

## Meeting Documents for Agenda Item 3

***Readers' guidance:*** \*I - For Information; \*C - For Comment; \*D - For Decision

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## **12<sup>th</sup> Meeting of the IRDR Science Committee ICSU Secretariat, Paris, France, 13-15 November 2014**

### **Agenda Item 3: Planning Meeting of IRDR Working Groups**

The purpose of this session is for the Working Groups (WGs)—DATA, FORIN and RIA—to conduct a short informal self-assessment of their progress so far, in order to proceed to WG / Core Project forward-planning, in terms of WG composition and format, research activities, networking and dissemination and application of results.

SC members had been sent a proposed guidance note for this session, which also listed desired outcomes.

**N.B.: AIRDR will be discussed in a separate item by the SC plenary, following up on the Chair's presentation during the 11<sup>th</sup> SC meeting and subsequent exchanges with the IPO.**

The outcomes from this session will be presented during the strategy and forward looking session on day 3 (morning), enriched by insights gained and exchanges during the networking and partnership session, and the SC business meeting proper.

With a view also to facilitating communication about WG activities (past, ongoing and planned), SC members will be asked to cover in their presentations the items suggested in the guidance note.

The exercise also serves the purpose of preparing (and allowing WGs to make adjustments prior to) the programme evaluation that will occur in 2015.

It is desirable that next to those SC members already actively involved in the respective WGs, also at least one SC member who is not (yet) involved volunteer to join the discussions to provide an active external commentary.

The three small break-out working group meetings will be preceded by a joint briefing on the likely budgetary situation in 2015, as well as on perceived likely elements under HFA2 that IRDR might want to be addressing. The SC Chair will join the WG RIA. The ED will remain available as resource person.

Items to be covered during the WG meetings include; outcomes are suggested:

- WG Composition (are additions needed? Consider: disciplines, non-academic sectors / stakeholders with a view to co-design of research and application, geographic spread, gender balance).  
Desired outcome: a list of possible new external WG members.

- Review of activities (completed, ongoing, and planned): give dates, links, supporting or resulting documents. Make specific reference to WG work plans, IRDR Strategic Plan, ICSU Science Plan for IRDR (addressing also explicitly notably the issue of multiple integration characteristic for IRDR).  
Desired Outcome: a calendar of past and future WG-related activities and events; a catalogue of products / programmes; an understanding of achievements and shortcomings compared to the programme and WG plans (work plans revised).
- List contributors (individuals and institutions) and contributions, such as case studies, articles, books, grey literature, software, contributions to teaching tools etc., applications (including interaction with government at all levels, business, civil society, NGO sector etc.).  
Desired outcome: better understanding of the network behind the WG to be used for the mapping of IRDR-related activities.
- Consider links with / involvement of / related initiatives (please give names), identifying potential Affiliated Projects (Terms of Reference under development), considering also new DRR science trajectories, and envisaged / needed changes of the DRR environment under HFA2 (and how the WG would be able to address those by appropriate alliances).  
Desired Outcome: list of potential Affiliated Projects (with rationale for alliance).
- Identify funding needs (for WG meetings to complete respective work plans (in the short term: 2015) and for case studies (until the end of the programme)).  
Desired Outcome: realistic and specific elements that can be built into an IRDR programme-wide fundraising strategy (with rationale).
- Suggest at least two initiatives that can be taken forward with the respective National or Regional Committees (including possibly involving ICSU's Regional Offices and UNISDR/UN regional bureaus).  
Desired Outcome: concrete guidance on needs- or opportunity-based options for closer liaising with the regional support networks of the Co-Sponsors.
- Identify venues in 2015 for the WGs / Core Projects to present or to be represented (by an SC member or her/his delegate).  
Desired outcome: basis for better forward planning for equitable and strategically meaningful allocation of resources for travel support for SC Members and their delegates.

Some feedback received suggests that it might be useful also to consider thematic sub-working groups, with easily recognisable leaders, which would probably entail also a widening of the network along the trajectories of these themes.

Additional elements can be included into the reports, but the suggested elements should be covered.

### **Attachments:**

3.1 Guidance Note: IRDR Working Groups Meetings

3.2 ICSU Science Plan for IRDR

3.3 IRDR Strategic Plan 2013-2017

3.4.1 Work Plans of the DATA, FORIN, RIA Working Groups

### 3.4.2 Background material for DATA:

- EU Disaster Loss Data Meeting, 23-24 October 2014: Agenda and Concept Note
- Agenda and concept note, UNESCAP First Meeting of the Expert Group on Disaster-related Statistics in Asia and the Pacific, Sendai, 27-29 Oct 2014
- CODATA Task Group - “Linked Open Data for Global Disaster Risk Research” (LODGD)

### 3.4.3 Background material for FORIN:

- Editorial in upcoming issue of *International Journal of Disaster Risk Reduction* by Ian Burton: “The forensic investigation of root causes and the post – 2015 framework for disaster risk reduction”
- Progress Report and Proposals on FORIN to Sendai PrepCom 2
- A Review of the FORIN Methodology and Existing FORIN Case Studies (July 2014)
- Concept Note: A FORIN Disaster Research Workshop Programme

### 3.4.4 Background material for RIA:

- Pathways for Transformation: Disaster risk management to enhance development goals (2014)

#### **Actions:**

3.1 SC members who are WG co-chairs are invited to lead the session and to prepare a short report for the strategic planning session on Saturday.

