knowledge, improving education on disasters, and increasing access to insurance for South Africans. The partners plan to collaborate on risk assessment, which will benefit both the government and local communities due to improved understanding of disaster risk, as well as provide insurers with the information required to offer effective, appropriately priced insurance products.

Conclusion

Countries interested in advancing risk assessment for financial applications will face numerous challenges but can also reap many benefits (including for additional applications) from this investment.

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Anthony Julies, Chief Director, Strategy and Risk Management, National Treasury, Government of South Africa

Further Resources

- World Bank-GFDRR Disaster Risk Financing & Insurance Program: http://www.gfdrr.org/gfdrr/DRFI
- Willis Research Network: http://www.willisresearchnetwork.com/
- Wharton Risk Management and Decision Processes Center: http://www.wharton.upenn.edu/riskcenter/
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For countries seeking to advance risk assessment for financial applications, some essential considerations include:

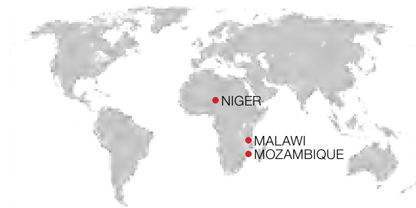
1. ***Identify what question needs to be answered, and how to get there.*** Before starting a risk assessment, the end-users should identify what question(s) require answering: Is the goal to identify the expected losses from disasters on a portfolio of assets? Is the goal to be able to design a risk financing and transfer strategy for those assets? The goal of the risk assessment will help to inform the approach and the respective responsibilities of different entities involved. For the government, this may require building catastrophe risk modeling expertise of relevant specialized agencies while increasing capacity of the different ministries to use the outputs for their own purposes. A ministry of finance, for example, requires expertise on using the outputs of a catastrophe risk assessment as an input into financial analysis of its disaster risk financing strategy, rather than expertise on catastrophe risk assessment.

2. ***Adopt an iterative approach to disaster risk assessment and financing.*** As illustrated by the cases of Mexico and Malawi, it is possible for a government to engage in disaster risk financing and insurance in parallel with improving its risk information and assessment. The government can protect itself in the short-term by budgeting for disasters based on previous experience, considering soft-triggering instruments (for example, contingent credit), and taking a parametric approach to risk transfer. Then, as additional information becomes available the government can periodically adjust its coverage and consider more indemnity-based insurance.

3. ***Collaborate and share risk information across stakeholders.*** Regardless of the stakeholders involved, advancing risk assessment for financial applications is a collaborative effort requiring information sharing. For example, a government that seeks to design and implement a disaster risk financing strategy based on in-house assessment of the exposure of public assets to disaster risk and the expected losses generated will likely need to collaborate with the ministry of finance, national disaster risk management agency, lines ministries holding exposure data, meteorological, geological, and other institutions holding hazard data, and others. Public-private partnerships (PPPs) can be especially valuable in this area.

GAR 2011

Photo © Ben Heys | Dreamstime.com



The Global Assessment Report [GAR]

Julio Serje, Program Officer, United Nations International Strategy for Disaster Reduction

The Global Assessment Report (GAR) on Disaster Risk Reduction (DRR) is a resource for understanding and analyzing global disaster risk today and in the future.

Since 2009, the United Nations International Strategy for Disaster Reduction (UNISDR) has published two editions of the GAR: the first one in 2009 (GAR09) was launched by the UN Secretary General in Bahrain, and the second (GAR11) was the background document for the Global Platform on Disaster Risk Reduction held in Geneva in June 2011.

GAR09 focused on the nexus between disaster risk and poverty in the context of global climate change. The 2011 edition "Revealing Risk, Redefining Development" looked at DRR as an integral part of development, highlighting the political and economic imperative to reduce disaster risks, and the benefits to be gained from doing so. The report offers guidance and suggestions to governments and nongovernmental actors alike on how they can, together, reduce disaster risks.

The GAR team is now engaged in the production of the third edition of the report that will be used to feed the discussions of the Global Platform for Disaster Risk Reduction, in Geneva, May 2013. Drawing on new and enhanced data, the report explores trends in disaster risk for each region and for countries with different socioeconomic development. At the same time, over 130 governments are engaged in self-assessments of their progress towards the Hyogo Framework for Action (HFA), contributing to what is now the most complete global overview of national efforts to reduce disaster risk

During the 2012 Understanding Risk (UR) Forum, the GAR session showcased the results of GAR11, with a special focus on the recommendations that provided specific and tangible suggestions on how to mainstream risk knowledge into development, and provided an overview of the progress on the work done for the upcoming GAR13. Specifically, the session focused on the area of drought risk assessment, a highly relevant topic in the African context and an area that still remains less well understood.

Highlights from GAR 11

The *Global Risk Update*, a risk assessment of five major hazards that was conducted as part of the scientific activities of GAR09 and GAR11, provided for the first time a seamlessly integrated point of reference and baseline data for the global community on disaster risk.

GAR11 reviewed how governments are scaling up disaster risk management (DRM) by adapting existing development instruments, such as national planning, public investment systems, and social protection mechanisms.

The global risk trends from the report indicate that in recent decades, countries in all regions have strengthened their capacity to reduce risks associated with major weather-related hazards, such as tropical cyclones and floods, and that mortality risk relative to population size is also falling.

However, unlike risks associated with tropical cyclones and floods, those associated with drought are not as well understood and remain a “hidden risk” and an area that requires further focus.

During the session a quantitative approach to measure the potential losses (risk) due to drought based on several historical data sources and probabilistic modeling was presented, looking at case studies from Malawi, Mozambique and Niger. Drought Loss Exceedance Probability Curves for principal rain fed crops were derived using a geo-spatial, stand-alone implementation of the Water Requirements Satisfaction Index – GeoWRSI,[8] currently being implemented by the United States Geological Survey (USGS) for the Famine Early Warning System (FEWSNET).

An innovative technique of using Disaster Loss Databases to construct hybrid risk models was presented. The hybrid risk model is built by constructing two loss exceedance curves: one derived empirically from recorded disaster losses, and the other derived analytically (for major hazards, such as earthquakes and tropical cyclones).

Systematically collected data about the impact of disasters is evaluated to obtain consistent economic loss values of all scales. From a statistically significant database a Loss Exceedance Curve can be obtained, which in turn can be ‘merged’ to the curve resulting from a probabilistic risk assessment, creating in this way a ‘ Hybrid’ curve with a much wider spectrum of intensities and frequencies.

GAR 13

Features of the 2013 GAR Report include:

- **An Improved Global Risk Update:** An enhanced probabilistic risk model for the world, addressing gaps in current knowledge on risk patterns and trends, will provide accurate and credible information for the global DRR community.
- **A Focus on Drought Risk Assessment:** Several methodological approaches to measure and locate drought hazard and drought risk are being tested.
- **Progress towards the Hyogo Framework of Action (HFA):** The 2011–2013 HFA Progress Review is a continued and enhanced monitoring of progress by countries and regions against the objectives and priorities for action of the HFA, including through regional and sub-national level assessments.
- **The Role of the Private Sector in DRR:** Policy research on the business case for DRR, including scoping studies on pilot industry-led and -agreed standards on DRR for a number of key sectors, industries and services.

[8] See: http://earlywarning.usgs.gov/fews/geowrsi.php

Contributors to the session

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Further Resources

- http://www.unisdr.org
- http://www.preventionweb.net

Q&A

Interview with

ALAN KNOTT-CRAIG JR.

CEO, World of Avatar

What recent innovations in the field of risk assessment will have the largest impact over the next 10 years?

The advent of "big data" will lead to massive improvements in the management of risk by allowing the recognition of patterns far in advance of major events.
An underrated and overlooked tool for risk assessment is data analytics using social network datasets. These tools allow you to predict behavior well in advance of action.

If you were in the elevator with your country's President/Prime Minister and only had 30 seconds to convince her/him of the importance of risk assessment, what would you say?

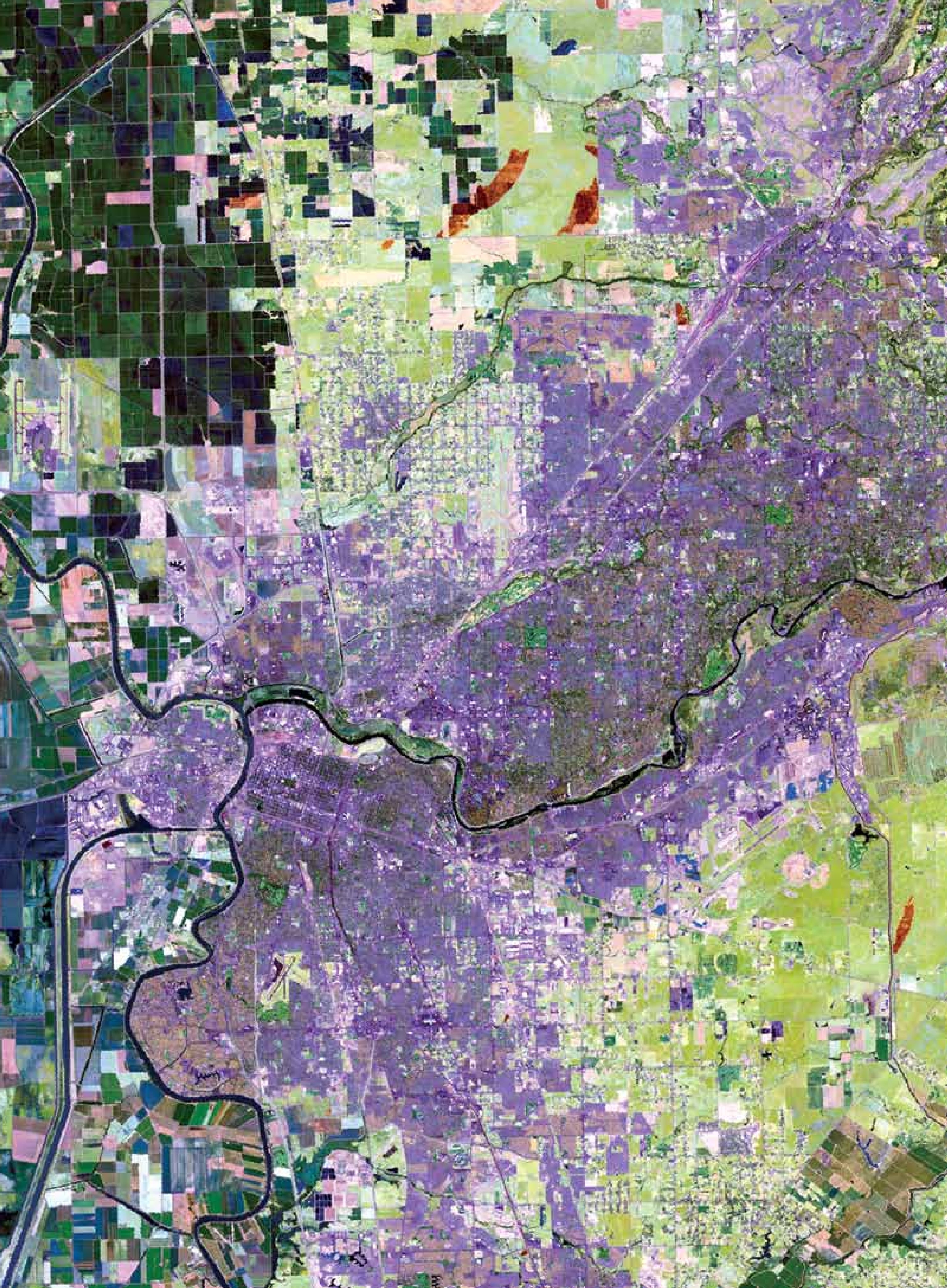
"Picture a global financial recession, spanning a minimum of 5 years, all because government didn't understand the risk of financial instruments."

What are the most significant challenges - both operationally and politically - to mainstreaming risk assessment and the Disaster Risk Management (DRM) agenda in your county?

Where do I start! We have bigger problems... I think mainstreaming is unrealistic. For now it's about getting into the head of policy-makers.

Alan Knott-Craig Jr., CEO, World of Avatar

Alan is the founder and CEO of World of Avatar, a developer of mobile applications for Africans. Between 2003 and 2006 co-founded five companies in the mobile telecoms sector. In 2006 appointed managing director of iBurst, the third largest wireless broadband network in South Africa. In April 2008 published *Don't Panic*, persuading South Africans to come home. In June 2008 founded The Trust, an NGO focused on assisting charities access skills and capital. In 2009 nominated as a Young Global Leader by the World Economic Forum. Alan is a qualified Chartered Accountant (SA.)



New Tools and Methodologies for Building Disaster Resilience: Moving from Risk Assessment to Mitigation

"If we get this right, if we actually connect our science to decision-making, we can save lives."

Dr. Trevor Dhu,
Risk and Vulnerability Manager, AusAID

The ultimate goal of disaster risk reduction (DRR) efforts, including risk assessments, is to build the resilience of communities. This requires communities and government, from local to national, and across different sectors such as finance, planning and infrastructure, to own and share a common and robust understanding of risk; and to take responsibility for managing and, where possible, mitigating these risks.

One of the major challenges faced by all risk assessment professionals is how to bridge the gap between scientists, policy-makers and communities to ensure we are making evidence-based decisions across a range of DRR and climate change adaptation (CCA) actions and investments.

At the 2012 Understanding Risk (UR) Forum the focus of the session was framed around the question of whether a better understanding of risk automatically leads to better decisions and tangible actions.

Turning risk assessments into action is complex but it can be done.

Three Key Characteristics of Successful Risk Assessments

1) Risk Assessments Must Be *Clear*: In order for risk assessments to affect change they must articulate risks in the language of the relevant decision-makers. This takes more than just a well-written and glossy report; risk assessments must be carefully targeted to a specific decision-maker and a specific set of problems.

In the case of the Pacific Catastrophe Risk and Financing

Questions posed during the UR Forum to the Panel:

1. Can technology make risk analysis easier, or do we run the risk of having a more rigorous understanding of risk without community ownership and subsequent action?

2. How do we take advantage of the emerging culture of open data and open source software, and leverage off new ways to encourage participatory mapping, to ensure that communities and all levels of government effectively use new science to guide their actions, and advocate for increased DRR?

3. How do we get the full value from our scientific efforts and ensure that better knowledge is reaching communities and governments in a way that is easily understood, believed and, above all, acted upon?

Photo: Sacramento, California.

Initiative (PCRAFI) the success of this program in influencing policies and decisions was underpinned by the focus on ensuring that the results of this risk assessment were clearly articulated and were relevant to the specific problem that decision-makers understood and could therefore take action on. Articulating the risk in unambiguous terms, such as the potential dollar costs of disasters resulted in a significant engagement, uptake, and action by the government (see Box 1).

Similarly, in Indonesia, the National Disaster Management Agency developed a draft Tsunami master plan based on the overwhelming tsunami risk information from Padang, West Sumatra. In this case, risk assessments have outlined that there is not only an imminent threat of tsunami in Padang in the next 50 years, but that this event could kill over 39,000 people and destroy critical infrastructure such as ports and airports. The plan includes a range of innovative actions for protecting people from future tsunami across all of Indonesia.

The ability to articulate risks in clear-cut terms that immediately and clearly connect to decision-makers has led to a genuine commitment to action.

2) Risk Assessments Must Be *Credible*: The ability for anyone to make decisions based on a risk assessment will be heavily influenced by their trust and belief in the results. Assessments that do not demonstrate a rigorous, scientific approach and are clear about their uncertainties will not change policies, processes, or actions..

In El Salvador, the Ministry of the Environment and Natural Resource's demonstrated that the first step in affecting change is to have credible evidence and information to share. By undertaking one of San Salvador's most rigorous and comprehensive earthquake risk assessments, the Ministry is now in a position to work with a broad range of stakeholders to prioritize and take action. This action includes classical ways of improving building safety through refining and improving the quality of building codes. It is also allowing engagement with other Government ministries on

Box 1: Risk Identification: Assessing Risk Region-Wide in the Pacific.

Photo: Carlo Iacovino

How to improve understanding of risk in the Pacific?
"No way around it, you have got to put dollars on the table"

This simple message from the World Bank's Michael Bonte-Grapentin was seen as a key factor in ensuring comprehensive risk assessments, such as the Pacific Catastrophe Risk and Financing Initiative (PCRAFI) reformed policies around risk financing in the Pacific.

PCRAFI created the largest collection of geospatial information on disaster risks available for Pacific Island countries. The platform includes detailed country information on assets, population, hazards, and risks.

The first phase of the program conducted detailed risk assessments for 15 countries, quantifying potential disaster losses from earthquakes, tsunamis, and tropical cyclones. This assessment includes the most comprehensive analysis of building, infrastructure, and cash crop exposure ever conducted for the region. Resulting exposure, hazard and risk maps, and data are shared with policy-makers and the public.

The project is a joint initiative of the Secretariat of the Pacific Community, Applied Geoscience Technology Division, the World Bank, and the Asian Development Bank. The Government of Japan and the Global Facility for Disaster Reduction and Recovery provided financial support.

topics such as the prioritization of key schools and hospitals for retrofitting programs. While the program is still ongoing, it is the credibility and compelling nature of the risk assessment that is allowing the first steps towards tangible mitigation.

For the Pacific, PCRAFI collected information on over 3,500,000 buildings across 15 countries in the Pacific and then used state-of-the-art probabilistic risk assessment techniques to analyze earthquake and cyclone risks. The sheer scale and level of detail of this assessment led to results that were highly credible and provided an information-base that was trusted.

3) Risk Assessments Must Be *Collaborative*: We all understand that many risk assessments require a range of technical disciplines from social science to engineering. However, there equally needs to be an early focus and engagement with the final decision-makers to ensure that they take ownership of the risks that they need to manage.

In Indonesia, new approaches to community-based, participatory mapping are encouraging communities to actively participate in, and take ownership of their risk. Using OpenStreetMap (OSM), these participatory approaches are closely aligned with community-based disaster risk management (DRM) programs that pride themselves on community ownership and subsequent community-driven actions.

Indonesia is also working with Australia and the World Bank to develop new software – the Indonesia Scenario Assessment for Emergencies (InaSAFE) – to draw together this community data with technical information on hazards from a range of other government agencies and universities.

These two tools, OSM and InaSAFE, are being used to develop a hybrid approach to risk assessments that allow communities and local governments to more closely engage and interact with the risk assessment process. They are leading to more accurate assessments with more direct impact and uptake by at-risk communities.

Similarly, governments need to articulate the need for and purpose of risk assessments. Yemen's Ministry of Planning and International Cooperation developed a film to communicate the tragic consequences of not truly understanding and mitigating our risks, using the example of the 2008 Hadramout and Al-Mahrah floods. However, work still needs to be done to understand the priority risks that should be considered in the reconstruction process and to help ensure that the Government can better protect its people.

This focus and call for better evidence to inform decision-making reinforces the need for risk assessments and the potential for these assessments to lead to changes and safer communities.

Conclusion

Unfortunately it is all too common to have risk assessments that do not lead to the changes or outcomes that are desperately needed. We need to continue to improve not just the technical rigor of what we do, but how we do it. We need to ensure that we maintain our credibility, but at the same time we must increase the targeting and clarity of our results and ensure that the people who have to take action based on risk assessments are engaged in, and have full ownership of the process from the beginning.

This will require all practitioners, from scientists and engineers, to policy-makers and communities to actively work together to ensure that every improvement in our understanding of risk leads to better decisions, tangible change, and therefore safer communities.

Contributors to the session

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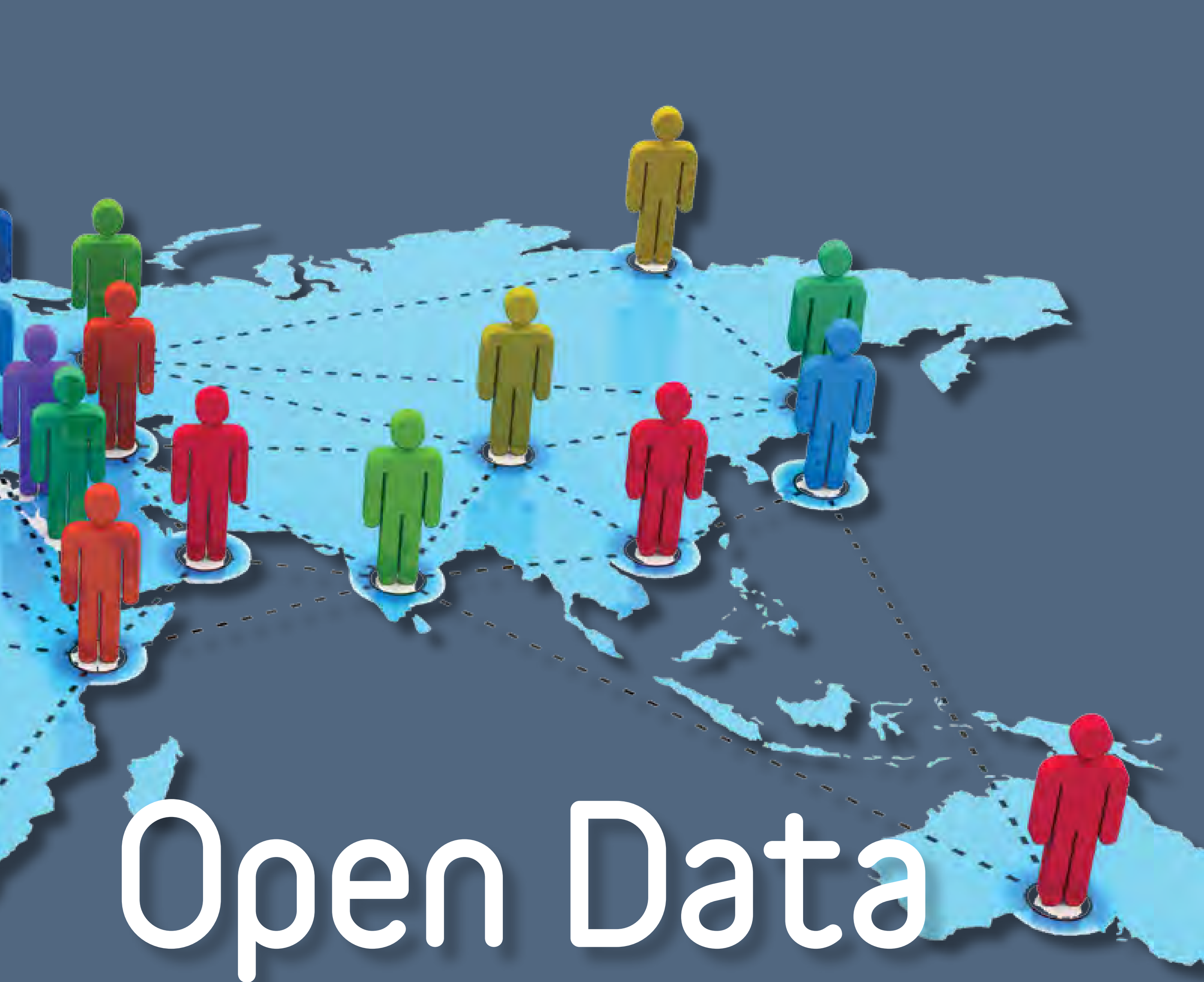
Abdullah Mohamed Ali Motafi, Deputy Public Works Minister, Yemen


TRINIDAD & TOBAGO
SAHEL
SRI LANKA
INDONESIA
HORN OF AFRICA
SOUTH AFRICA



Open Data

"The importance of making information about hazard risks available cannot be overemphasized." —Natural Hazards, UnNatural Disasters, the Economics of Effective Prevention

Robert Soden,
OpenDRI Lead, Global Facility for Disaster Reduction and Recovery, World Bank

In order to build resilient societies, policy-makers and the public must have access to the right data and information to make good decisions. Decisions such as where and how to build safer schools, how to insure farmers against drought, and how to protect coastal cities against future climate impacts cannot be made without knowledge of the most accurate and updated information on risk.

However, decision-makers typically lack access to actionable data and/ or the analytical tools to leverage this data. Furthermore, the frequent duplication of research and data collection due to lack of sharing between institutions is commonplace. And so, even when *"information is collected, it is not always shared, even though sharing information on hazards involves relatively little expense because some government agencies already collect and analyze data on hazard risks."*[9]

9 GFDRR, *Natural Hazards, UnNatural Disasters,* (2010).

Sharing data and creating open systems promotes transparency and accountability. It can help crack black box approaches and build more participatory and innovative platforms for a dynamic and actionable understanding of risk.

Challenges

Risk analysis requires the integration of many different kinds of data and information. A flood risk model for a single catchment, for example, might take datasets describing rainfall volume and intensity, elevation and slope, land-use patterns, soil characteristics, as well as location and description of critical infrastructure, population centers, and other assets that could be negatively impacted by flooding.

In most cases, these critical input datasets are in the hands of a wide range of actors across different ministries or administrative units, the private sector, and international or non-governmental organizations. Too often, data sharing arrangements between these groups are weak, informal, incomplete or insufficient. At times there is a lack of adequate technological infrastructure for data management and distribution, leading to the inaccessibility of this data.

Furthermore, in many cases, risk analysis has been a closed process conducted by private consultancies and expert practitioners with limited participation or input from the broader government sector and the public. This has led to a lack of meaningful use of the outputs in policy-making and planning processes, unnecessary duplication of work, and a failure to meaningfully communicate this information to at-risk populations.

Moreover, often governments struggle to open hazard and risk information due to concerns of cost recovery for funds spent on data collection, privacy and security issues, and lack of technical capacity to effectively share risk data.

Responses to Institutional Challenges

Based on the experience of national mapping agencies engaged in open data programs in South Africa and Indonesia, the following responses to institutional challenges are articulated below:

▶ **Cost Recovery:** Many countries sell hazard and risk data to recover the costs of data collection and the operational expenses of the ministry, resulting in an unwillingness to share data at no cost. However, there is little evidence supporting data sales as an effective fund-raising activity. In fact, the infrastructure and capacity necessary to conduct data sales is often more expensive than revenue generated through this approach. Furthermore, studies have also shown that open data policies spur scientific research, the development of software tools, and guide decision-making, creating economic benefits.

▶ **Security and Privacy:** Often governments are concerned about opening building stock and tenure data due to the perceived sensitivity of real estate prices to sharing this information. Yet, the raw data required to build exposure databases for risk assessment is non-sensitive and is often already public. By opening the underlying raw data, existing maps can be validated, and the data can contribute to other research and analysis. Moreover, there are already well-established practices in place for opening other datasets that have equal or more impact on real estate values such as air and water quality, crime statistics, and educational indicators.

▶ **Technical and Management Capacity:** Many countries lack

During the UR Forum a multidisciplinary panel addressed the following questions:

1. What are the specific challenges that the open data movement is facing in the field of disaster risk assessment?
2. What have we learned from early attempts at building open data initiatives around hazard, exposure, and risk information?
3. What partnerships can be built at the international level to help countries open their own data?
4. What challenges and opportunities will these efforts face in years to come?

Open Data: "Facts Cannot be Copyrighted"

In its simplest framing, data can be said to be open when it is both legally and technically open. For data to be considered legally open, it must be released under a license that allows for the reuse and redistribution for either commercial or non-commercial uses. Examples include the Creative Commons suite of licenses (http://creativecommons.org/) or the Open Data Commons Open Database License (ODBL) (http://opendatacommons.org/licenses/odbl/).

Technically open data is data that is available over the web on a permanent address, which can be downloaded or accessed through an Application Programming Interface (API) in structured and non-proprietary formats. Open formats for geospatial data, which comprises the majority of risk-related information, include shapefile, GeoTiff, and CSV or OGC compliant web services (for more details: http://www.opengeospatial.org/standards)

The open data philosophy has existed within the scientific community for decades, championed by those who argue that facts cannot be copyrighted and point to the many ways in which free access to basic data encourages beneficial research and innovation in academia and the private sector.

More recently there has been a strong emphasis on open government data as part of a larger strategy to promote transparency, accountability, and participation in governance. The Open Government Partnership (OGP) (http://www.opengovpartnership.org/) is a new multilateral initiative under which 47 governments have committed themselves to adopting these principles as part of anti-corruption efforts, improving delivery of public services, and other endeavors. Web-portals like Data.gov have made huge amounts of government data available.

Development institutions such as the World Bank, the African Development Bank, and US AID have also adopted open data policies and practices in the last few years as part of efforts to make the development process more inclusive and transparent.

the technical and management capacity to effectively build open data initiatives. This capacity includes the necessary institutional arrangements, the technical capacity to manage and release data, and the human capacity to make effective use of open data. Efforts to build capacity include initiatives such as the Mapping Africa for Africa project. Led by the South African Government, it provides funding and capacity-building to national mapping agencies in the region. The Africa Development Bank's Open Data Initiative is also partnering with governments in the region to assist them with launching their own open data projects and platforms.

The Demand Side of Open Data

In the eyes of some within the open data movement, the process of making data technically and legally open is only the beginning. It is argued that ensuring data is open is a necessary but insufficient part of broader efforts towards open government or open development. Below are a couple of tactics for ensuring that open data is used and useful to these ends.

- **Engaging Volunteer Technology Communities (VTCs).** Apps competitions, developer challenges, and targeted hackathons are a common way of quickly generating innovative applications and visualizations that both demonstrate the utility and raise the profile of open data projects. The Random Hacks of Kindness (RHoK) network is a partnership between the World Bank, NASA, Google, Yahoo, Microsoft, Hewlett Packard, and other organizations that connects leading technologists and innovators to subject matter experts to develop novel

Regional Open Data Partnerships

The University for the West Indies (UWI) and the Eastern Caribbean: The World Bank and the UWI in Trinidad and Tobago are partnering to support regional open data efforts to build climate and disaster resilience in the Eastern Caribbean.

Since 2011, a series of regional workshops and trainings have brought together government counterparts, data management practitioners, regional experts, and UWI faculty and students to discuss risk assessment, data standards and sharing, open source software, and community mapping. These efforts are helping countries in the region develop institutional arrangements and technical capacity to open, manage, and use geospatial data to improve information-based decision-making related to disaster risk management and climate change adaptation.

A critical and unique element of this initiative are the efforts being made to develop a regional community of practice and a network of technical experts that focus on open data and disaster risk assessment. The integrated regional approach of the workshops and trainings, as well as an online social networking platform launched in support of the activities, allow participants to connect and share experience about common challenges, solutions, and innovations across the region.

International Collaboration for the Horn and Sahel Crises: The droughts of 2011 and 2012 in the Horn of Africa and the Sahel are regional challenges that require regional analysis and solutions. However, collecting the right data and information in support of these efforts is especially challenging because of the cross-border character of the emergencies.

A partnership of institutions including the World Bank, the Regional Center for Mapping of Resources for Development (RCMRD), the World Food Program (WFP), National Aeronautics and Space Administration (NASA)-SERVIR, the UN Office for the Coordination of Humanitarian Affair (OCHA), the UN High Commissioner for Refugees (HCR), the Famine Early Warning Systems Network (FEWSNET), and Development Seed, convened in September 2011 to help address lack of up-to-date and accurate information to combat the droughts.

This partnership launched two data sharing platforms (http://horn.rcmrd.org and http://sahelresponse.org) in order to allow regional and international organizations to share and visualize their data describing the droughts. By pulling together data sources into one site, the platforms offer the ability to strengthen data sharing between partners and donors. A common operating picture is critical for a coordinated response, and these platforms help bring together critical datasets to inform the response.

These platforms are now being used in support of efforts to understand and combat the crises as well as develop further capacity in the affected regions to conduct risk assessment and use open data and open source tools to build long-term resilience to drought and other natural hazards.

OpenDRI
OPEN DATA FOR RESILIENCE INITIATIVE

Random Hacks of Kindness, Lusaka, Zambia.

applications for development challenges.

▶ **Engaging Government.** A critical user group of open data in the risk assessment context is government. For governments to engage in open risk data activities, projects must link closely to the meaningful use of this data. In Indonesia and Sri Lanka, for example, the government has participated in open data projects using community mapping. These projects are closely tied to the development of free and open source impact modeling software that will help disaster management agencies conduct contingency planning and post-disaster damage assessments. (For more information on these approaches, see "New Tools and Methodologies for Building Disaster Resilience p. 25").

Operationalizing Open Data for Understanding Risk

In 2011, the World Bank created the Open Data for Resilience Initiative (OpenDRI) to tackle the open data mandate within the disaster and climate change risk assessment context. OpenDRI has active efforts underway in over 25 countries and partners with governments, universities, international agencies, and the private sector to ensure open access to data strengthens the risk assessment process.

These projects take a variety of different forms, depending on the context, but include helping governments establish institutional arrangements in support of open data, community mapping activities, and the development of new tools to leverage open data for risk decision-making.

Although a young and growing program, the early successes of OpenDRI demonstrate the appetite for, and value of, the open data vision in our efforts to understand risk.

Contributors to the session

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Further Resources

- Open Data Handbook: http://opendatahandbook.org
- International Aid Transparency Initiative: http://www.aidtransparency.net
- GeoNode: http://geonode.org
- OpenStreetMap: http://www.openstreetmap.org
- Open Data for Africa: http://www.afdb.org/en/knowledge/statistics/open-data-for-africa
- World Bank Open Data Initiative: http://data.worldbank.org
- Open Knowledge Foundation: http://okfn.org/

Photo: Festival in Kathmandu, Nepal. Credit: © Thinkstock.com

Applications of Crowdsourcing for Development and Disaster Response

Kate Chapman,
Acting Executive Director,
Humanitarian OpenStreetMap Team

The first step is to determine whether crowdsourcing and its technologies are the correct approach for a project. Often, practitioners mistakenly seize upon a particular technology first and then try to figure out how to make it work second.

Crowdsourcing is a process where distributed groups of people work together to complete a task or solve a problem. Examples of large crowdsourcing-related platforms and projects include Amazon Mechanical Turk[10], Wikipedia, and Zooniverse[11].

There are other projects that operate on different scales, that is, in terms of the number of participants, the quantity of information processed and the purpose. In recent years crowdsourcing methodologies and applications have been applied to the field of disaster risk management (DRM), and mainly in the area of response. Distributing and sharing tasks through crowdsourcing can help direct and distribute aid in a crisis, for example. But it can also be a strong method for creating more detailed reporting on mapping vulnerable areas for disaster risk reduction (DRR) activities.

This session sought to show how to apply crowdsourcing efforts to disaster risk assessment, contingency planning, and other *ex ante* preparedness activities. Work has begun in this area but is in relatively early stages. Through an analysis of past projects, the panelists looked at what one should consider before starting a crowdsourcing project, outlining the types of incentives that work with crowds, what ethical considerations need to be taken into account, and potential methodologies and technologies.

Incentives of Participants

When evaluating possible incentives for crowdsourcing it is important to evaluate if simply paying for completion of microtasks will be more cost-effective than the cost of organizing volunteers. There are, however examples where the "crowd" is made up of global volunteers, and this generally will happen after a crisis.

The January 12th, 2010 earthquake in Haiti gave attention to a movement that has come to be called "Volunteer Technology Communities"(VTCs). These digital groups existed prior to the earthquake but not in the numbers that exist today. Digital volunteers possess varying technical skills and are mostly incentivized to engage for the altruistic goal of helping others. It is difficult to count the actual size of these groups, but it is dwarfed by the number of individuals participating in commercial crowdsourcing projects.

During a crisis, digital volunteers are not the only volunteers in crowdsourcing projects. Local community members may volunteer because they see the value of assisting their friends and family or other local benefits, and often they may be part of the impacted communities themselves.

To garner the crowd, some projects use simple recognition as an incentive. For example, the ship log transcription project, Old Weather[12], rewards participants as "captain of the ship" if they transcribed the most logs of that ship.

Other types of badges and rewards are typical when the incentive of crowdsourcing is gamification. In gamification of crowdsourcing, a game is created around a task and the incentive for participants can be points or other recognition.

Commercial tools, such as Amazon Mechanical Turk and Crowdflower[13], provide platforms for setting up crowdsourcing projects. Along with providing technology, they provide recruitment to projects, and distribution of funding to the paid crowdsourcing workers.

Though digital volunteers, local volunteers, and paid workers are not the only possible avenues for getting tasks done, they are a good starting point in an evaluation.

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10 See: https://www.mturk.com
11 See: https://www.zooniverse.org
12 See: https://www.oldweather.org
13 See: crowdflower.com

Creating Critical Infrastructure Baseline Data with Participatory Mapping - Indonesia

Indonesia Demo Map

As part of pilot programs in Indonesia, participatory mapping was used to collect data for preparedness and flood contingency planning activity. This effort was led by the Province of Jakarta's Disaster Management Agency (BPBD) and involved 500 representatives from all 267 urban villages and 70 students from the University of Indonesia.

OpenStreetMap (OSM) tools were used to map 6,000 buildings and critical infrastructure, including schools, hospitals, and places of worship and 2,668 RW (subvillage) boundaries.

The collected information was used through the Indonesia Scenario Assessment for Emergencies (InaSAFE) platform as part of the 2011/2012 Jakarta flood contingency planning, and can be used for future emergency exercises and DRM planning. The exercise helped to raise awareness, enhance technical skills and engage local stakeholders in DRM.

OSM offers several important features for participatory mapping: open source tools for online or offline mapping, a common platform for uploading, hosting data with free and open access and an active global community of users, and customized resources for a growing community in Indonesia; see http://en.openstreetmap.or.id/.

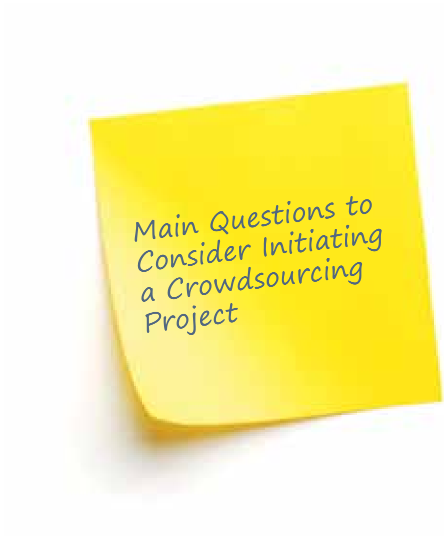
This work is part of an innovative approach to DRM through a partnership led by Indonesia's National Disaster Management Agency (BNPB) and AusAID through the Australia-Indonesia Facility for Disaster Reduction (AIFDR), United Nations Office for the Coordination of Humanitarian Affairs (OCHA) Indonesia, and the Humanitarian OpenStreetMap Team (HOT), with support from the World Bank and Global Facility for Disaster Reduction and Recovery (GFDRR).

Local Knowledge and Impacted Communities

Engaging community members in any crowdsourcing project is key, as they can provide local knowledge that the global crowd may not have. For example, when collecting exposure data via smartphones, the text messages often contain local nicknames for a place. Without that local information it could be impossible to determine where the place is.

Communities also know the places that are important to them and the history behind them. When performing a DRR activity, communities can pinpoint where previous events have occurred, what the effects were, and other details that may be only anecdotal and not available in official records.

Along with the importance of local knowledge comes the importance of engaging the impacted communities themselves in the process. There are non-technical ways to engage communities and for them to have access to the data collected. Instead of using smartphones, printed maps can be marked up, with "walking papers." The Public Laboratory for Open Technology and Science (PLOTS) initiative is piloting this approach by engaging communities in grassroots mapping tools, such as balloon or kite mapping.



1. What is the size of your crowd? Is it anyone on the Internet that is interested?
2. Is it a small community the cares very deeply about your specific project?
3. Are there ethical and safety considerations about the data being collected?
4. What workflows and technologies are you going to use?
5. How vital is the accuracy of the data? What level of error are you willing to accept?
6. What verification is necessary?

The safety of the communities themselves also needs to be considered if the project takes place in a conflict setting. In situations where there is danger to the communities the most important initial questions should be "should this project take place?" and "can this project be done safely?"

The Place of Verification

When crowdsourcing is initially described it can sound inaccurate and problematic. The idea of proposing a task to a group of various people, "a crowd," has the potential to be rife with inaccuracies, and this is why the verification process is important.

The different types of verification have many considerations:

- ▶ What do you know about the individuals and their skills in your crowd?
- ▶ Do you have historical information about the previous work of the individual?
- ▶ How critical is the accuracy of your data?
- ▶ Do participants have incentives for providing either accurate/ inaccurate information?
- ▶ How does the individual data point look when compared to others?
- ▶ Statistically does the information make sense? (note, this alone is not a good indicator)

By looking at these questions you can measure the importance of the level of verification in the process.

Conclusion

There are many elements that need to be considered before using crowdsourcing to accomplish a task. There will be circumstances where crowdsourcing is either going to be ineffective or inappropriate for a multitude of reasons. However, by performing careful planning upfront and taking into consideration as much information as possible about the crowd you are engaging, there will be a higher likelihood of success.

Contributors to the session

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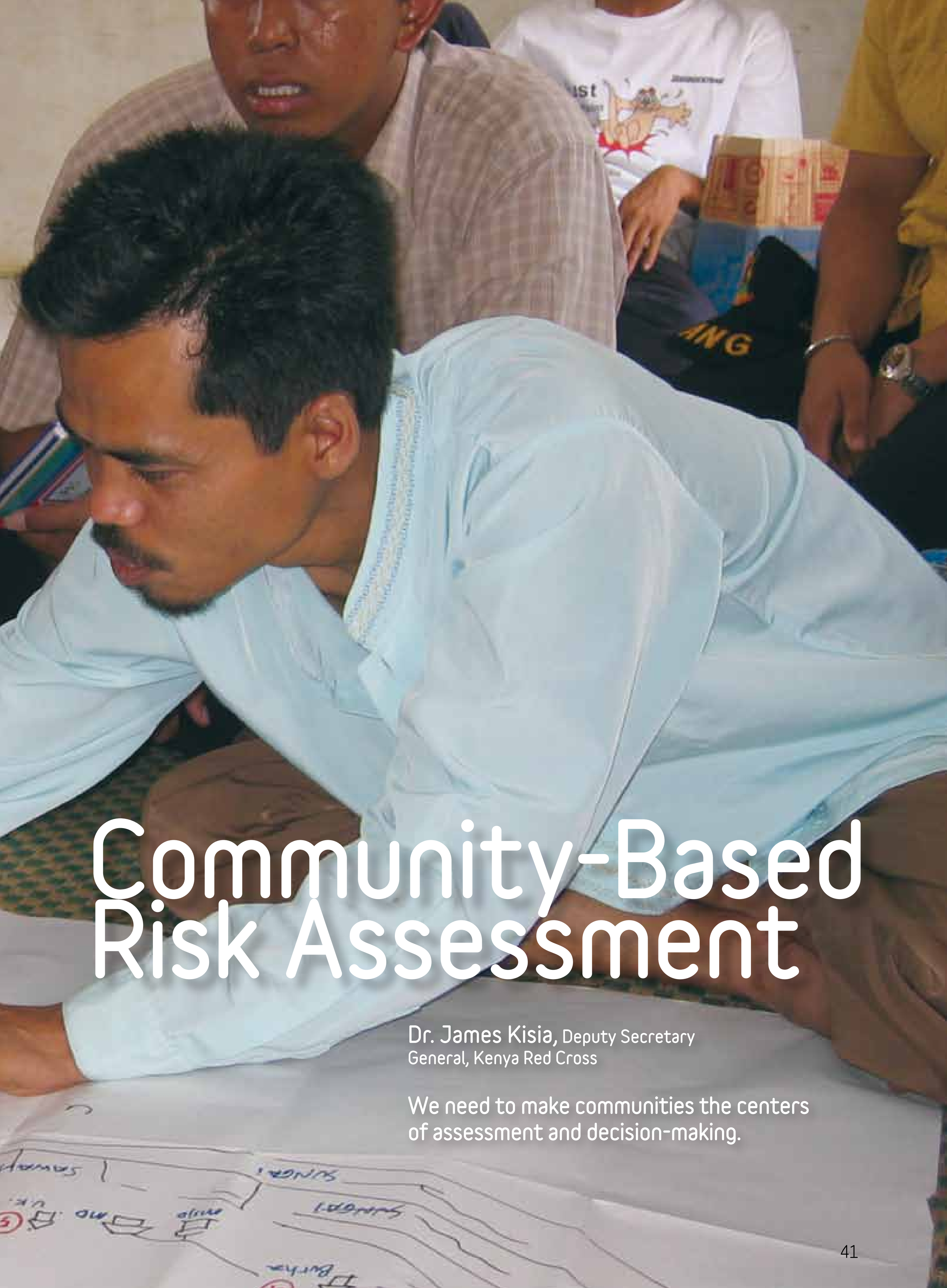
Helena Puig Larrauri, Co-founder, Standby Task Force

Rob Munro, Chief Executive Officer, Idibon

Photo: Australia – Indonesia Facility for Disaster Reduction, Mapping Workshop. Credit: Abby Baca

Photo: Indonesia participatory mapping. Credit: Gavin Macgregor Skinner



Community-Based Risk Assessment

Dr. James Kisia, Deputy Secretary General, Kenya Red Cross

We need to make communities the centers of assessment and decision-making.

In 1601, James Lancaster discovered that lime juice was effective for preventing scurvy, an affliction caused by a deficiency in Vitamin C that was affecting sailors. More than a century later, Scottish physician James Lind proved Lancaster's theory through a clinical trial. However, it was not until 200 years later that the British Royal Navy required ships to store lime juice on ships. The Merchant Navy waited even longer before they took up the innovation. Tens of thousands of sailor perished from scurvy during the interim.

The lesson to be learned here is if the sailors had been at the center of the decision-making process, it would not have taken 200 years to bring lime juice aboard. This example illustrates a recurring theme in disaster risk management (DRM). People are slow to react to new innovations and solutions because they leave responsibility to those in authority instead of those who are directly affected.

Solutions are often not as linear as the ones proposed by government agencies or large development organizations. Instead, they tend to be much more highly contextual. Decision-makers at the top often suffer from the same limitations, that is, looking to connect the dots or make sense of the whole rather than starting from the details.

Communities possess a lot of knowledge; they are clear on the risks they face and what must be done to reduce their exposure or vulnerability to those risks. Communities are frequently only thought of as the victims of natural hazards, when in fact they are also the first responders. Most of this knowledge is tacit, which represents a challenge for those outside trying to help. One must be creative in accessing that knowledge and then fully understanding it.

This panel explored ways to proactively involve communities in assessing and reducing risk, exploring tools that enable risk reduction.

Collaborative Approaches

Effective DRM at the government level, whether national or sub-national, requires the full engagement of local communities. Governments have the responsibility to ensure the safety of citizens, the mandate and the capacity to promote research and provide public goods, and typically the ability to implement large-scale risk reduction programs.

However, strong collaboration with the private sector, civil society, academia, and local communities is necessary for government policy to translate into local action. The impacts of disasters are felt locally and communities need to be empowered and supported to manage risk.

Effective DRM strategy, therefore, requires a decentralized approach and an appropriate division of labor and resources between all levels of government, even down to the village level.

Community Mapping

Participatory mapping techniques provide an effective tool to engage communities in disaster risk assessment activities.

Community maps can provide a comprehensive layout of where vulnerable people are residing and in what numbers, and where the safe houses are located.

By engaging communities in the exercise and providing the map as a reference, local first responders are equipped with the right information to make decisions to reduce risk and develop contingency plans in the case of a natural hazard.

A How-to Guide - Andhra Pradesh, India

Below is a set of guidelines for organizing a community mapping exercise to assess exposure and vulnerability (Figure 1).

Step 1 - Assessment: The community first obtains information about the history of disasters in their village and any disaster-related problems that were encountered. The information is collected either verbally through interviews with local residents or from written records. In general, verbal records are more common at the village level.

Step 2 - Identification: The community is then charged with

FIGURE 1: A community exposure and vulnerability map in Andhra Pradesh, India created through a collaborative process between the regional DRM agency the Coastal Area Disaster Mitigation Efforts (CADME) and local residents.

identifying all vulnerable groups of people in the village. Vulnerable people generally include those aged 60 years old and above, pregnant women, mothers, physically and mentally-disabled people, and children under the age of 14.

Vulnerable areas of the village are then identified. In the case of Andhra Pradesh because floods and monsoons are the most prevalent hazards, elevated and low-lying areas also need to be identified and cyclone shelters and evacuation routes should also be inspected.

Step 3 - Resource Inventory: A community task force is then responsible for identifying and securing all the necessary resources in the case of a disaster. A resource inventory registry with donor names and mobile numbers is made. Based on this inventory, task force members can arrange transport facilities and allocate accommodations to the evacuees.

Step 4 - Contingency Plan Development: Contingency plans are developed by the local community through a consultation process where community members discuss what happened in the village during the last disaster, list what caused damage and where, assess who and what is at risk, and discuss how to best mitigate the risk.

Step 5 – Exposure and Vulnerability Mapping: This map serves as a reference for the entire village, with each map including mark-ups of the following assets: elevated areas; cyclone shelters; roadways; storage areas for books, records and daily use materials; government agencies; and emergency centers, such police stations, ambulances, fire stations, hospitals etc.

With this map communities can work towards determining plans to overcome disaster risk and develop safety and response plans, in a process that significantly contributes to ownership of the assessment results.

Contributors to the session

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The Climate and Gender Game

The following was taken from "Games for a New Climate", a publication by the Boston University Pardee Center and the Red Cross / Red Crescent Climate Centre, which has been supporting communities by creating games that simulate the complexity of decision-making on individual and group levels.

Disasters exacerbate existing gender inequities. In many cases, mortality amongst women is significantly higher than men. While the factors behind these figures may vary, the trend is avoidable if addressed upfront in disaster risk management (DRM) strategies. The Climate Centre has been piloting the use of experiential learning games to build collective intelligence in communities and enhance the understanding of climate science and climate-compatible development. While there is growing consensus as to the differential impacts of climate change on the most vulnerable, the fact that women and girls are differently affected remains an overlooked issue that may indeed hold the key to resilience in communities around the world.

The Kenya Red Cross is working with rural farming communities experiencing more extreme droughts as well as floods, sometimes in the same district or at the same time in different parts of the country. Together with the Red Cross Climate Centre and PopTech, Kenya Red Cross designed a game to match a new initiative in the village of Matuu, the introduction of drought-resistant cassava as an alternative to maize.

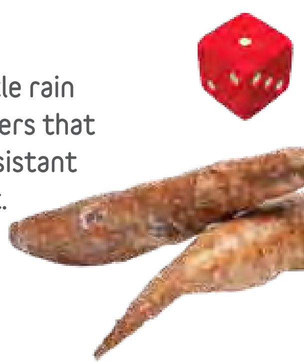
The designers infused this game of planting decisions with the 'broken' element of gender differences, which in Kenya include land ownership (over 90% of the land belongs to men), and unequal access to credit or fertilizer. Fictional gender roles are assigned randomly to participants. Those who play the role of women find themselves starting the game with fewer beans, and they cannot harvest as much as the fictional men do.

Rules: Players are divided into three teams, one with all women, one with all men, and one with both genders. These teams represent farming cooperatives and their respective territories are marked on the ground with two pieces of string, representing rivers that players cannot cross.

Each player receives a harvest of three beans at the start of the game. Each round of the game is a planting and harvest cycle. Each individual farmer must decide what to plant, based on the historical probability of rainfall.

A six-sided die is used to represent the historical probability distribution function of rains.

A roll of 1, is too little rain – drought. Only players that planted drought-resistant cassava can harvest.



A room or outdoor area is separated into three sections marked for 1) drought-resistant cassava, 2) maize, and 3) rice. Players who choose to plant maize, which requires good rain, but will fail if there is flood or drought, indicate they are planting maize by walking to one side of the room. Players who choose to protect against drought or flooding must walk to the cassava or rice areas and pay one bean.

If there are normal rains (a 2 – 5 is rolled), all farmers collect two beans. If a disaster is rolled (a 1 or a 6), anyone who planted maize or the wrong crop for the type of disaster rolled, must pay four beans to feed their family that season. All farmers who planted the correct crop for the disaster rolled collect two beans. Anyone who can no longer pay is out of the game and must migrate to the city to find work.

Climate Change: Once players are comfortable with the game dynamics after several rounds, climate change is introduced. The die is exchanged for a truncated cone, which is flipped in the air to simulate the new rainfall probability: if it lands on the wide base, that means flood, if it lands on the small base, that means drought, and if it rolls on its side, that indicates good rains.

Gender Inequality: After a couple more rounds, to better reflect reality, gender inequality is introduced. Bracelets are randomly distributed to about half of the players; those wearing a bracelet are told that they are now playing the role of men, and those without a bracelet will play as women and, to reflect the unequal access of women to assets and the unequal pay for equal work, women start this new phase of the game with one less bean - and will harvest only one bean.

Players up to this point have been able to observe how the all-men and all-women teams have fared compared to each other and the mixed gender team. (The facilitator may ask the players about any observations at this time.)

After prizes are distributed to the one player with the most beans and to the co-op team which lost the fewest farmers to the city, players are encouraged to share their feelings about the game, to discuss how they felt about the gender roles, what the game revealed that was surprising or concerning, and what they see as the root causes and possible paths to solve their specific climate-related problems.

The Kenya Red Cross is now using this game both to simulate the opportunities that can be opened over time through alternative planting decisions in a changing climate, and also to open deep conversation within affected communities around the differential implications and life-choice consequences of climate change for women and girls versus men and boys.

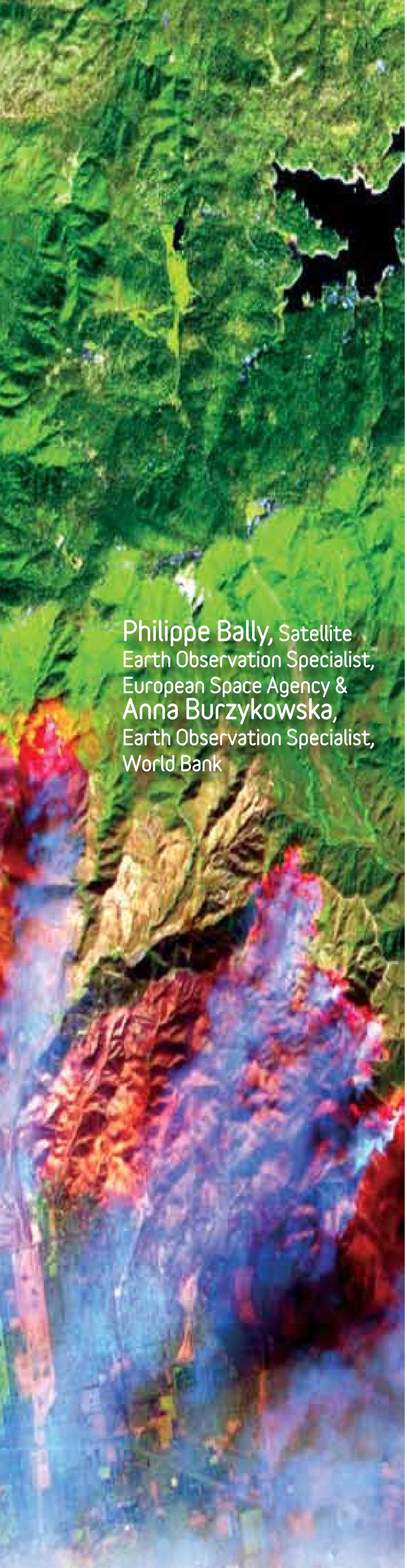
Further Resources

- Video to support training of trainers (9 minutes): http://www.youtube.com/watch?v=R8eRhS2XnCA&feature=youtu.be
- Introductory Video (5 minutes): http://youtu.be/BleWKuaFU60

A roll of 6 is too much rain – flood. Only players that planted rice can harvest.

Normal, good rain is any roll from 2 and 5. This is good for planting maize, beans, cassava and rice. All players can harvest.

Photo: California wild fires.



Philippe Bally, Satellite Earth Observation Specialist, European Space Agency &
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Satellite Earth Observation in Support of Disaster Risk Management in Africa

Understanding our environment and the fundamental forces that shape it can reduce the risk of natural disasters. In this context, Earth Observation (EO) satellites can provide useful information, often that which cannot be obtained by other sources, to make rapid and effective decisions to mitigate, prepare for, and respond to a range of disasters.

The technical specifications, accuracies, limitations, constraints as well as costs of using EO for emergency response and risk assessment have all been documented. However, globally, many users are not aware of the opportunities, nor have the capacity to incorporate them in operational decision-making. The cost and the limited availability of EO data and services are regarded as an obstacle to obtaining the full benefits of this innovative technology in lower income economies.

Recently, however, the ability of African national and regional organizations to access and effectively use space-based services to prevent and mitigate disaster risks has significantly improved. For instance, countries such as Nigeria, Algeria, Egypt, and South Africa have developed active space programs, operating their own satellites, while Morocco and Kenya stand out as examples of countries that have a strong and capable user base.

Moreover, various international initiatives such as the Regional Network for Information Exchange and Training in Emergencies (Garnet-e project), dedicated specifically to disaster management, have increased the use of EO applications on a regional basis.

The capacity to integrate EO-based technology and information into national disaster risk management (DRM) strategies varies from country-to-country. It largely depends on the economic development level, the type of data and information needed for different stages of the DRM cycle, as well as the responsibilities of national authorities and specialized agencies to collect, process, and distribute satellite-based data and information services to their users.

DRM at the South Africa National Space Agency (SANSA)

SANSA is one of the leaders in the region when it comes to providing satellite imagery and value-added products to Southern African countries in support of DRM. The Hartebeeshoek facility is the only Africa-based station suited for the major EO missions and puts South Africa in a unique position as a hub for expertise and technology development, as well as technology transfer to other emerging space nations in Africa.

The Earth Observation Directorate at SANSA is responsible for the storage and pre-/processing of satellite imagery received at the receiving station, generation of information products, and distribution of satellite data and products to the users. In 2012, SANSA provided SPOT imagery to Namibia to generate reference sets in selected flood-prone areas and supported the post-disaster assessment in inundated areas along the Limpopo River (Figure 1).

It also supplies a reliable feed of MODIS data to the regional Advanced Fire Information System (AFIS) - an operation alert and mapping service providing near real-time information related to the detection, monitoring, and assessment of fires in Southern Africa. This is based on data derived from the Terra and Aqua MODIS and Meteosat Second Generation (MSG) satellites.

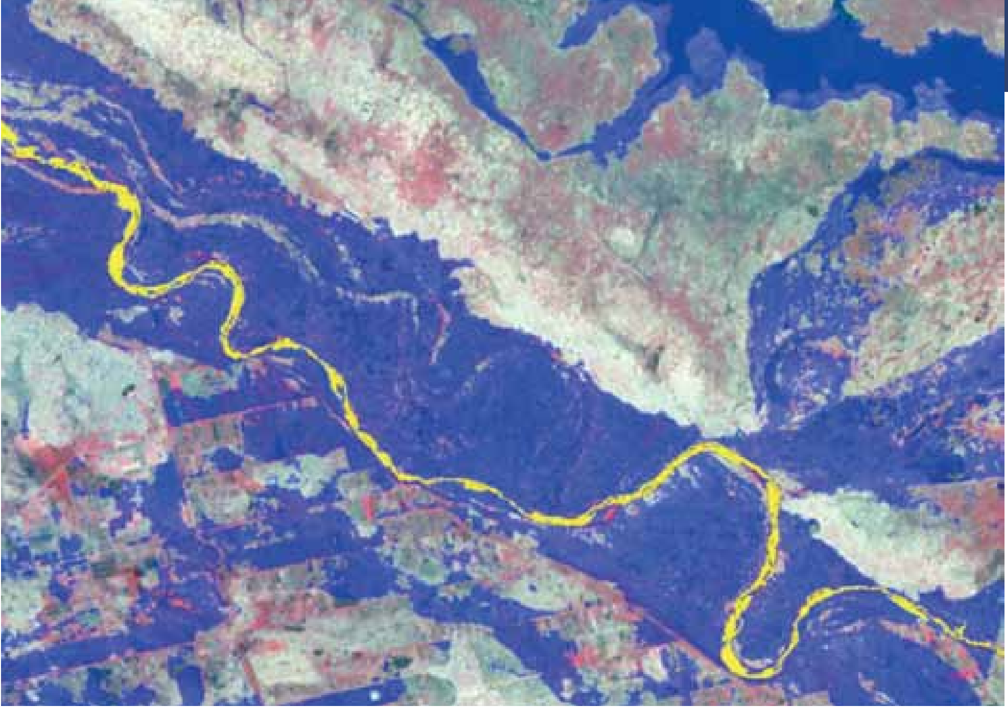
Interestingly, in 2009 South Africa developed its own prototype EO satellite to demonstrate on-orbit technology capabilities and to derive data for further research. After a successful launch, the imagery of SumbandilaSat, or "pathfinder", captured the areas affected by the 2011 tsunami damage in Japan (Figure 2) and supported the Hydrological Services of Namibia in assessing the impact of 2011 flooding in Oshakati (Figure 3). In the future, SANSA plans to establish a regional office that supports DRM using EO.

EO Technologies for Flood Mapping and Hydrological Modeling in Namibia

Namibia is the most arid country in sub-Saharan Africa, with seasonal rainfalls and mostly ephemeral river flows being low and erratic. From 2008-2011, the northern parts of the country experienced exceptional floods with major impacts on the livelihoods of the people and the socio-economic development of the area. Many of the areas affected were difficult to access. Satellite remote sensing was used for the hydrological monitoring, early warning, forecasting, and modeling systems because of its specific suitability to observe large areas with difficult ground access. It also provided both qualitative insight in the hydrological processes and the quantification of the impacts.

Four applications were developed: (i) Areal precipitation monitoring, providing near-real-time areal rainfall estimates from cloud-temperature observations; (ii) Direct and indirect river flow monitoring, applying various experimental methods; (iii) Flood mapping, using optical and in particular radar imagery that is not affected by adverse weather conditions; and (iv) Flood forecasting models, with EO providing rainfall, soil moisture, evaporation, and catchment conditions as inputs for water balance.

◀ NASA EO-1 image showing complexity of ephemeral Cuvelai Delta in Angola and Namibia (30 March 2011) Courtesy: GFSC NASA



◀ **FIGURE 1:** SPOT imagery was used for flood assessment along the Limpopo River. Credits: SANSA, SPOT data © CNES distributed by Spot Image.

FIGURE 2: SumbandilaSat image on the right was used for disaster assessment in Japan in 2011. (Left Google Earth image before the tsunami). Credits: SANSA. ▶

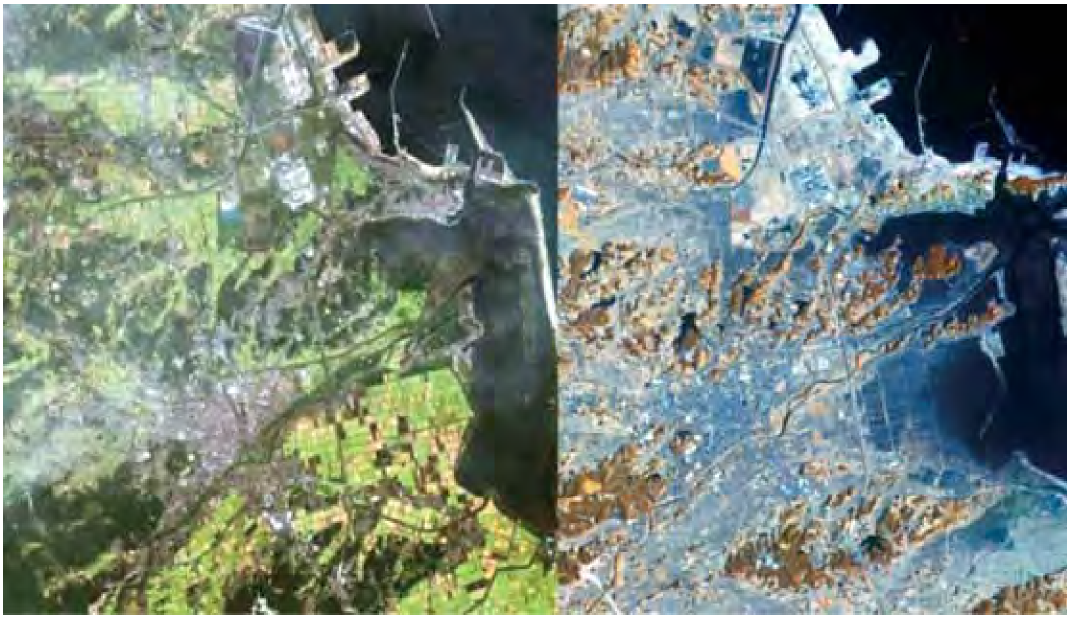


FIGURE 3: SumbandilaSat image on the right showing impact of flooding, Oshakati Namibia in 2011. (Left Google Earth image of Oshakati before the flood). Credits: SANSA. ▼

Providing better access to Charter-generated information means that much more needs to be done to enhance the capacity of the requesting authorities to use this information effectively.

International Charter for Space and Major Disasters in Africa

The International Charter for Space and Major Disasters is the key international mechanisms established to respond to global disasters with satellite-based information for situational awareness. The use of Charter's services in Africa is rapidly growing, and currently supports disaster response in 22 countries (Figure 4).

Many African national disaster management agencies rely solely on the Charter as the main source of EO-based rapid mapping methodologies for disaster response. As a result Charter members have recently adopted the principle of Universal Access enabling any national disaster management authority to submit requests for emergency response. The affected country will no longer have to be a Charter member to access and use the assets.

In addition, the Charter has defined a process to evaluate the ability of national authorities to benefit from such access in accordance with operational procedures.

Providing better access to Charter-generated information means that much more needs to be done to enhance the capacity of the requesting authorities to use this information effectively. Partnering with organizations such as the Global Facility for Disaster Risk Reduction and Recovery (GFDRR) can help achieve this goal.

European Space Agency DRM Practice and Collaboration with the World Bank

The rapid pace of technology advancement has led to the launch of an impressive array of satellite systems. These missions are now multi-purpose and offer exceptional coverage and scope, including: (i) Medium and high/very high resolution optical data; (ii) Infrared and thermal data; (iii) Medium and high resolution SAR data (C, L and X band) and interferometric SAR data products; and (iv) Meteorological data sets and models.

Taken collectively, the world's satellite systems offer a large volume of imagery and as such constitute a unique tool for various DRM applications (Figure 5). In particular, the launch of

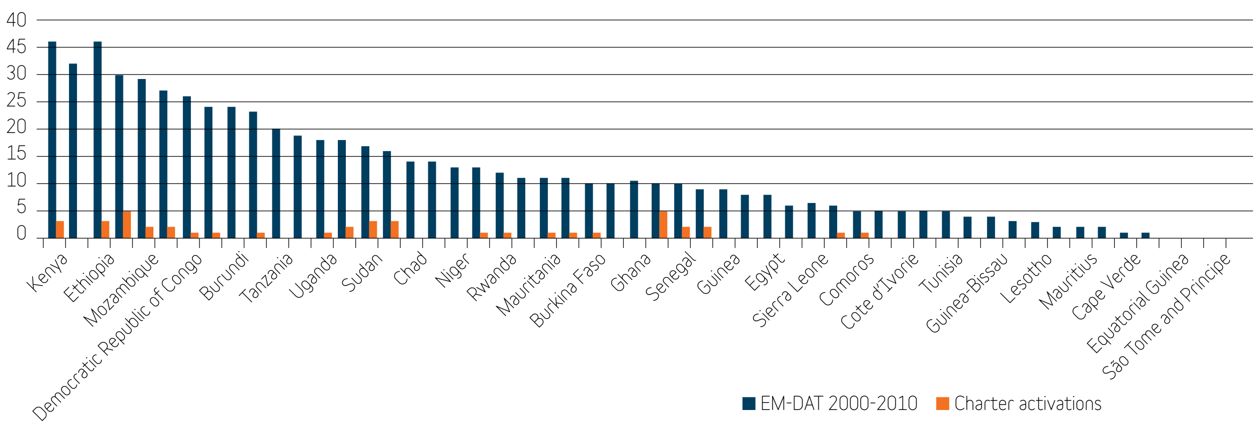


FIGURE 4: International Charter activations in Africa over 2000-2010 (red) compared to mass disaster occurrence according to CRED's EM-DAT database. Credits: ESA, Argans Ltd, CRED.

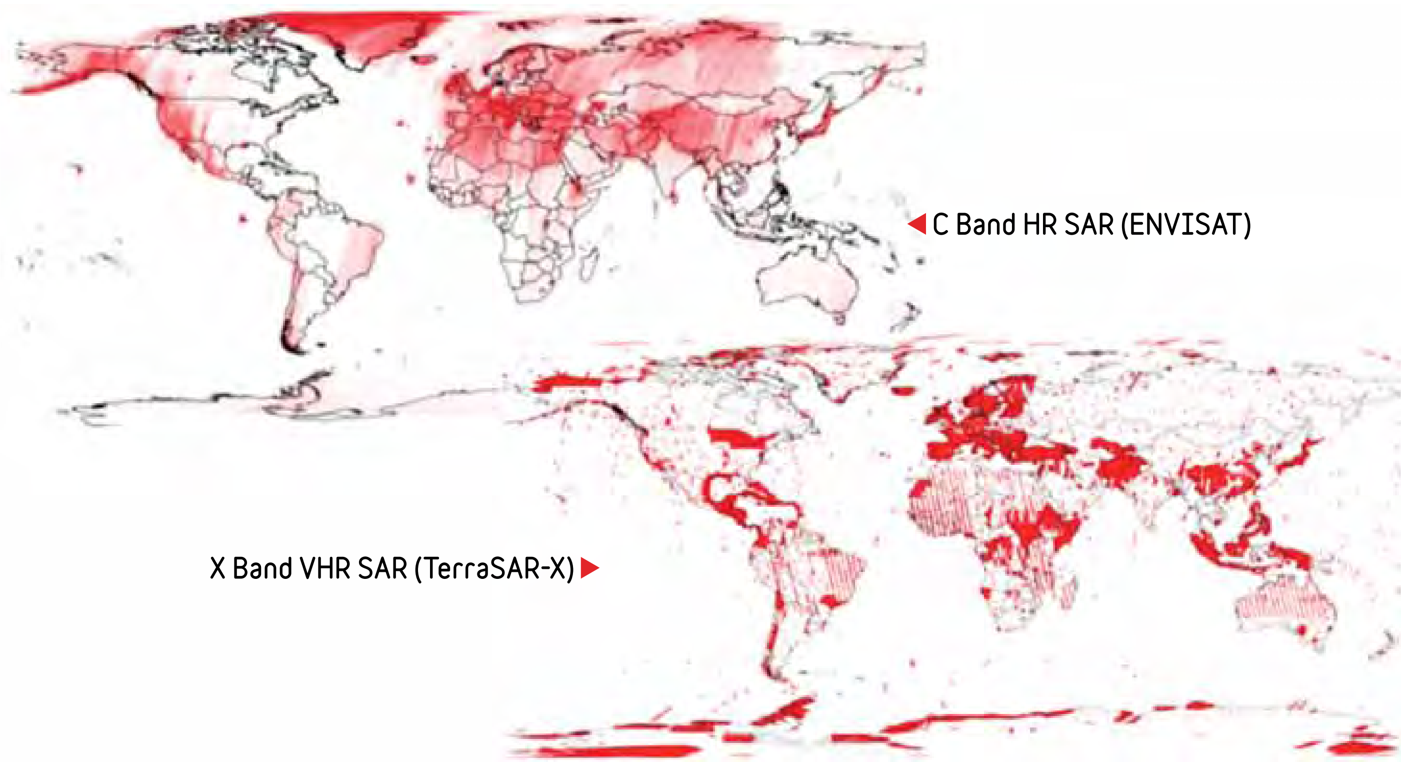


FIGURE 5: Overview of the density of archive for data from two EO missions providing radar imagery to support emergency response: ESA's ENVISAT ASAR, showing IM Descending IS2 VV C Band data and DLR's TERRASAR-X, showing Stripmap X Band data in this example. CSA's RADARSAT, JAXA4s ALOS and ASI's Cosmo-Skymed are other examples of space borne systems providing all weather SAR data. Credits: ESA, DLR.

ESA Sentinel satellites developed under the Global Monitoring for Environment and Security (GMES) program will provide key sources of data to manage and assess risks on an operational basis.

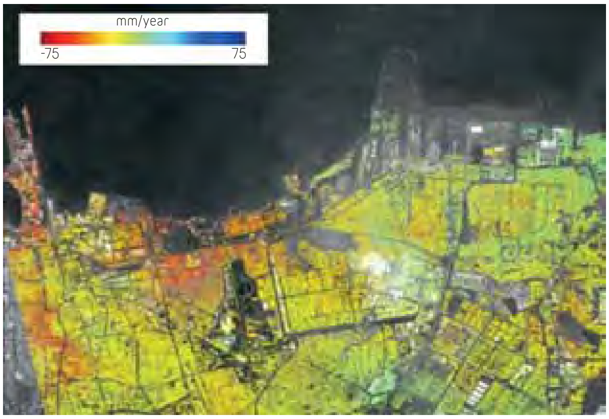
- Sentinel-1 is aimed to provide data for systematic terrain deformation monitoring for all types of geo-hazards
- Sentinel-2 will provide high-resolution multispectral imagery to support asset and hazard mapping for a broad range of hazard types
- Sentinel-3 will provide thermal-infrared imagery with high temporal sampling

The Sentinels will offer a depth and breadth of coverage not previously possible with most sensors on a single platform. Sentinel-1 will acquire imagery over an area 200 times the size of Malawi in interferometric Wide-Swath mode at high spatial resolution every day. For applications requiring optical data, Sentinel-2 (A and B) will provide complete global coverage of land surface at 10m resolution every five days.

New EO techniques are also being developed and applied to address specific localized risks and new disaster types. One of the most promising applications is Interferometric Synthetic Aperture Radar-based Persistent Scatterer Interferometry (InSAR-based PSI). It can provide very dense spatial data and detailed measurements of surface displacements (at the sub centimeter or even millimeter level). This can be used for measuring risks associated with earthquakes, volcanoes, and landslides, as well as collapsed cities and distortions of flood defense structures in coastal lowlands.

ESA and the World Bank have piloted a number of projects using EO for risk assessment. The outputs included urban mapping and thematic mapping to support risk assessment for hazards such

FIGURE 6: Deformation map in Jakarta Bay and harbor derived from the PSI analysis of VHR COSMO-SkyMed data (Oct. 2010 – Apr. 2011). Color scale between -75 (red) and 75 (blue) mm/year. Credit: EOWorld project/ Altamira Information for ESA, World Bank.



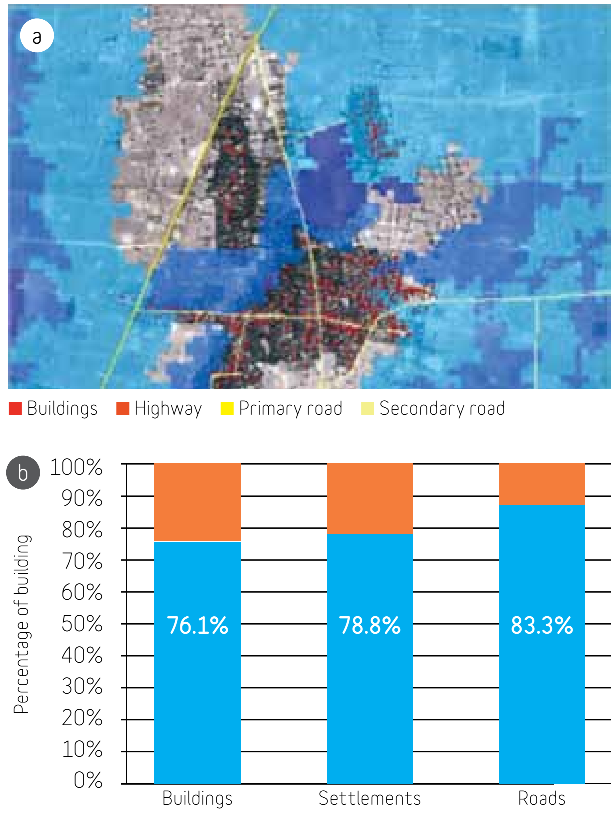


FIGURE 7 a & b: Inventory of buildings and roads in the Mekong basin. Under 2001 flood conditions: 79% of the settlement area, 88% of the road network, and more than 90% of the cropland would be affected by high water levels. Credits: EOWorld project/Geoville for ESA, World Bank.

as flooding, terrain subsidence and landslides in Tunis, Alexandria, Jakarta, Yogyakarta, Rio de Janeiro, Ho Chi Minh City and Guyana's capital city, Georgetown (Figure 6).

EO is also a cost-effective means for developing inventories of buildings, infrastructure, and crops across tens of thousands of square kilometers of land, as was done in the Mekong River Basin (Figure 7 a & b).

Increasingly, EO is being integrated as a DRM pillar. The future use of this technology will grow along with the complexity of the issues addressed in various projects including urban, agricultural or climate risk assessment, insurance/reinsurance as well as hydro-meteorological and climate information services. New methodologies for processing data are being developed that will make this technique more affordable and enable the developing world to benefit.

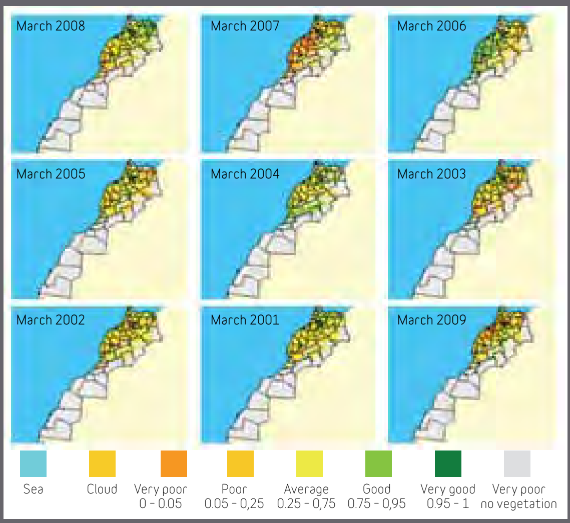
In the next few years, the ESA Sentinel satellites will be launched as part of the joint European Union-ESA GMES program. The GMES program aims to ensure long-term continuity of acquisitions with global observations that are conducted in a systematic fashion with free and open access to data. This has the potential to enable local users and policy-makers in African countries to enhance their ability to use satellite EO for DRM.

Conclusion

EO is beneficial in providing information that can support various stages of the DRM cycle. Satellite applications allow for decisions to be made faster and more effectively and very often provide access to information that could not be obtained by other sources. However, the extent to which it will contribute to DRM capabilities in developing countries, especially in Africa, depends on the ability to set clear priorities concerning enabling relevant IT infrastructure, building local institutional capacity, embracing international cooperation, as well as ensuring the sustainability of the capabilities that have been already developed.

Drought and forest fires monitoring in North Africa

The Arab region is particularly vulnerable to drought, with 87% of the total area classified as desert and high levels of aridity and poor vegetation cover. EO is known for its added value in improving the quality of agricultural statistics by providing early warning and forecasting systems concerning potential food insecurity.



◀ An example of using EO for spatiotemporal monitoring of drought in Morocco. A drought early warning system was set up and operationalized based on high temporal resolution images, such as MODIS, NOAA-AVHRR, and SPOT VEGETATION.

Satellite data provides a useful source of drought indices, such as Standardized Vegetation Index (SVI), which is calculated on the basis of the Normalized Difference Vegetation Index (NDVI) time series. NDVI combined with satellite-derived temporal series of Normalized Difference Water Index (NDWI) can further improve the assessment of drought severity by combining information from Visible, Near-Infrared, and Shortwave Infrared (SWIR) channels, which are sensitive to vegetation water content. Moreover, satellites such as Tropical Rainfall Measuring Mission (TRMM) can contribute to precipitation estimation. Used in conjunction with meteorological satellites, these sensors generate valuable information, especially in areas where there is no precipitation ground radar.

Another area of EO developed in North Africa pertains to forest fire risk assessment and monitoring. EO provides information for the daily monitoring of forest fire risk index, through the analysis of NDVI and land surface temperature (LST) time series, as well as the extraction of relevant EO-based indicators such as the Vegetation Drought Index (VDI) and Vegetation Regression Index (VRI). The Regional Center for Disaster Risk Reduction (RCDRR) is using high and low resolution images for forest fire risk evaluation, hotspot detection, determining the interface between forest and human activities, burnt area cartography, and damage assessment.

For many developing countries EO is still considered economically sensitive and regarded as a relatively high-cost innovation. However, there are emerging opportunities to embrace EO. An adequate and timely response by African states will lay the foundations for their ability to better understand natural hazards and build resilience, while advancing their technological base.

International financing institutions also have a role to play in linking EO to international development and developing partnerships with specialized organizations based on a shared recognition that EO can help achieve these and other development outcomes.

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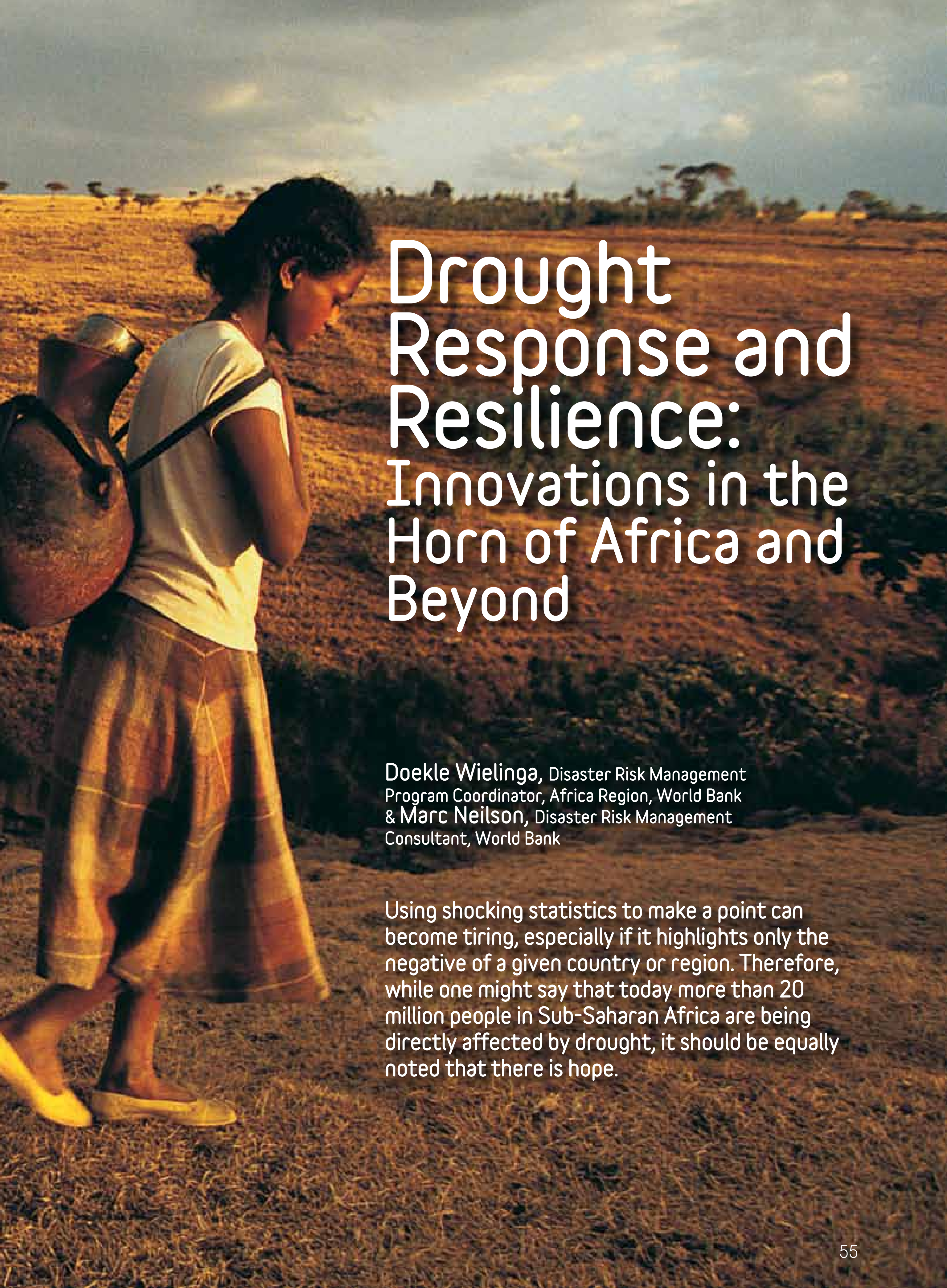
Photo: Women carrying water, Ethiopia. Credit: Stockbyte.



Drought Response and Resilience:
Innovations in the Horn of Africa and Beyond

Doekle Wielinga, Disaster Risk Management Program Coordinator, Africa Region, World Bank
& **Marc Neilson,** Disaster Risk Management Consultant, World Bank

Using shocking statistics to make a point can become tiring, especially if it highlights only the negative of a given country or region. Therefore, while one might say that today more than 20 million people in Sub-Saharan Africa are being directly affected by drought, it should be equally noted that there is hope.

The Horn of Africa remains under stress 18 months after the start of the 2011 drought, and the Sahel Region of West Africa just emerged from a widespread drought affecting 19 million people. Adding to these crises is climate change, which aggravates localized drought conditions outside of normal seasonal cycles. Drought especially affects the most vulnerable and at-risk populations, often resulting in large-scale migrations and displacement. An innovative response to drought is therefore key.

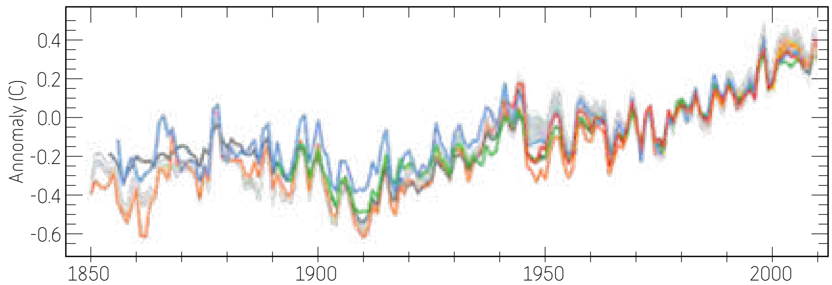
Fortunately, because of major innovations in hydro-meteorological forecasting and disaster risk management (DRM), certain communities have been able to better implement drought response and resilience mechanisms. Disaster risk managers are now responding to drought in a host of new ways, from geo-spatial mapping to leveraging local cultural practices, to improve overall drought resilience. As drought is a global issue, examining responses within but also outside of Africa helps to shed light on some of these latest innovations.

Tapping into Local Knowledge – Colorado Basin, United States

Many responses to drought are short-term and often do not work beyond the time period of implementation. What is important is to identify possible thresholds, that is, the critical transition from one climatic state to another.

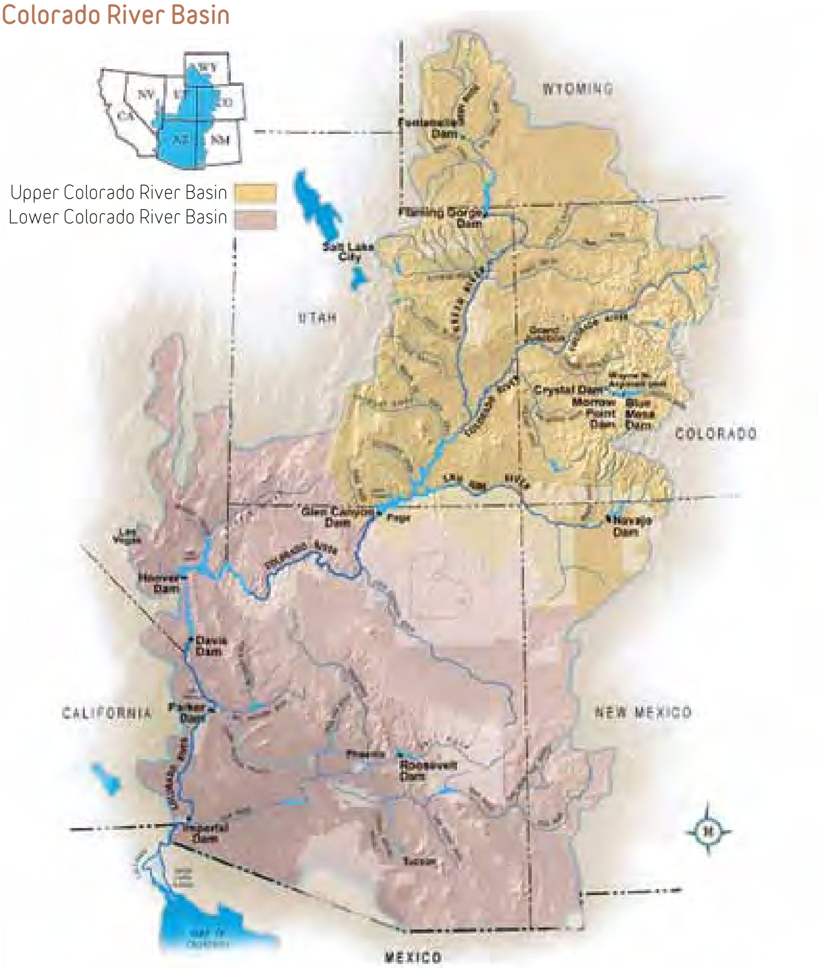
Using the example from the United States Colorado River Basin, Dr. Pulwarty from the National Oceanic and Atmospheric Administration (NOAA) presented an historical perspective starting from 1922 using the hydrological variability on

Sea Surface Temperatures



Source: NOAA 2012

Colorado River Basin



Source: NOAA 2012

record. There has been a steady decline in precipitation levels in the Basin with the exception of a few good years. Combined with factors such as a decrease in snowmelt and an increase in demand, the Basin has long since been threatened.

Ways to identify thresholds can be done through drought early warning systems, monitoring and forecasting, awareness campaigns, energy preparedness, and consistent drought and flood assessments, as are being conducted by NOAA and the US Drought Information Center.

In addition, incorporating local knowledge in historical analysis can refine the timing of changing climatic events. To identify the critical thresholds over that period, scientists engaged the Native American Navajo people. This local knowledge filled in monitoring gaps and accounted for procedural equity. Together, they were able to identify the most important climate drivers and plan accordingly 40 years in advance.

With proper management, the Basin is expected to continue to act as a major water reservoir with the long-term planning, including the establishment of operating criteria and guidelines, an annual water management operating plan, schedules for water and power, and automated hydroelectric generation and control. In addition, the Basin managers use the Surface Water Supply Index[14] to keep track of water levels.

Challenges remain, including a lack of models capable of measuring thresholds, and many public sector applications require a more systematic connection between early warning scenarios. However, the socialization of lessons learned by communities and organizations through their own experiences, combined with longer-term planning and better early warning systems, are key to mapping transitions to drought and building resilience.

Innovative Tools in the Horn of Africa

Drought and climate risk are a significant challenge for global food security. It is projected that by 2050, with increasing climatic change, 10-20% more people will be at risk of hunger due to climate change risks. Building resilience is essential. In fact, resilience is an underlying theme linked to innovations in drought management.

The World Food Program (WFP) is piloting a series of resilience programs to address food insecurity through index insurance, risk transfer, social protection, and emergency preparedness.

Using WFP's much utilized food security mapping, food security trends were highlighted in the Horn of Africa during the severe 2011 drought. Moving beyond the obvious short-term effects, the indirect losses due to drought were highlighted (loss of livelihoods, loss of assets, children dropping out of school). Local communities expected seasonal food shortages but as was the case in Southeastern Ethiopia, just a slight change in climatic conditions resulted in much lower household food availability, thus highlighting the slim margin by which many of the world's poor live.

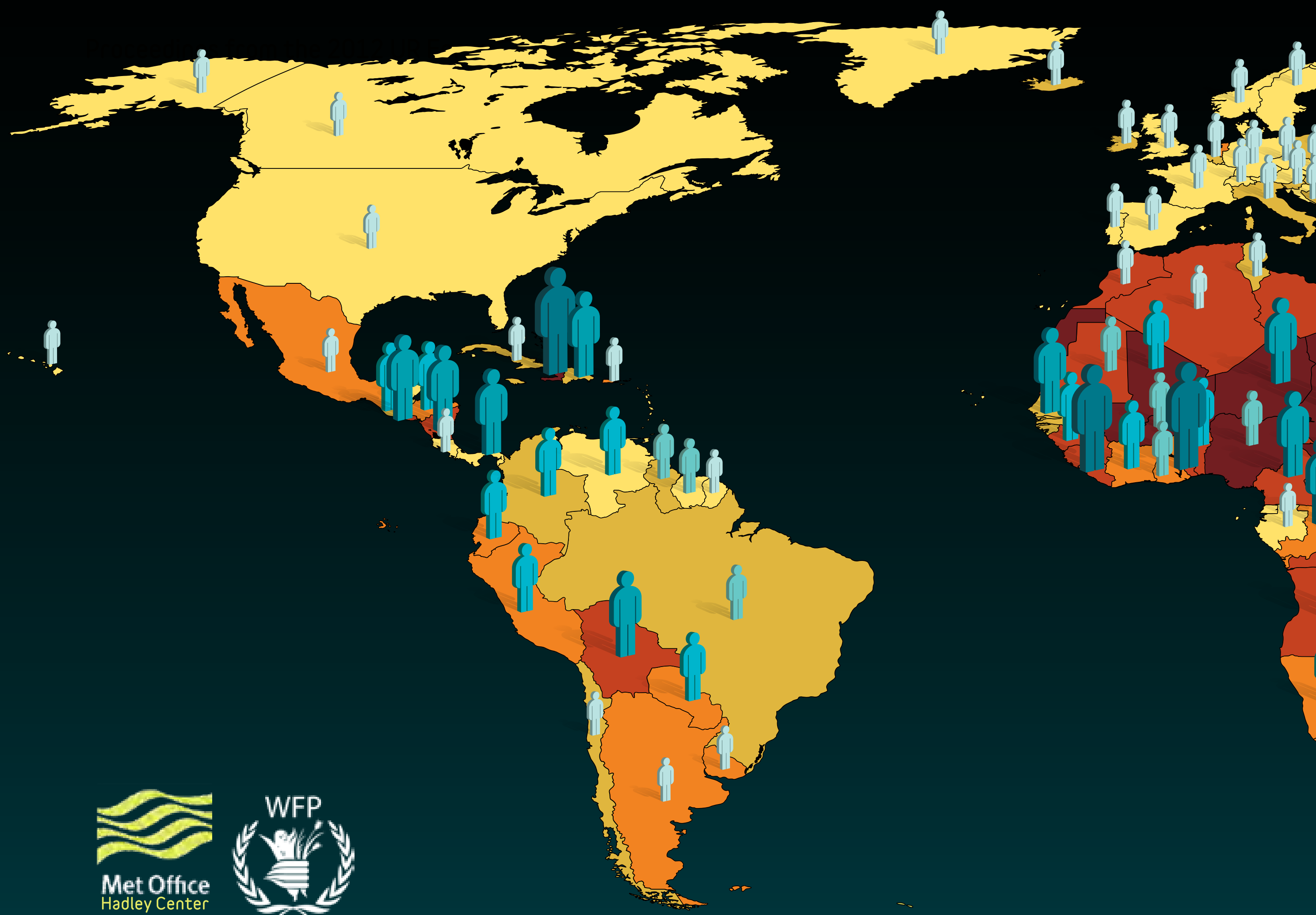
To help address the lack of household food availability, the Livelihoods, Early Assessment and Protection (LEAP) program has a Food Security Early Warning Tool[15] that provides national authorities in Ethiopia with an advanced early warning in the case of drought, which in turn triggers contingency financing. The meteorological information comes from satellite data and a network of automated weather stations, providing an objective and transparent trigger.

Another initiative, the R4 Rural Resilience Initiative[16] uses social safety nets to transfer risks during lean seasons and stimulate agricultural growth and diversification. The program provides farmers with access to insurance should their crops fail or in the event of a natural disaster. By building a sustainable commercial rural

[14] Surface Water Supply Index: http://www.ut.nrcs.usda.gov/snow/watersupply/swsi_about.html

[15] See: http://www.wfp.org/disaster-risk-reduction/leap

[16] See: http://www.oxfamamerica.org/publications/r4-rural-resilience-initiative-1



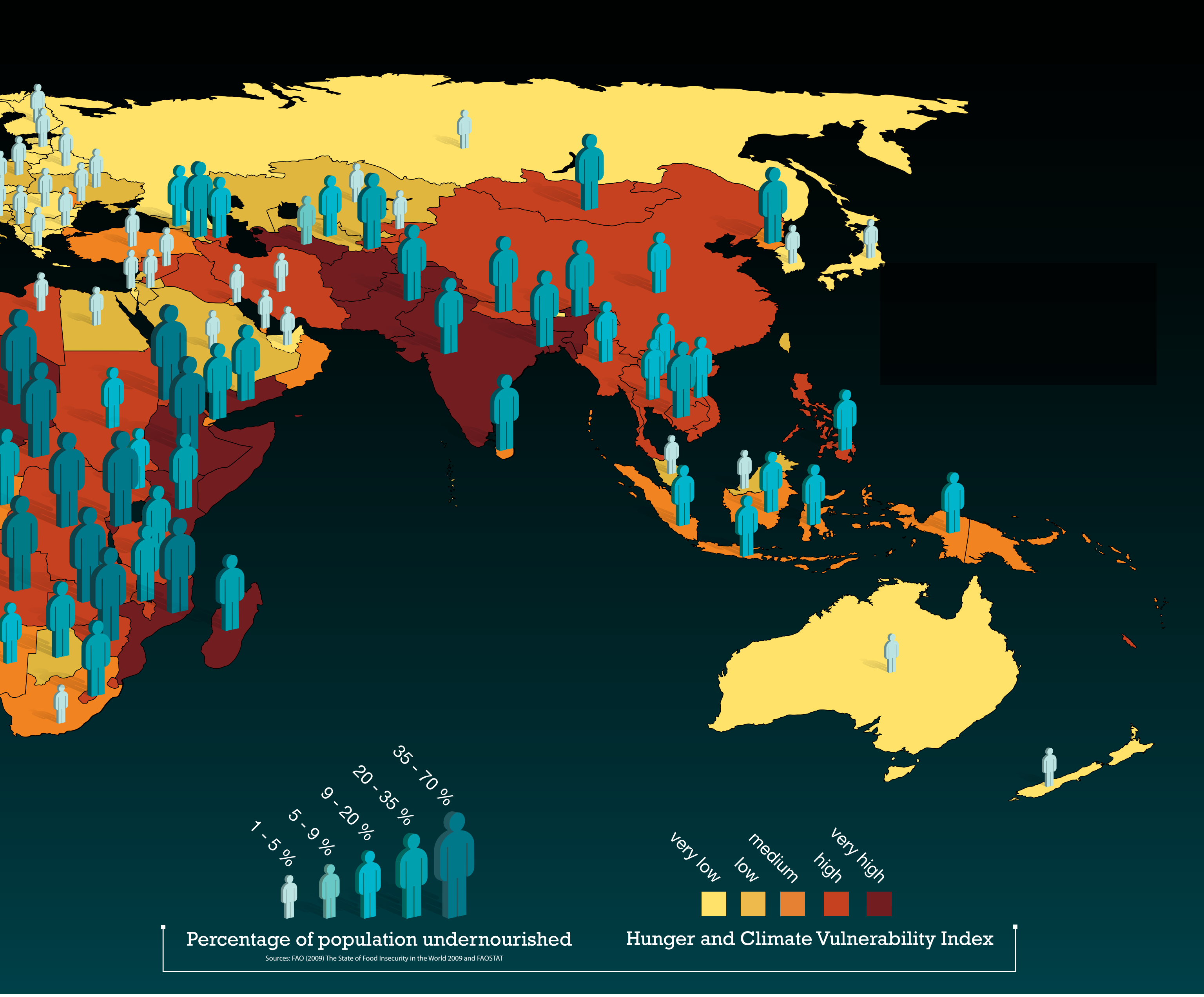
Food insecurity and climate change

insurance market and improving government social protections, communities benefit in the long-run.

Taking the community resilience theme a step further, East Africa's Inter-Governmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC) is piloting the development of a web-based mapping system and an SMS early warning system for mobile phones, Fikia[17]. Using a holistic approach throughout East Africa, the software covers everything from sharing meteorological information with farmers, to helping humanitarian organizations receive resources and funding. The software also relies on crowdsourcing to better inform local leaders of the affected areas in the event of a natural disaster.

The region still faces challenges with the under-utilization of weather forecasts, unreliable information dissemination, and lack of technological uptake. ICPAC is piloting a series of projects that aims to re-package weather forecasts into tailor-made information products and advisories for farmers and pastoralists. Using local workshops, field days, SMS messaging, radio and television, and even church gatherings to disseminate the message, farmers are better able to make guided decisions about the kind of farming technologies needed for increased food production. Progress includes rain gauge installations, the delivery of starter inputs (seeds, maize, fertilizers), and capacity-building for extension staff.

[17] See: http://www.fikia.org/



Conclusion

In order to build long-term resilience to drought it is necessary to combine traditional methods with local knowledge, and innovative technological tools with community-based solutions. New innovations in drought response and resilience offer hope and the ability to predict, withstand, and overcome future drought crises.

Contributors to the session

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Panelists

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Photo: This Landsat image of 3 October 2011 shows the Mississippi River Delta, where the largest river in the United States empties into the Gulf of Mexico. In this false-colour image, land vegetation appears pink, while the sediment in the surrounding waters are bright blue and green. Credit: USGS/ESA.

Flood Risks across Spatial Scales

Brenden Jongman, VU University of Amsterdam;
Dr. Jaap Kwadijk, Deltares;
Zuzana Stanton-Geddes, World Bank; & **Hessel Winsemius,** Deltares.

One of the greatest challenges in risk mapping is finding appropriate ways to ensure that decision-makers receive the necessary information to help them make better-informed decisions to reduce, transfer, or manage their risk.

Flooding of river and coastal systems is recognized as one of the most frequent and damaging natural hazards affecting societies around the world. In 2010 alone, floods affected 178 million people. The total losses in exceptional years such as 1998 and 2010 exceeded $40 billion.[18] In Thailand, the 2011 floods resulted in losses of approximately $45 billion, equivalent to 5% of Gross Domestic Product (GDP).Vulnerability is projected to increase: by 2025, 410 million urban Asians will be at risk of coastal flooding.[19]

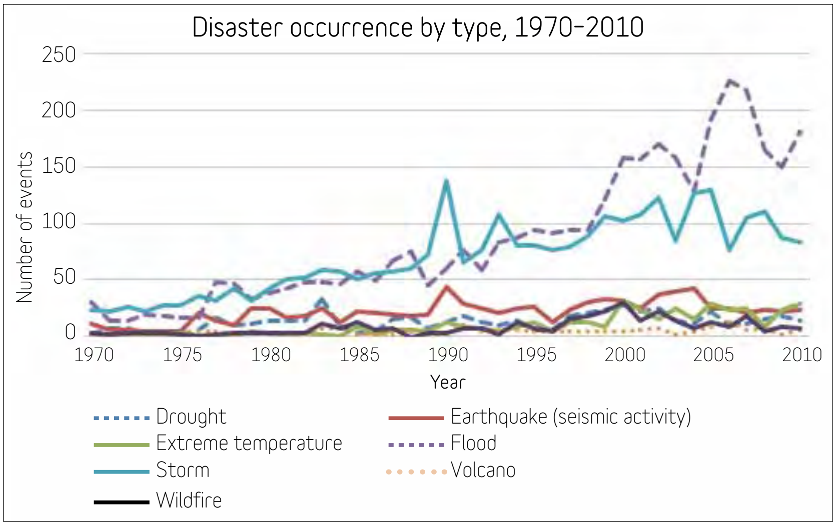
There are multiple stakeholders involved in flood risk management who require information at different spatial scales, time horizons, and levels of detail. This includes households and communities, cities and national governments (weighing specific local risk management options), businesses and (re-)insurers (estimating the costs required to cover potential claims), as well as global financing and development institutions (providing funding for infrastructure, basic services or adaptation programs).

To minimize the impact of floods, adaptation measures, mitigation strategies, and financing schemes are developed at spatial scales ranging from local to global. The information needed for risk analysis and decision-making varies with the scale.

This session sought to clarify what flood risks information needs may arise at different spatial scales and what solutions are available.

18 World Bank, *Cities and Flooding,* (2012).

19 Asian Development Bank, 'Green Urbanization in Asia Key' Special Chapter in *Indicators for Asia and the Pacific,* (2012).



Number of reported disaster events. *Source:* based on EM-DAT/CRE

Global Scale Assessments

At the global scale, large-scale flood risk estimates made with Global Flood Risk IMAGE Scenarios (GLOFRIS), a new approach to modeling, enable users to make a dynamic flood risk assessment at a scale of 1×1 km^2 for any region in the world using a global hydrological model and spatial datasets of population, land-use, and infrastructure.[20]

The approach is dynamic in the sense that it can perform flood risk assessment under different scenarios of climate change and socio-economic development. It requires global-scale outlines of flood hazard, exposure, and vulnerability for current and future climate and socio-economic scenarios.

A case study on the 1999-2000 floods in Mozambique showed current flood risk in densely populated areas such as Maputo and the Zambezi Delta, and demonstrated that the modeled flood risk estimates can be sufficiently validated with recorded losses.

The approach quantified the effects of development, economic growth, urban expansion, and climate change on flood risk. The level of detail of such analyses is high enough to establish how flood risk changes and which developments matter within a given region. In the case of Mozambique, the impact of a growing population and associated land-use, causes the largest and most certain increase in flood risk.

1. ***Global-scale assessments*** estimate which countries face greater flood risk in current and future time frames, and can determine what impacts variability in flood risk across space and time. This information can guide decisions on where to invest, in what measures (e.g. land use or climate adaptation) and how to distribute funding for adaptation. This type of assessment requires global-scale outlines of flood hazard, exposure, and vulnerability for current and changing climate and/or socio economic scenarios.
2. ***Regional-scale assessments*** estimate the needs in investment in flood protection along rivers and coasts, and can determine required insurance and re-insurance premiums. This type of assessment requires more detailed regional information, including base data such as elevation, as well as system knowledge, including system dimensions and safety measures.
3. ***Local-scale assessments*** can provide the necessary information for cost/benefit analyses of investments in flood protection at the asset level, or identify suitable evacuation routes in a given area. Such assessments require very high-resolution models and elevation data.

[20] See: http://www.hydrol-earth-syst-sci-discuss.net/9/9611/2012/hessd-9-9611-2012.html

For international development organizations this information can be valuable to identify flood-prone areas and dynamically assess the effect of their policies on the people and assets at risk of flooding. Research is continuing to include more vulnerability indicators, enhance the economic risk assessment methods, and use more local damage data for the validation of the global approach.

Rapid Assessment Models

Often during disaster emergencies, it is challenging to provide accurate flood risk estimates within a limited timeframe and with limited resources. This is often the case in remote regions in Africa. Rapid assessment methods can be very useful in data-poor areas, providing a first indication of what regions or areas are at risk, and what possible measures for risk reduction one can focus on.

A case study on the city of Oshakati, Namibia demonstrates that an inundation model based on globally available elevation data, such as Shuttle Radar Topography Mission (SRTM)[21], combined with elevated features and obstructions can be useful in providing quick initial risk information. The rapid assessment model revealed where water flows during a disaster event, why certain areas would flood, and what can be done in terms of infrastructural measures or strategic planning.

For more detailed decision-making, rapid assessment models can be constructed by applying the SRTM elevation model with elevated features, such as major road infrastructure, from OpenStreetMap (OSM)[22]. From this model details on the direction flooded water will flow given a certain breach or upstream flood level, as well as what elements in the landscape determine this direction, can be analyzed.

An Integrated Approach to Flood Risk Management at the City Level

As outlined in a recent World Bank flagship report *"Cities and Flooding. A Guide to Integrated Urban Flood Risk Management for the 21st Century"*, an integrated approach to flood risk management can help cities make robust decisions to reduce, manage, and transfer flood risks.

Flood Risk Management Planning in the Philippines

Photo: Manila, Philippines flood. Credit: © Thinkstock.com

Following the devastating Ondoy and Pepeng typhoons in 2009, the Government of the Philippines and the World Bank, with support from Global Facility for Disaster Reduction and Recovery, the Asian Development Bank, AusAID, and the Japan International Cooperation Agency, undertook a post disaster needs assessment. Recommendations for strengthening resilience to disasters were made and a comprehensive program of support followed. This included the formulation of a disaster risk financing strategy, a flood management master plan for Metro Manila, and a Development Policy Loan with a Catastrophe Deferred Drawdown Option - the loan provides rapid liquidity for the government in the event of a disaster.

[21] See: http://srtm.usgs.gov/index.php

[22] See: http://www.openstreetmap.org/. To learn more about OpenStreetMap initiatives in Indonesia, see: http://en.openstreetmap.or.id/

Urban flooding is becoming increasingly more costly as low- and middle-income countries transition into largely urban societies. Unplanned or poorly planned urbanization puts more people and assets in harms' way. While it is impossible to entirely eliminate the risk of flooding, to better manage the impact of floods, decision-makers need to understand the causes and effects of flood hazard as well as the exposure and vulnerability of the communities and assets. This includes the spatial and structural risks of the existing or planned settlements.

In managing flood risk, rather than trying to find the optimal flood protection solution, cities ought to adopt a robust approach that can cope with uncertainty, take into account potential weak spots and failures, and adapt to a wider range of future scenarios. In other words, implementing a robust approach requires the adoption of a balanced combination of structural and non-structural measures.

While structural measures "keep the water away from people", non-structural measures "keep the people away from the water." Structural measures such as physical flood defenses can only address an element of the issue at stake. A more holistic approach would include options such as wetland restoration. For example, research shows that mangroves can help prevent damage to coastal infrastructure from flooding. During storms, hurricanes, and periods of high wind, waves can cause flooding. Mangroves can play a role in reducing the wave height by as much as 66% over 100 meters of forest.[23]

Delineating flood zones in land-use plans and issuing policies to restrict development in these zones is also an example of a non-structural measure.

A number of cities have been moving towards more sustainable solutions to flood risk management[24] For example, the 2005 German Flood Act places strict flood control obligations on government and individuals to manage flood risk in advance, including the way flood zoning is managed and how warnings are issued. Better urban planning, coordination, and development provide a unique opportunity to have a lasting positive impact on the lives of many urban dwellers, especially the poor and marginalized who face some of the highest risks.

Through analytical work, technical assistance, and lending projects, the World Bank is supporting a number of countries adopt integrated flood risk management plans, with the right balance of structural and non structural measures.

Open and Participatory Tools

At each spatial scale, tools are available to establish risk estimates. The question that still arises is how applicable the high-resolution tools are over the whole globe, especially with regards to the simulation of floods in very flat areas, using uncertain elevation models.

Although better global elevation models are becoming available (for example, through the TanDEM-X mission), locally obtained elevation is generally currently still more useful to decision-makers due to its higher vertical accuracy, as compared to satellite-based elevation.

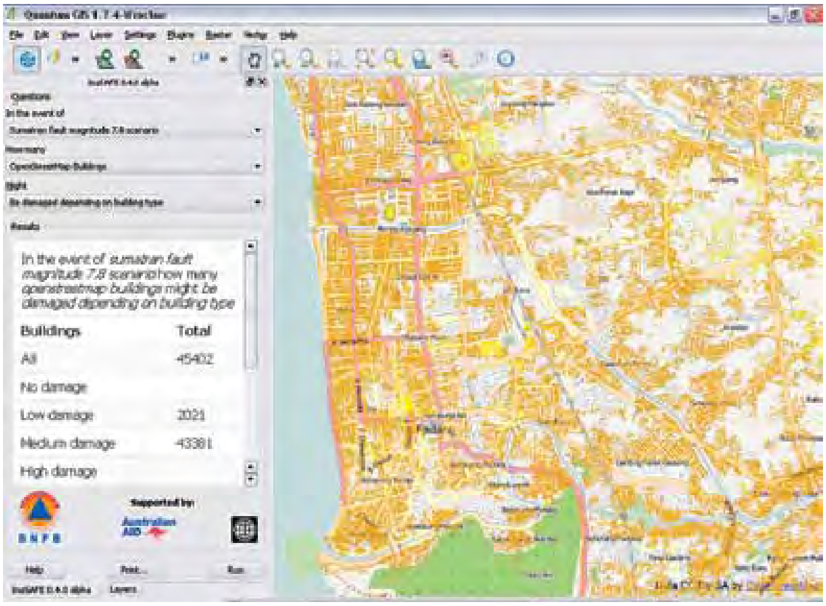
To ensure that risk identification and risk assessment tools and methodologies become globally applicable, practitioners and decision-makers should seek to bridge knowledge and experience across different core areas of disaster risk management (DRM). This includes incorporating various open data and open-source initiatives, crowdsourcing and community mapping exercises, and satellite applications in the process.

Much can be learnt from innovative Web 2.0 open initiatives such as OSM or InaSAFE[25]. Participatory initiatives allow the communities to be engaged in the process of risk identification and DRM by creating

23 McIvor, A.L., Möller, I., Spencer, T. and Spalding. M. (2012). "Reduction of wind and swell waves by mangroves". Natural Coastal Protection Series: Report 1. Cambridge Coastal Research Unit Working Paper 40, The Nature Conservancy and Wetlands International.

24 See for example Chapter 7 in World Bank, (2012), Cities and Flooding which provides case studies on efforts in Germany, Indonesia, Argentina, and in Mozambique.

25 See: http://inasafe.org/.



Indonesia Scenario Assessment for Emergencies – InaSAFE

information about their immediate surroundings, and making it available for the whole community of stakeholders to use.

In the context of flooding, an open flood data and modeling platform allows for the sharing of useful risk data and tools, including models, locally obtained elevation data, river profiles, exposure data and information on vulnerability, in an inclusive and ultimately sustainable manner.

Linking existing efforts in risk identification and assessment, such as for example the CAPRA probabilistic assessment initiative[26], can also further support the development of an open and participatory environment as well as a better-linked and informed community of practitioners.

[26] See: http://www.ecapra.org/

Conclusion

Information needs on flood risks arise at different spatial scales. There are various solutions and applications that can provide this information. By embracing new tools that are open and collaborative users are able to download and share data, models, and vulnerability information, which can provide new risk information for global, regional, or local flood risk assessments. This will allow decision-makers to be better equipped to make informed decisions to reduce, transfer, and manage disaster risks.

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Further Resources

- World Bank (2012). *Cities and Flooding. A Guide to Integrated Urban Flood Risk Management for the 21st Century.* By Abhas Jha, Robin Bloch and Jessica Lamond. www.gfdrr.org/gfdrr/urbanfloods
- World Bank (forthcoming). *Disaster Risk Management in East Asia Pacific: A Strategic Guide for Policy Makers.* www.worldbank.org/eapdisasters
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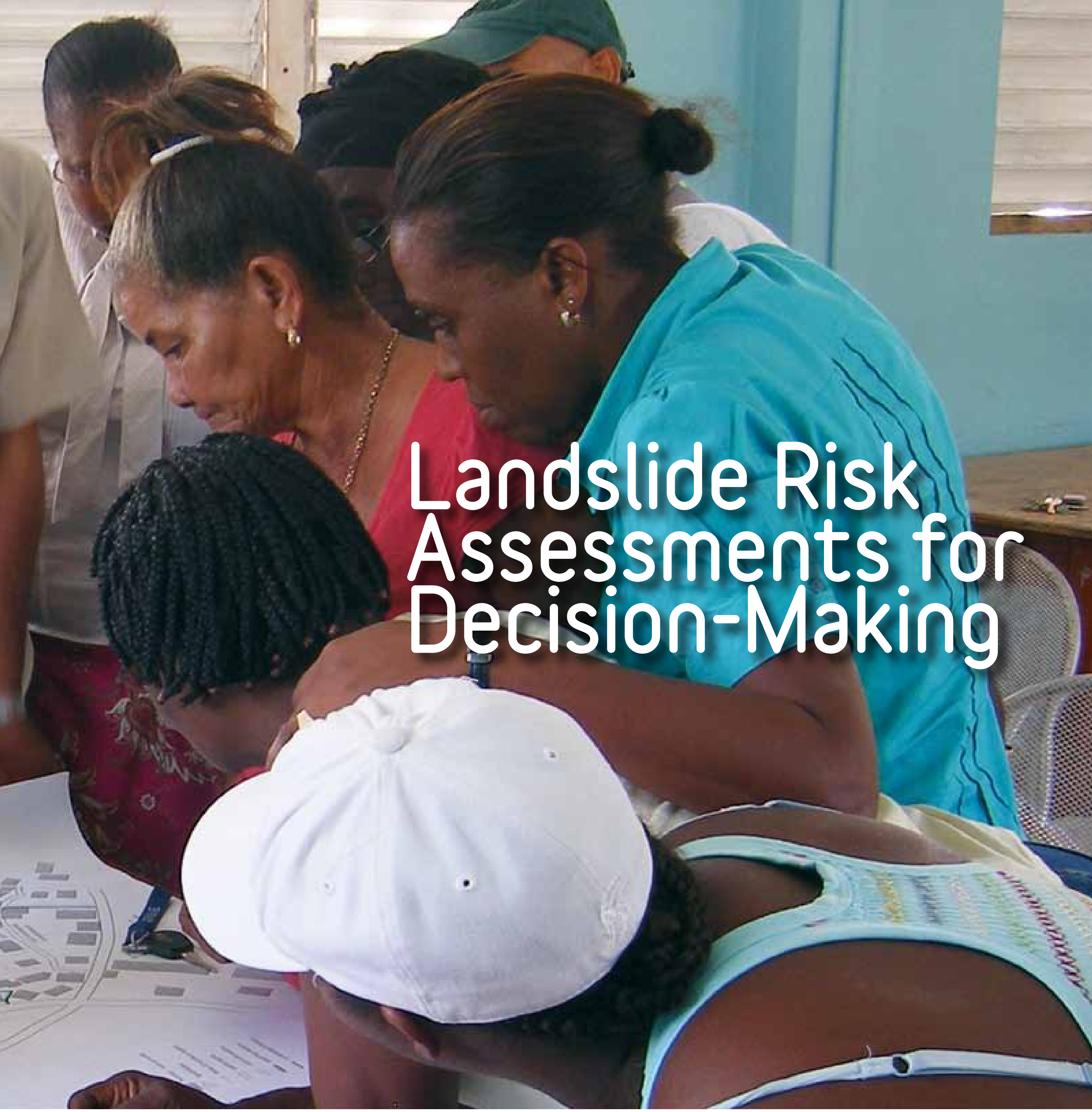
- Winsemius, H.C., Van Beek, L.P.H, Jongman, B., Ward, P.J. & Bouwman, A. (2012). A framework for global river flood risk assessments. *Hydrology Earth System Sciences Discussions,* 9, 9611-9659.

Photo: Discussing the surface water and slope stability issues and potential drainage solutions at a MoSSaiC community meeting.



Landslide Risk Assessments for Decision-Making

Dr. Cees van Westen,
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University of Twente

Landslide risk is an incredibly multidisciplinary problem: it's a social problem, a technical engineering problem, a water problem, and a housing problem.

Landslides are a relatively underestimated type of hazard and do not seem to show up prominently in disaster statistics. Individual landslides might not cause such extreme losses as other types of hazards do, but since they occur more frequently the cumulative effect might be more than one would expect. Furthermore, other processes often trigger landslides; such as earthquakes or extreme rainfall events and the resulting landslide losses are often grouped under the main triggering events.

Studies done by the landslide research center of Durham University on the actual death toll of landslides in the past decade revealed that in the EM-DAT database the death toll was less than 10,000 whereas the actual number was about eight times as high.

Landslides pose an increasing risk to many countries, closely related to both demographic pressures and territory mismanagement, such as illegal settlements, deforestation and lack of appropriate wastewater management.

A sound landslide risk management is based on a landslide risk assessment. Risk assessments provide critical information required to identify suitable strategies and mitigation measures.

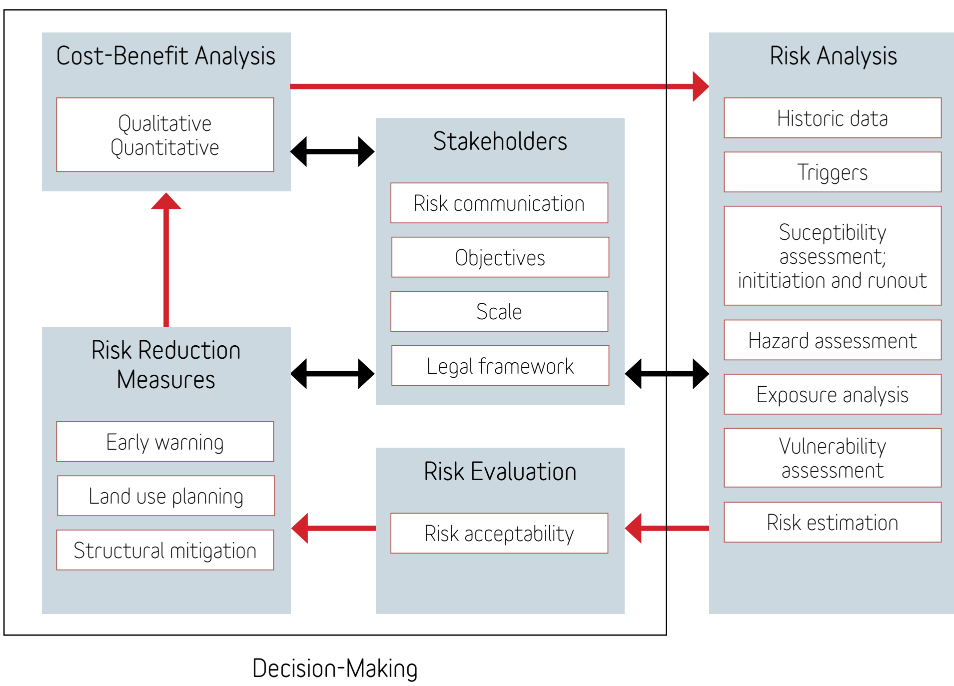
Assessing Landslide Risk

Quantitative landslide hazard and risk assessment is quite a challenge as it involves a number of uncertainties. In order to implement a landslide risk assessment, it is necessary to have the following information, outlined in Figure 1.

For landslide risk analysis, historical data on past landslides is indispensable for generating landslide susceptibility maps for initiation; as is an analysis of the triggering factors of landslides, which include earthquakes, rainfall, snow melt, anthropogenic activities etc. The main difficulties are that input datasets have a large degree of uncertainty.

Landslide susceptibility maps indicate the zones where landslides may occur and the areas that may be affected by landslide runout (debris). The terrain is divided into zones that have different likelihoods of landslides occurring.[27]

FIGURE 1: Framework for landslide risk assessment and decision-making



27 The likelihood may be indicated either qualitatively (as high, moderate low, and not susceptible) or quantitatively (e.g. as the density in number per square kilometers, area affected per square kilometer, safety factor, height or velocity of runout).

Susceptibility maps can show the potential initiation areas (initiation susceptibility) and theses maps can form an input into the modeling of potential runout areas (runout susceptibility).

A landslide susceptibility assessment can be considered as (i) the initial step towards a quantitative landslide hazard and risk assessment; (ii) an end product in itself, or (iii) used in qualitative risk assessment if there is insufficient information available on past landslide occurrences in order to assess the spatial, temporal and magnitude probability of landslides[28].

Converting susceptibility into hazard requires information on temporal, spatial and intensity probabilities. In most of the methods that convert susceptibility to hazard, triggering events play a major role, hence the importance of obtaining event-based landslide inventories to determine (i) the temporal probability of the trigger; (ii) the spatial probability of landslides occurring within the various susceptibility classes; and (iii) the intensity probability.

Intensity probability is the probability of local effects of the landslides (such as height of debris, velocity, horizontal or vertical displacement, or impact pressure). For estimating landslide magnitudes, the area of landslide can be considered as a proxy to the volume, which is often difficult to collect from inventories. The frequency / size analysis of landslide area can be carried out by calculating the probability density function of the landslide area.

Temporal probability assessment of landslides is either done using rainfall threshold estimation, through multi-temporal data sets in statistical modeling, or through dynamic modeling.

The next step is exposure and vulnerability assessment. Exposure assessment analyzes the number of elements at risk and can be carried out by counting the number of elements exposed (e.g. number of buildings), or by expressing them in monetary values (e.g. replacement costs); vulnerability assessment analyzes the degree of loss to elements with a given intensity. The limited availability of historical landslide damage data makes it difficult to construct vulnerability curves. Therefore at a medium scale, expert opinion and the application of simplified vulnerability curves or vulnerability matrices are used.

The last component of landslide risk assessment is to integrate the hazard, exposure, and vulnerability components into an estimation of risk. For each hazard scenario with a given temporal probability the losses are calculated by multiplying the vulnerability (V) and the amount of exposed elements at risk (A). The result is a list of specific risk scenarios, each one with its annual probability of occurrence and associated losses (V*A). The specific risk is calculated for many different situations, related to hazard type, return period and type of element at risk.

Given the large uncertainty involved in many of the components of the hazard and vulnerability assessment, it is best to indicate the losses as minimum, average, and maximum values for a given temporal probability.

Using Landslide Risk Assessments in Decision-Making

Landslide risk assessments provide the critical information required to identify suitable strategies and mitigation measures. Such strategies, such as the integration of landslide hazard zones into land-use planning, structural measures to stabilize slopes, development of drainage systems or the establishment of early-warning systems, are all critically dependent on reliable information. However, the complexities associated with gathering this information present the broad challenges indicated above.

Based on the estimated risk, evaluations should be carried out according to pre-defined standards. However, in many countries a

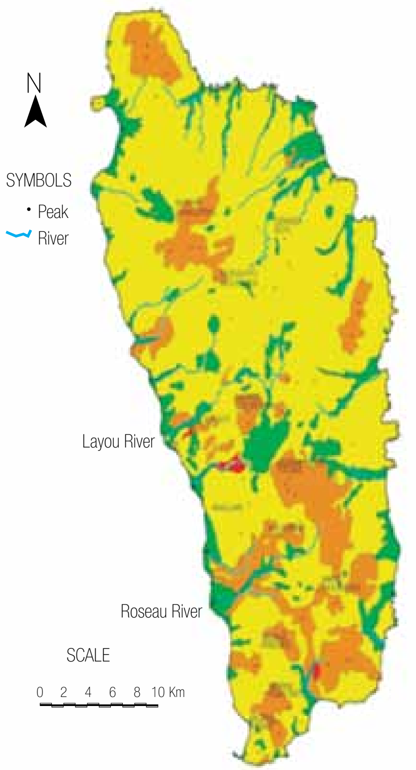
[28] Many methods have been proposed for landslide susceptibility assessment, ranging from expert weighting, statistical modeling towards the application of physical models, which require much more input data. Methods for assessing landslide runout may be classified as empirical and analytical/rational. For hazard zoning purposes both methods are widely used given their capability of being integrated in GIS platforms. However, they vary a lot depending on the type of process modeled, the size of the study area (modeling individual events or modeling over an entire area), availability of past occurrences for model validation, and parameterization.

standard for risk acceptability does not exist, leading to unbalanced decisions. The implementation of the most optimal risk reduction measures should be based on cost/benefit analysis or cost/effective analysis. For such informed decision-making a reliable estimation of the landslide risk is essential.

Stakeholders play a crucial role in this process, but their participation can be problematic when there are many perspectives and agendas. In addition, communicating risk and the role of uncertainty is a major challenge.

Landslide Susceptibility Assessment in the Caribbean

In many of the lesser-developed areas of the world, regional development planning is increasingly important for meeting the needs of current and future inhabitants.



Map 1: Dominica, West Indies

Landslide Susceptibility

Low Moderate
High Extreme

Expansion of economic capability, infrastructure, and residential capacity requires significant investment, and so efforts to limit the negative effects of landslides and other natural hazards on these investments are crucial.

Many of the newer approaches to identifying and mapping landslide susceptibility within a developing area are hindered by insufficient data in the places where it is most needed.

An approach called matrix assessment was originally designed for regional development planning where data may be limited. Its application produces a landslide-susceptibility map suitable for use with other planning data in a Geographic Information Systems (GIS) environment. Its development also generates basic landslide inventory data suitable for site-specific studies and for refining landslide hazard assessments in the future (Map 1).

This example demonstrates how this methodology can be applied in a geologically complex setting. A validated approach to mapping landslide susceptibility, which does not require extensive input data, offers a significant benefit to planning in lesser-developed parts of the world.

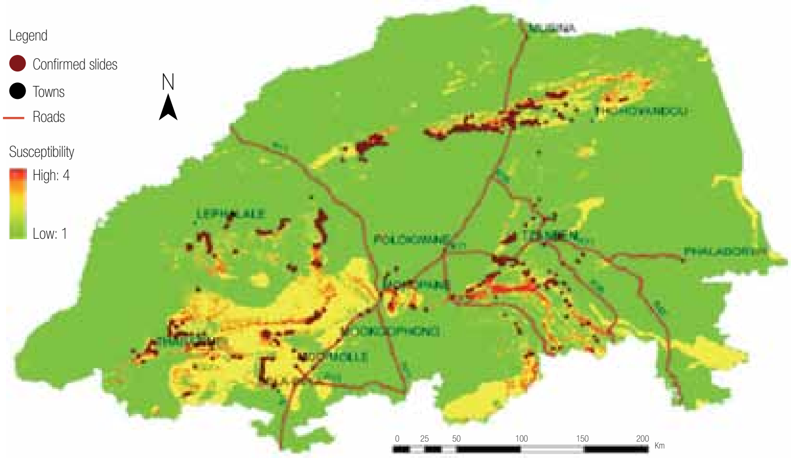
Dealing with Incomplete Landslide Inventories for Landslide Susceptibility Mapping in South Africa

In response to the needs of local and provincial authorities to reduce economic and social losses due to landslides, the systematic creation of inventories and susceptibility mapping of zones prone to slope instability is currently being undertaken for the entire country of South Africa.

Unfortunately, very few research monographs on local landslide and slope instability problems exist in the country and no systematic database on past landslide occurrences is available. As a result, the available landslide maps are generalized and merely highlight qualitatively the relative landslide incidence and thus hazard susceptibility at a regional scale.

In the Limpopo Province, erratic heavy-rainfall events are increasing in frequency and provide an impetus to rapidly map this geohazard in the interests of community safety. A preliminary susceptibility map based on a semiquantitative, bivariate statistical approach and multicriterion fuzzy-set decision theory can now guide planning in the typically hilly areas constraining rural community development (Map 2).

The greatest value of the maps is in raising general public and government awareness of this geohazard.



Map 2: Resulting landslide susceptibility map of Limpopo province

A Community-based Approach for Landslide Risk Reduction in Jamaica

The Management of Slope Stability in Communities (MoSSaiC) methodology, which has been successfully implemented in Saint Lucia, Dominica and Saint Vincent, is a methodology that engages policymakers, community members in particular, managers and practitioners in reducing landslide risk.

The focus of the work is firmly embedded in the communities. It uses existing within-country capacity to reduce urban landslide hazard and identifies hazard drivers to justify interventions.

The project comprises of three components, the first of which involves the development of a toolkit and a short video on MoSSaiC methodology and its application. This outlines the best practices for landslide risk reduction and promotes safer slope management in vulnerable communities. The second entails training on the MoSSaiC methodologies, while the final component involves the implementation of the landslide reduction measures in the selected communities. For more information see: http://www.mossaic.org/

Contributors to the session

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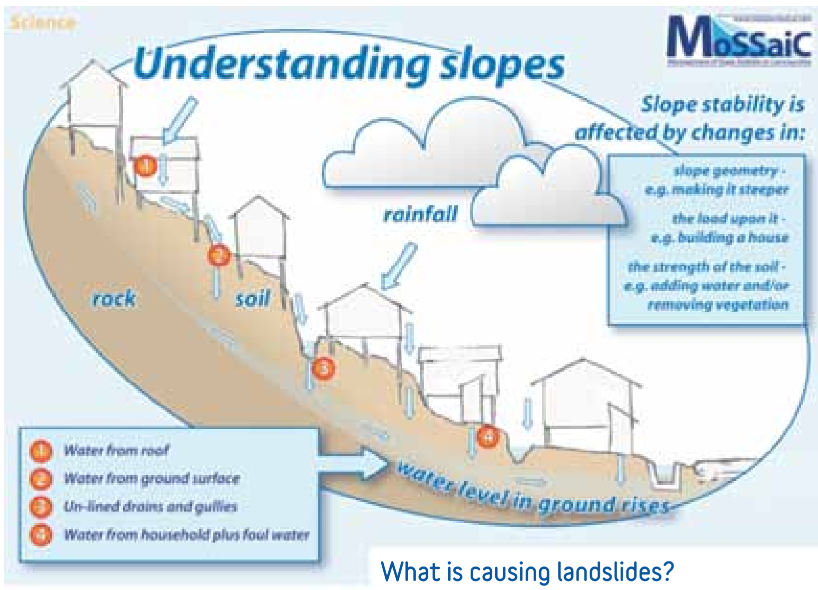


FIGURE 3: Understanding slopes: what causes landslides in urbanized slopes

Further Resources

- Durham University Landslide Research Center: http://www.landslidecentre.org/
- Guidelines and documents from the SafeLand project: SafeLand was a Large-scale integrating Collaborative research project funded by Seventh Framework Programme for research and technological development (FP7) of the European Commission. Thematically the project belongs to Cooperation Theme 6 Environment (including climate change), Sub-Activity 6.1.3 Natural Hazards. The project team composed of 27 institutions from 13 European countries produced a number of very interesting guidelines and documents related to landslide hazard and risk assessment and risk management. The documents can be downloaded at: http://www.safeland-fp7.eu/results/Pages/Summaryreport.aspx

Photo: Colfax County, North Dakota, U.S.A. Supercell produced 3 tornadoes and softball sized hail. © Christopher White | Dreamstime.com

Meteorological, Hydrological, and Climate Services to Support Risk Analysis

Eugene Poolman, Chief Forecaster, Disaster Risk Reduction, South African Weather Service, & **Jean-Baptiste Migraine**, Disaster Risk Management Specialist, Global Facility for Disaster Reduction and Recovery

Meteorological, hydrological, and climate services routinely develop hazard products and services, with great potential to support disaster risk management (DRM), including risk analysis. During this session lessons from new partnerships with DRM entities and technical partners involved in risk analysis and mapping were shared.

Every year, disasters related to meteorological, hydrological, and climate hazards cause significant loss of life, and set back economic and social development. Disaster statistics indicate that 90 % of events, 71 % of casualties and 78 % of related economic losses are caused by weather-, climate- and water-related hazards such as droughts, floods, windstorms, tropical cyclones, storm surges, extreme temperatures, landslides and wild fires, or by health epidemics and insect infestations directly linked to meteorological and hydrological conditions. Over the past five decades, economic losses related to hydro-meteorological hazards have increased, but the human toll has fallen dramatically. This is thanks to scientific advances in forecasting, combined with proactive disaster risk reduction (DRR) policies and tools, including risk analysis, contingency planning and early warning systems.[30]

This session outlined the development of risk analysis products for tropical cyclones, floods, and drought by meteorological, hydrological, and climate services, at the global and local level. A number of challenges were identified as well as a series of steps forward to develop partnerships to address these challenges.

Meteorological, Hydrological and Climate Services for Risk Analysis

1. Tropical Cyclones

Dissemination of tropical cyclone hazard information is a good example of efficient regional and international coordination. In 1972 the WMO Tropical Cyclone Program designated specialized centers in La Réunion, New Delhi, Tokyo, Honolulu, Nadi, and Miami to provide forecasts and

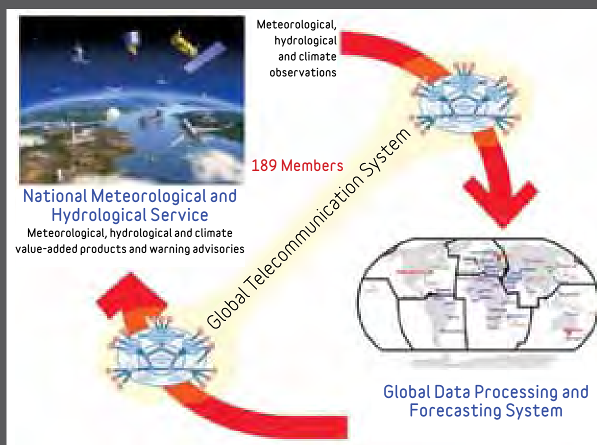
World Meteorological Organization (WMO) and Risk Analysis

The WMO is launching an Expert Advisory Group on Hazard/Risk Analysis that will provide guidance on: (i) Standards and guidelines for hazard definition and monitoring; (ii) Standardization of hazard databases and metadata; (iii) Geographic Information Systems (GIS)-based hazard analysis; and (iv) Forecasting of hazard characteristics, for meteorological, hydrological, and climate related hazards.

The guidelines will be issued by 2015 through the work of the WMO Technical Commissions, in cooperation with the Expert Advisory Group.

This new Group will strongly support core disaster risk reduction (DRR) activities of meteorological, hydrological, and climate services, including risk analysis to support strategic planning, institutional and operational capacity development to support multi-hazard early warning systems, disaster risk financing, sectoral risk management, and humanitarian planning and response.

The WMO is also setting-up the Global Framework for Climate Services that aims to improve availability of science-based and customized climate services for DRR at national, regional, and global levels. It is assisting its members in the implementation of the WMO Information System (WIS), an online tool that will enable access to meteorological, hydrological, and climate data to a wider community of users.



For more information see: http://www.wmo.int/pages/prog/drr/index_en.html

[29] Munich RE. (2012).

[30] *Ibid.*

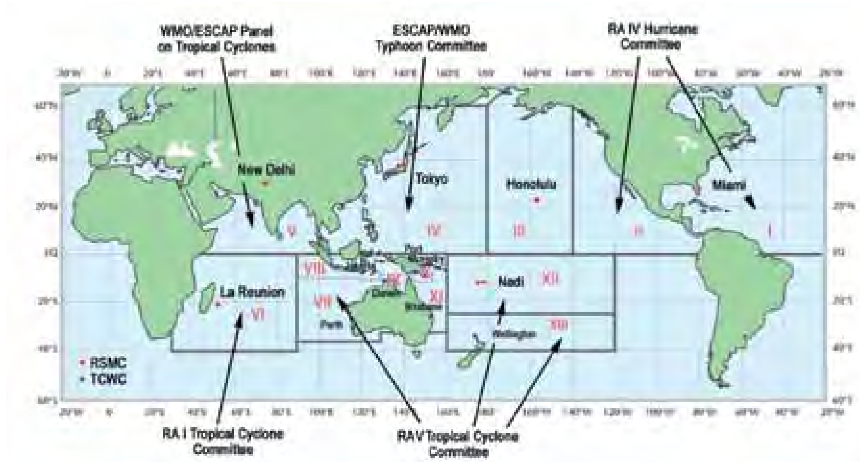


FIGURE 1: 6 WMO-designated Tropical Cyclone Basins and Regional Specialized Meteorological Centers

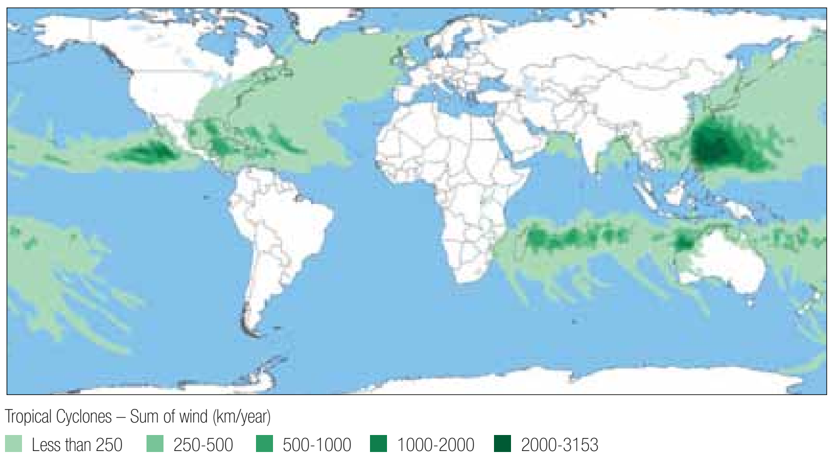


FIGURE 2: Hazard layer in the Global Assessment Report - GAR 2009 (See: http://www.understandrisk.org/sites/default/files/files/useruploads/02-maskrey-gar.pdf).

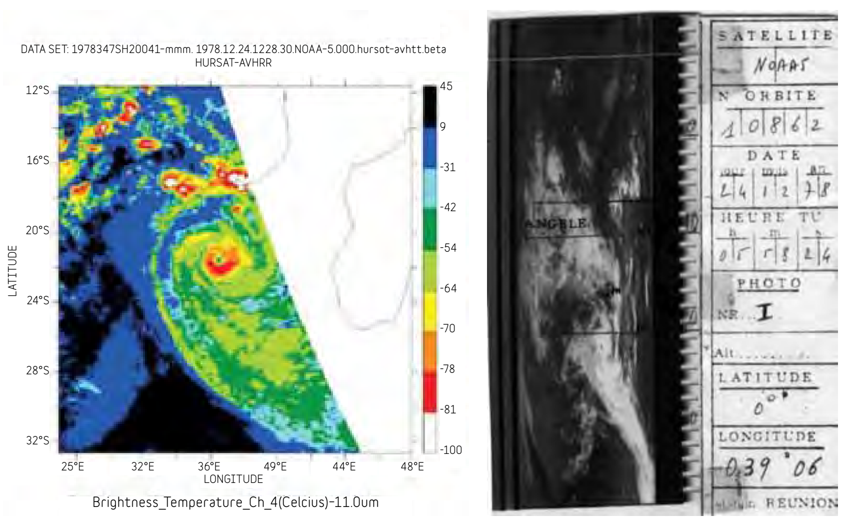


FIGURE 3: Météo-France in la Réunion is re-analyzing past cyclone tracks to estimate parameters and control quality of historical databases.

maintain 'best-track' databases for their respective area of responsibility. Databases include 6-hourly positions of the storms' centers and relevant parameters on intensity, size, and structure (see Figure 1).

The Tropical Cyclone hazard map of the Global Assessment Report (GAR) is built upon information from these six centers (Figure 2).

At the regional level, Météo-France in La Réunion is the tropical cyclone regional specialized center for the southwestern part of the Indian Ocean. Its current activities include "re-analyzing" past satellite imagery (1978-1998) to improve the quality of the tropical cyclone database for the southwestern Indian Ocean, and to identify trends in the evolution of tropical cyclone activity (Figure 3).

The center is also contributing to a risk modeling project for La Réunion with regards to storm surge, windstorm, and surface water flooding. The model under development will define the relationship between hazard intensity and expected damage for the development of loss exceedance curves and event-by-event losses scenarios.

In this context, Météo-France is providing historical hazard data about tropical storms and climate records of wind and rainfall hazards in La Réunion. It is also providing expert advice for the project implementation to enable utilization of hazard information in the risk modeling process.

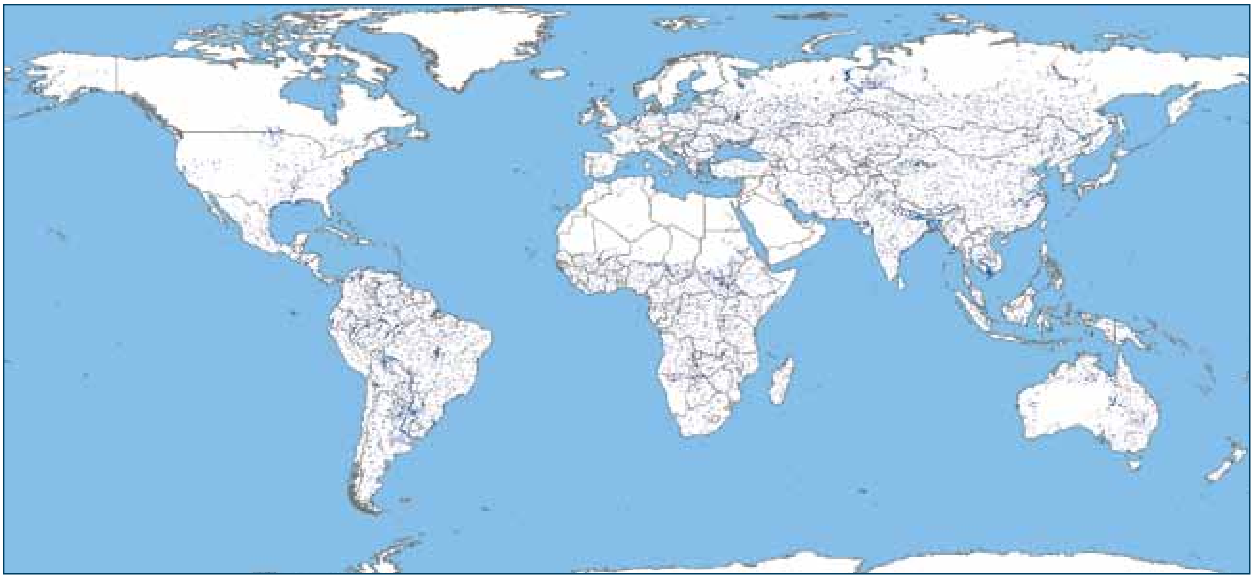


FIGURE 4: Flood Hazard Map (event frequency for cyclone surges, river flooding, and tsunamis) in the GAR 2011

2. Floods

The development of a global harmonized flood hazard dataset remains a challenge. Numerous parameters can be recorded to characterize flooding situations, but global standards have yet to be developed.

The river flood frequency dataset used for the GAR is based upon a combination of: (i) Statistical estimation of peak-flow and related river stage; (ii) Observed floods from 1999 to 2007, from the Dartmouth Flood Observatory (DFO); and (iii) Hydrological records from national hydrological services (Figure 4).

Flood hazard and risk analysis are typically relevant at the scale of the watershed and are often developed with the view to influence policies and plans within specific administrative boundaries. The development of flood hazard and risk analyses therefore requires complex collaborations across administrative boundaries and across fields of expertise. Meteorological and hydrological agencies are typically expected to collaborate with emergency response agencies, as well as with a number of sectoral agencies (such as agriculture, transport, energy).

The Zambezi Basin was presented as a successful example, whereby national meteorological and hydrological services developed hazard maps together with local and national DRM authorities. These maps will be used for land-use and urban planning, DRM and emergency preparedness, as well as for enhanced water resources management (Figure 5).

3. Drought

Despite the repeated occurrences of droughts throughout history and their large impacts, standard data collection and methods for drought hazard assessment and monitoring are still at a very early stage.

FIGURE 5: Flood Inundation Area Map - Zambezi Basin

There are several types of drought, including meteorological, agricultural, and hydrological. Although meteorological drought is increasingly well characterized, the measurement of agricultural and hydrological drought remains a challenge since it depends not only on a wide range of physical factors (rainfall, soil moisture, temperature, soil and crop type, stream flow, groundwater, snow pack) but also on socio-economic factors (for example, land, labor and capital assets, adaptive capacity, trade-offs between profit-maximizing and risk-reduction, etc.).

WMO adopted the Standardized Precipitation Index (SPI) as a global standard to measure meteorological droughts in 2009. However, 20–30 years (optimally 50–60 years) of monthly rainfall data is needed to calculate the SPI and many gaps exist in data series in drought-prone regions. Interpolation techniques still need to be validated for the development of a global dataset satisfactorily representing meteorological drought hazard.

The measurement of agricultural and hydrological drought at the global scale remains an even more complex challenge, since no agreed global standard exists.

A number of National Drought Early Warning Information Systems are currently getting assessed through a collaborative process involving WMO, the National Integrated Drought Information System (NIDIS), and the United Nations International Strategy for Disaster Reduction (UN ISDR).[31]

Drought typically affects large territories, crosses state boundaries, and spans long periods of time. "Climate Outlook Forums" have been organized to provide consensus projections for the 3-6 months in the greater Horn of Africa, Southern Africa, West Africa, Asia, South Asia, Central America, Caribbean, Western Coast of South America, Southeast of South America, Pacific Islands, and Southeastern Europe (Figure 6).

In the United States (US), the 1998 National Drought Policy Act guarantees relevant collaboration between different government agencies on drought-related issues. The US Drought Monitor tool is an important output resulting from these collaborations. Since 2006, the US routinely produces local-scale information (i.e., county to sub-county level) regarding the level of drought stress on vegetation in near real-time. The

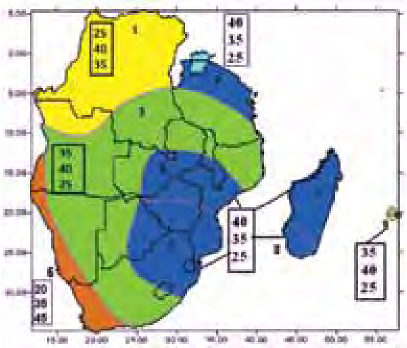


FIGURE 6: Rainfall forecast for January-March 2012, as issued by the Southern Africa Regional Climate Outlook Forum in August 2011

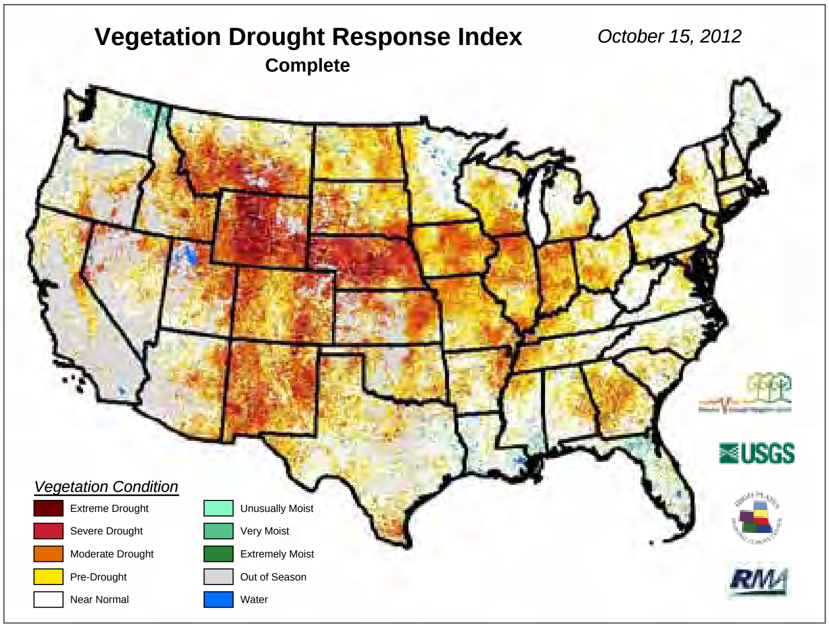


FIGURE 7: In the US, the Vegetation Drought Response Index (VegDRI) combines satellite-based observations of vegetation conditions, climate-based drought indexes and biophysical characteristics.

[31] This assessment will be presented at the High Level Meeting on National Drought Policy (11-15 March 2013), which is expected to influence the development of sound national frameworks for drought risk management.

A Collaborative Approach by the South African Weather Service (SAWS)

The South Africa Weather Service (SAWS) is piloting a number of risk assessment applications developed in partnership with the National Disaster Management Center (NDMC) and involving various sectors at local, national and regional levels.

With 130 automatic weather stations, 112 climate stations, 1512 rainfall stations, its radar network, lightning detection network and air quality monitoring network, SAWS performs hazard observations, monitoring, and forecasting. It supports the Southern Africa region through a number of climate-related activities, notably "Severe Weather Forecasting Demonstration Projects" and "Southern Africa Climate Outlook Forum".

At the national level, SAWS provided reports, data, and products for hazard and risk assessment needs of various disaster management agencies. For example, guidance for flash flood risk estimation or potential drought conditions are provided in real-time to all users (water, agriculture, transport, etc.).

The SAWS has statistics on the likely occurrence of extreme weather phenomena with a historical database of weather events since 1900, CAELUM. This database has been instrumental for improving and validating the EM-DAT database for South Africa.

resulting Vegetation Drought Response Index (VegDRI) is a perfect example of collaboration across sectors, linking early information with a wide range of users.

The Way Forward

The session identified a number of challenges regarding the participation of meteorological, hydrological, and climate services in the development of risk analysis products; some existing initiatives address these challenges:

(i) The knowledge of the existence of some products and services is still limited to a small network of specialists. The latest progress with WMO Information System (WIS) and Global Telecommunication System (GTS) will enable data catalogs to be accessed online by a wider community of users. At the global level, the WIS will allow users outside the meteorological community to access the meteorological, hydrological, and climate information catalog and get information about where information is available, and the conditions of availability. The WIS is being established at the national level by WMO members and should progressively become operational in 2013. Close partnerships between agencies responsible for meteorology, hydrology, climate, and those in charge of mapping, planning, and sectoral developments are therefore very timely in this context, so as to allow for the better understanding and utilization of meteorological, hydrological, and climate services for risk mapping.

(ii) Often the available products are either not sufficiently standardized and customized or not "user-friendly" enough to be used directly by the risk mapping community. The WMO DRR Program Expert Advisory Group on Hazard and Risk Analysis, to be launched early 2013, will provide guidance with respect to: (i) standards and guidelines for hazard definition and monitoring; (ii) standardization of hazard databases and metadata; (iii) Geographic Information Systems (GIS)-based hazard analysis; and (iv) forecasting of hazard characteristics. Furthermore, through cooperation with Member States and Regional Specialized Centers, the DRR Program will work to ensure that a set of standard hazard databases are available regionally through strengthened data sharing among Members and Global and Regional Specialized Meteorological and Climate Centers for the development of regional hazard maps and related services to support regional cooperation.

(iii) Coordination and sharing of data across sectors is insufficient. The Global Framework for Climate Services (GFCS), which is under development, should partially address this need with the following five components: (i) User Interface Platform; (ii)

Services Information System; (iii) Observations and Monitoring; (iv) Research, Modeling and Prediction; and (v) Capacity- building. The goal is to better coordinate existing data for decision-making for the food security, water management, DRR, and health sectors. GFCS will build upon developments of WMO and its partners to ensure that climate services can be provided operationally to support these sectors and decision areas.

(iv) Some products and services are either not available, or available at a cost which is unaffordable to the DRM community. WMO Resolution 40 of 1995 and Resolution 25 of 1999 call for open exchange of respectively meteorological and hydrological "essential" data and products, at least those contributing to the "protection of life and property and the well being of all nations". However, a number of issues still prevent data from being openly exchanged, including commercial interests, national security, absence of data, or the lack of institutional partnerships. Availability of open data and products is still highly variable from country-to-country.

(v) There are challenges for flood hazard information that relate to collaboration needs between meteorological, hydrological, and climate services and a number of sectoral agencies (agriculture, energy, dam management, etc.), in a context where watersheds often cross administrative boundaries. Precise elevation data is often missing and the development of hydrological models remains complex. In addition, a number of areas are affected by a combination of riverine, flash flood, storm surge or tsunami-related flooding, requiring even wider collaboration strategies. Governance frameworks are evolving in countries, and new technologies are becoming available worldwide that should contribute to the enhanced availability and accuracy of flood hazard information.

(vi) Drought hazard information is provided by a number of organizations, but there is no commonly shared definition of the drought hazard. While some national meteorological and hydrological services are organized in "Regional Climate Outlook Forums," and are able to develop an agreed understanding about drought hazard, the development of a global drought hazard dataset still remains a challenge. Drought hazard assessment requires enhanced national and regional drought policy frameworks, coordination between institutions, and inclusion of social indicators. The WMO, the World Bank, and its partners are working on the development and promotion of integrated drought, and drought risk, management, spanning policy, institutional and technical aspects.

Contributors to the session

Maryam Golnaraghi, Chief of Disaster Risk Reduction Programme, World Meteorological Organisation

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Further Resources

- World Bank and GFDRR support to Weather and Climate Information and Decision-Support Systems: http://www.gfdrr.org/gfdrr/WCIDS
- Disaster Risk Reduction Programme of the World Meteorological Organization: http://www.wmo.int/disasters
- WMO at a Glance: http://www.wmo.int/pages/about/documents/WMO990.pdf
- Regional Climate Outlook Forums for Drought Hazard Analysis: http://www.wmo.int/pages/prog/wcp/wcasp/RCOF_Concept.html and http://www.wmo.int/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.html
- WMO Information System: http://www.wmo.int/pages/themes/wis/index_en.html
- Implementation plan of the global framework for climate services: http://www.wmo.int/pages/gfcs/office/documents/GCFSIPv2.pdf
- Hazard data used for the Global Assessment Report is available from the Global Risk Data Platform: http://preview.grid.unep.ch/

Photo: Earth at night showing city lights of Africa and Europe. Credit © Thinkstock.com

Working Together to Advance Earthquake Risk Assessment

Dr. Rui Pinho,
Secretary General, Global Earthquake Model

By working together globally we can share data, approaches, and tools that will help us better understand earthquake risk.

Despite it being well-known that earthquakes can cause significant damage, earthquake risk assessment tools and data are out of reach in many areas of the world. There are currently no global standards that allow us to compare risk and approaches for risk analysis, despite recent earthquake events in Sumatra, Christchurch, and Tohoku, showing us the importance of working together to better understand earthquake behaviour and consequences.

Seismic risk is on the rise in Sub-Saharan Africa due to increased urbanization and population growth. However, short-term crises and other pressing issues are higher on the agenda of most decision-makers, resulting in an underestimation of seismic risk.

Several mega-cities in the region are located near active rifts and tectonic elements (such as Nairobi and Accra) and would suffer greatly from an earthquake. Moreover, seismologists in the region are facing challenges in estimating earthquake risk reliably and providing the information necessary for governments and agencies to build resilience.

However, the latest scientific and technological developments, open-source and open data approaches, and increased international collaboration, are enabling organizations and individuals in the region to make use of existing initiatives, knowledge, tools and data, to analyze and understand seismic risk collaboratively.

Global Collaboration

To rigorously determine and understand seismic risk as an input to decision-making to reduce or transfer risk, one needs to not

Global Earthquake Model

The Global Earthquake Model (GEM) serves as an international forum for collaboration and knowledge exchange to jointly advance seismic risk assessment as an input for risk mitigation and management. Through global projects, regional collaborations, and open-source software, the GEM community is developing tools and resources that allow organizations and practitioners to transparently analyze earthquake risk anywhere in the world.
www.globalquakemodel.org

Utilizing GEM

There are many ways in which scientists, governments, and organisations can use and build upon GEM. In 2014 a platform for risk assessment will become available that will integrate open source tools, global datasets, models, and risk information (maps, indicators, etc.).

Some key products will become available before 2014, such as the global instrumental catalogue that leading experts are currently putting together. More than 20,000 earthquakes that happened between 1900 and 2009 were re-examined and assembled in a single database, following the same method.

The *OpenQuake* engine, a software that allows users to calculate seismic hazard and seismic risk at any scale, was released to GEM's stakeholders in 2011 to provide users and organisations worldwide with the opportunity to use and test it, while it is being developed and enhanced.

Regional programmes, such as the Earthquake Model for the Middle East (EMME) and the Seismic Hazard Harmonisation in Europe (SHARE) in Europe, are using this open-source software to develop models for seismic hazard and risk. In other regions, the GEM Foundation promotes collaboration on seismic risk through technology transfer sessions, both on the theory of hazard and risk assessment, and the use of the software.

During the 2012 UR Forum, 30 scientists from the region were invited to participate in meetings and technical sessions. Worldwide more than 150 users (from 45 countries) have been testing and using the software, and improving it jointly so it can serve a variety of stakeholders in assessing their risk and in comparing outputs. For example, Ecuador's new seismic hazard maps are calculated with the software and GEM partners are using the software in a variety of ways. Geoscience Australia used *OpenQuake* during training on earthquake risk modelling for Asia-Pacific scientists.

only look at past data but also the geophysics of the earth, the elements at risk, and the vulnerability of buildings and of society.

Collecting and integrating datasets on all these elements for the globe is a huge effort that requires collaborative contributions from scientists, governments, and organizations worldwide.

Earthquake Hazard and Risk in Sub-Saharan Africa

Earthquakes impacted Ethiopia, Mozambique, Botswana, Malawi and Madagascar, countries that lie along the East African Rift system, in the last decade. The risk of earthquakes is rising in many countries. With high population growth and urbanization on the rise, more than in any other continent, the risk of serious losses and damages caused by an earthquake is increasing.

In mega-cities like Accra, Nairobi, and Johannesburg the risk is very real. But even there, where people live near, or on fault lines, they are not aware of the risk they are facing. The fact that many people are moving from rural housing built from natural materials to poorly constructed concrete and brick buildings only aggravates the risk.

The capacity of seismic research institutes in the region is also limited. Natural hazards such as drought and flood mainly receive the attention of governments and donors. Furthermore, the focus historically has been mainly on seismic hazard, not risk. These factors result in people, and more importantly decision-makers, generally underestimating earthquake risk in Sub-Saharan Africa.

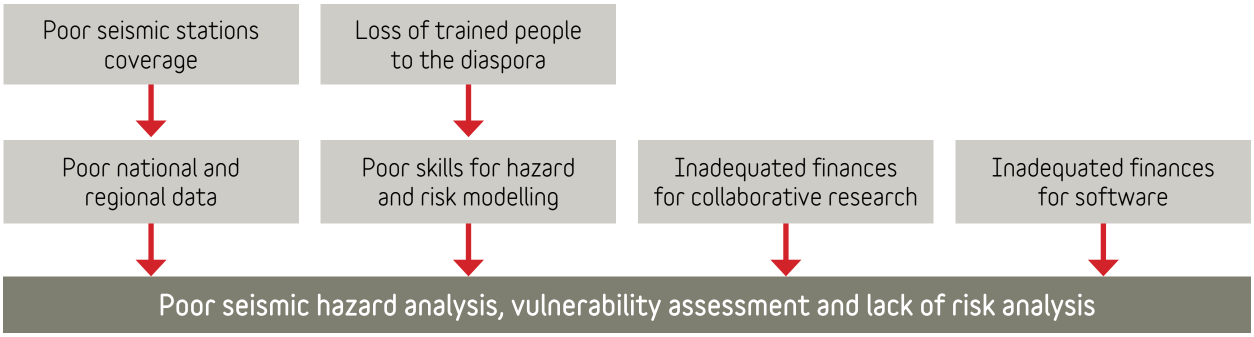
The challenges the region faces in earthquake risk analysis is visualized in Figure 1.

There are various steps that can be taken to overcome these challenges:

1 Moving from Trainings to Partnerships

Scientific cooperation between developed and developing countries is currently mainly focused on training. However, often those trained tend to work outside

FIGURE 1



their region. What is needed is to move from training to creating an infrastructure that facilitates and stimulates much-needed in-country research.

One option is to create more equal research partnerships between African institutions and institutions in developed countries. This will enable local institutions to become more than data providers and investments in sustainable research infrastructure would serve as a base for risk mitigation in the area.

2 Engaging the Diaspora

Even though scientists move abroad, there are ways to keep them involved in seismic hazard and risk assessment in their country of origin. There are inspiring examples of North African scientists in Europe or the USA who are actively facilitating joint projects at home. It is important to promote and facilitate such links further.

3 Creating Collaborators

Many institutions and individuals fear that they are being used for their data. Changing this perception is critical. We need to facilitate data collaboration by aggregating data in a way that is more valuable to the providers.

One example is data on buildings in Sub-Saharan Africa. In order to develop seismic risk profiles it is important that data and knowledge on African buildings is brought together. GEM has been encouraging structural engineers to collaborate on issues such as identifying the key building typologies that exists in the region, providing input on the cost of repair and replacement of buildings, and providing comments on the GEM global building taxonomy and the global exposure database. The data and knowledge they contribute can be shared both with GEM and with a wider community.

Within the *OpenQuake* platform, users will have the option to share data and risk analyses or keep them to themselves and/or trusted contacts. By providing a forum for discussion, collaborators can learn from each other and perform better risk assessments. This will in turn hopefully stimulate others to participate.

4 Communicating Risk to Governments

With the right tools and data, scientists and practitioners in the region can produce the models, maps, and estimates of human, infrastructure, and financial impact that can help governments make decisions related to urban and financial planning, risk reduction, and transferring risk through financial mechanisms. Developing such best practice information requires data collection, research collaboration, and capacity-building.

Advancing Seismic Hazard and Risk Assessment in Sub-Saharan Africa

In order to overcome these challenges, scientists in Sub-Saharan Africa are leveraging the GEM platform to create a local collaborative project for seismic hazard assessment and risk estimation.

The regional program has four main goals:

1. To ensure that global standards and procedures are compatible with African conditions
2. To transfer knowledge and technology to African practitioners and scientists
3. To apply GEM tools to reduce earthquake risk in Africa
4. To contribute to the development of earthquake resistant African infrastructure

By building on existing networks, knowledge and data, the collaborators of the initiative have identified opportunities to work together on a number of areas:

- Collection, harmonization and integration of data in order to model and map seismic hazard in the region;
- Collection of data on buildings and people in a systematic manner in order to move from seismic hazard mapping to risk analysis;
- Build capacity to archive current and future earthquakes (investing in monitoring equipment, training of scientists and technicians);
- Increase research activity, collaboration in the region, and participation in international conferences;
- Foster collaborative research with institutions in developed countries;
- Sensitize governments to support and maintain local capacity;
- Promote awareness among governmental institutions, the construction sector, and the general public at large on seismic risk.

The GEM Sub-Saharan Africa group invites all scientists and practitioners in the region to get involved in this initiative to advance seismic hazard and risk assessment in the region together, and invites local governments and (international) organizations to help sustain the effort.

Contributors to the session

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Capacity-Building Sessions at the

2012 UR Forum Mapping Global Risk

An Africa, Caribbean and Pacific (ACP) - European Union (EU) Sponsored Event

During the Understanding Risk (UR) Forum a series of community meetings and training sessions in tools and emerging applications for disaster risk assessment were organized. The sessions were targeted at participants from Africa, Caribbean and Pacific (ACP) countries. With ACP-EU funds various disaster risk management practitioners from government agencies were nominated to attend the training.

The aim of the training events was to promote knowledge exchange and build technical capacity. The sessions created an enabling environment for further growth and development, opening up discussions on how to promote the disaster risk agenda further in these regions, and particularly in Africa.

All of the tools highlighted in the training sessions are open and participatory tools.

1. CAPRA (Probabilistic Risk Assessment) Program
2. GEM Technical Training
3. GeoNode and Scenario Assessment for Emergencies (SAFE)
4. OpenStreetMap (OSM)
5. Disaster Loss Accounting with DesInventar

1. CAPRA (Probabilistic Risk Assessment) Program

The objective of the CAPRA Program is to support disaster risk management (DRM) mainstreaming into country development policies and programs by providing methodologies and tools to generate, understand, and integrate disaster risk information through capacity-building and strategic technical assistance. The CAPRA Program offers a free and open source multi-hazard software Platform for risk assessment and decision-making support. The Platform combines hazard information with exposure and physical vulnerability data, allowing users to determine risk on an inter-related multi-hazard basis. The CAPRA Platform may be used to support the design of risk reduction measure including risk-financing strategies.

This training session at the UR Forum introduced the CAPRA probabilistic framework and provided various examples of applications derived from probabilistic risk assessments related to flood and seismic risk assessment modules. During this event, the CAPRA Program also held a community of practice meeting, which focused on sharing knowledge and experiences implementing Technical Assistance Projects (TAPs). TAPs are partnerships between the World Bank and government institutions to support government agencies with specific needs requiring disaster risk information within the context of the CAPRA Program's institutional strengthening framework. This meeting shared and discussed the lessons learned from eight TAPs between Latin American and the Caribbean and South Asia region.

For more information, please visit:
http://www.ecapra.org

Trainers: Fernando Ramirez, Oscar Ishizawa, and Erika Vargas, World Bank and Eduardo Reinoso, Carolina Rogelis, Evaluacion de Riesgos Naturales (ERN)

2. GEM Technical Training

Global Earthquake Model (GEM) is a global effort to collaboratively develop and enhance databases, methodologies, (software) tools, and resources for earthquake risk assessment across the globe.

The OpenQuake Platform is being developed to integrate all of these elements in a single intuitive GIS-environment. Based on the contributions of hundreds of collaborating organizations and experts worldwide, from 2014 onwards the platform will allow users to calculate, share, and explore risk from earthquakes in many different ways. The complex calculations that are the basis for estimating seismic risk can be carried out with an open-source software that is already available in a preliminary version for worldwide testing: the OpenQuake Engine.

The OpenQuake Engine is an advanced, science-based software for seismic hazard and risk calculations at any scale. The outputs users can produce with it range from hazard maps to event-loss tables and risk scenarios. Currently the engine has users from more than 45 countries; individuals and organizations that are active in the fields of (earthquake) hazard and risk assessment. The further development of OpenQuake Engine is based on the requirements that emanate from scientists and practitioners from around the world, within the scope of GEM.

During the UR Forum, GEM brought together thirty scientists from around Africa to participate in a number of technology transfer sessions, including training and exercises with the OpenQuake Engine to ease working with it.

For more information on OpenQuake, please visit:
http://www.globalquakemodel.org/

Trainers: Atalay Ayele, Helen Crowley, Mohamed El Gabry, Marco Pagani, Graeme Weatherill and Ben Wyss - Global Earthquake Model

3. GeoNode and Scenario Assessment for Emergencies (SAFE)

GeoNode is an open-source platform that facilitates the creation, sharing and collaborative use of geospatial data and supports other risk assessment tools such as CAPRA (GeoNode provides the data management for CAPRA) and Scenario Assessment for Emergencies (SAFE).

The tool is build upon free open-source software and is designed to allow non-technical users to easily share their data and use it to create interactive maps. GeoNode surpasses existing spatial data infrastructure solutions by integrating robust social and cartographic tools.

SAFE is a suite of innovative web-based open-source tools aimed at helping decision-makers understand the risk of natural hazards and build resilience. By producing realistic natural hazard impact scenarios, decision-makers can implement better planning, preparedness and response activities.

SAFE provides a simple yet rigorous way to combine data from scientists, local governments and communities to provide insights into the likely effects of future disaster events. The software is focused on examining the impacts that a series of hazard scenarios have on specific sectors. The vision is to be able to rapidly customize risk information for different stakeholders with an interactive, decision-oriented tool. The software leads users through the impact analysis process and has tools to estimate the likely damage that a hazard will cause to people and critical infrastructure such as schools, hospitals, roads, etc.

The tool can be used for rapid post-disaster impact estimation, contingency planning, infrastructure / spatial planning and multi-hazard impact assessment. While pioneered in Indonesia, the approach and tools are now being adapted in other regions.

GeoNode and SAFE are part of the Open Data for Resilience Initiative (OpenDRI), a GFDRR initiative that promotes the sharing of hazard and risk data (http://www.gfdrr.org/gfdrr/opendri).

For more information please visit:
http://geonode.org/ and http://inasafe.org/

Trainers: Robert Soden, Ariel Nunez, and Abigail Baca, GFDRR Labs World Bank

4. OpenStreetMap (OSM)

OpenStreetMap (OSM) is an Internet project with the goal of creating a free global map of human settlement and the natural environment. Like Wikipedia, OSM benefits from the ongoing input of thousands of people around the world who are teamed to create accurate, detailed, and up-to-date maps. Worldwide, the OSM community collects data on roads, railways, paths, waterways, and even bicycle routes. In addition to the transportation ways that are mapped, data is gathered on features along the roads, such as businesses, buildings (private and public), parks and natural areas, land use, cultural resources, and recreational facilities.

Besides being comprehensive, the data of OSM maps is also of high quality. On other maps, roads may not be precisely aligned, trails may be missing, and important features can be ignored. Furthermore, other maps can include nonexistent 'trap streets' to catch illicit copiers.

However, at OSM data is reviewed and corrected by dozens of contributors, especially data from urban areas, and they are free to fix any errors they find.

OSM has been used in many contexts around the world including disaster response and disaster risk reduction (DRR). For DRR, OSM provides a methodology for collecting exposure data for risk assessment. Having a community dedicated to this cause ensures that the data increases in detail and currency. The training session at UR taught participants how to join this community and discussed the benefits of free and open map data, as well as how they can begin using it in their own projects.

For more information please visit:
http://www.openstreetmap.org/

Trainers: Kate Chapman and Pierre Beland - Humanitarian OpenStreetMap Team

5. Disaster Loss Accounting with DesInventar

The Disaster Inventory System - DesInventar (Sistema de Inventario de Desastres) is a conceptual and methodological tool for the construction of databases of loss, damage, or effects caused by emergencies or disasters. Without credible loss and damage estimates it is difficult to generate the political momentum for increasing investment in risk reduction and climate change adaptation.

Rigorously accounting and analyzing disaster losses through the development of national disaster databases represents a low-cost, high-impact strategy to fill this gap, and is the crucial first step to generate the information necessary for accurate risk assessments and to inform public policy in disaster risk reduction and climate change adaptation. Later on the physical losses recorded in the databases can be translated into monetary/economic losses enabling an initial evidence-based estimate of recurrent losses.

The DesInventar training session at the Understanding Risk Forum illustrated practical, proven and simple tools to build disaster loss databases and methods to analyze and use its information.

For more information on this tool, please visit:
http://www.desinventar.org/en/

Trainer: Julio Serje, UNISDR

Philippe Bally, Kate Chapman, Derek Clarke, Trevor Dhu, Souleyman Diop, Rosauge Guale, Emmanuel Kala, Ja
Eugene Poolman, Julio Serje, Robert Soden, Maarten Van Aalst, Kenneth Verosub, Cees van Westen, Cla
Dickson, Laura Dorling, Tiguist Fisseha, Marc Forni, Niels Holm-Nielsen, Sarwat Hussain, Christina Irene, Osc
Fernando Ramirez, Keiko Saito, Sahar Safaie, Alanna Simpson, Anthea Serritslev, David Sislen, Wilfred Solom
Nothando Nyathi, Mmenyane Seoposengwe, Chalida Chararnsuk, Brendan McNulty, Francis Muraya, Emma P
Fast, Francis Ghesquiere, Jonathan Kamkwalala, Alan Knott-Craig, Mayor Patricia de Lille, Andrew Maskrey
Balgis Osman-Elasha, Alhamndou Dorsouma, Sofia Bettencourt, Tony Nyong, Laban Ogallo, Alhassane Diallo, J
Donaldson, Anthony Julies, Andrew Maskrey, Wadid Erian, Harikishan Jayanthi, Julio Serje, Nicole Keller, Dur
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Atalay Ayele, Maryam Golnaraghi, Philippe Caroff, Osborne Shela, Roger Pulwarty, Eugene Poolman, Malcolm
Winsemius, Jaap Kwadijk, Rosauge Guale, Roger Pulwarty, Mustapha Darboe, Niels Balzer, Abdishakur Othow
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Understanding Risk Team

Thank you!

Feedback from the UR Community on UR2012

Watch live interviews from participants of the 2012 Forum online:
https://www.understandrisk.org/page/closing-video

"UR2012 was a great opportunity to learn and understand how institutions, countries and regions are progressing in Disaster Risk Assessment and Management."
—Annie Edwards, Physical Planning Division, Ministry of Environment, Natural Resources Physical Planning and Fisheries, Dominica

"It was a remarkably balanced program between social interaction opportunities and technical exchanges. As a technical specialist, I greatly appreciated broadening my perceptions of risk to include financial and conceptual aspects of risk management."
—Jerome De Graff, California State University, Fresno

"A gathering of a very interesting mix of people from governments, financing, (re)insurance, NGOs, knowledge institutes, all exchanging their information needs and information availability and new possibilities. Excellent meeting about an exciting cross-discipline subject, where a lot is still to be learned and developed together!"
—Hessel Winsemius, Deltares

"Good networking and sound boarding opportunity. Allows me to get an understanding of how things are being done in other parts of the world and to promote best practice."
—Nabeel Rylands, Western Cape Provincial Disaster Management Centre, South Africa

"Common problem, common efforts, common wisdom, common gains!"
—Amod Mani Dixit, NSET

"The Understanding Risk Community provides an opportunity to learn of new or different concepts and methodologies that stimulate creative approaches to improving resilience."
—John Kelmelis, Pennsylvania State University

"The UR Community creates an environment for sharing experiences and increasing translational knowledge in the hopes of empowering its members as leaders in the reduction of disaster risk consequences."
—Carl Taylor, Fraser Institute for Health Research

"As risks are shared, so are solutions. And that is what this community is about".
—Daniel Boshoff, Santam

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