3.2 SC members are expected to decide on priority support for activities, in the light of the short overview over budgetary constraints.

**N.B.: WG members are invited to submit (in digital form or hard copy) any relevant material related to meetings past or upcoming and publications/products that can be feature on the IRDR website.**




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**12<sup>th</sup> Meeting of the IRDR Science Committee  
ICSU Secretariat, Paris, France, 13-15 November 2014**

**Guidance Note for Working Groups Meetings (Day 1; morning)**

The purpose of this session is for the WGs to conduct a short informal self-assessment of their progress (or shortcomings) so far, in order to proceed to WG / Core Project forward-planning, in terms of WG composition, activities, networking and dissemination and application of results.

The outcomes will be presented during the strategy and forward looking session on Day 3 (morning), enriched, it is hoped, by insights from and exchanges during the networking and partnership session and the SC business meeting proper.

The exercise also serves the purpose of preparing (and allowing WGs to make last minute adjustments prior to) the programme evaluation that will occur in 2015.

It is desirable that next to those SC members already actively involved in the respective WGs also at least one SC member who is not (yet) involved volunteer to join the discussions to provide an active external commentary.

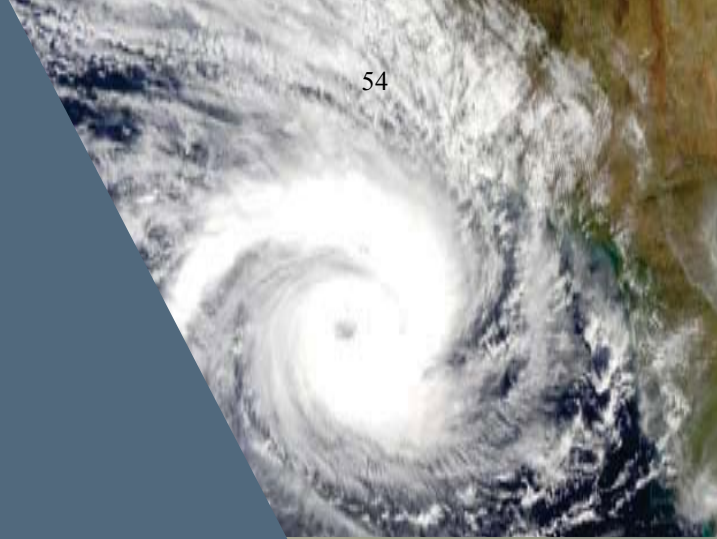
Items to be covered during the WG meetings on Day 1 include:

- Reflecting on composition of the WG (what additions are needed: disciplines, non-academic sectors / stakeholders with a view to co-design of research and application, geographic spread. Please also give due consideration to gender balance.
- Mapping activities (completed, ongoing, planned (with dates and, where available, links or supporting documents) with specific reference to WG / Core Project work plans, IRDR Strategic Plan and ICSU Science Plan for IRDR (addressing notably the issue of multiple integration as required under this Programme).
- Listing, in the process, contributors (individuals and institutions) and contributions (case studies, products (articles, books, grey literature, software, contributions to teaching tools etc.), applications (incl. interaction with government at all levels, business, civil society, NGO sector etc.), to be used also for the comprehensive mapping of IRDR-related activities.
- Spelling out, against the backdrop of the ICSU Science Plan for IRDR, the IRDR Strategic Plan and the WG / Core Project Work Plan, achievements and shortcomings (for steps to address these shortcomings and to disseminate outcomes see next section).
- Considering, for future developments how to link up to / involve / make use of related initiatives (please name), incl. opportunities of inviting potential Affiliated Projects (ToR

under development), considering DRR science trajectories, and envisaged / needed changes of the DRR environment under HFA2.

- Identify funding needs (for WG meetings to complete respective work plans; for case studies) in the short term (2015) and until the end of IRDR cycle one.
- Suggesting at least two initiatives each (i.e.: per WG) that can be taken forward with the respective National or Regional Committees (incl. ICSU's Regional Offices and UNISDR/UN regional bureaus).
- Identifying venues and contexts (in 2014/15) where it would be desirable for the WG / Core Project to be present and/or to present (with a view to allocating equitably and strategically resources for travel support for SC Members and their delegates).

Please feel free to add to this list, but please also make sure you use the list as guidance and try to provide all the information that we need urgently to be able to support you in 2015 (incl. budgeting and fundraising).



# A Science Plan for Integrated Research on Disaster Risk

Addressing the challenge of natural and human-induced environmental hazards



**ICSU**

International Council for Science

# About ICSU

**Founded in 1931**, the International Council for Science (ICSU) is a non-governmental organization with a global membership of national scientific bodies (114 Members, representing 134 countries) and international Scientific Unions (29 Members). The Council is frequently called upon to speak on behalf of the global scientific community and to act as an advisor in matters ranging from scientific conduct to the environment. ICSU's activities focus on three areas: planning and coordinating research; science for policy; and strengthening the Universality of Science.

**ICSU's mission** is to strengthen international science for the benefit of society. To do this, ICSU mobilizes the knowledge and resources of the international science community to:

- **Identify** and address major issues of importance to science and society
- **Facilitate** interaction amongst scientists across all disciplines and from all countries
- **Promote** the participation of all scientists—regardless of race, citizenship, language, political stance, or gender—in the international scientific endeavour
- **Provide** independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society and the private sector.



Suggested citation: International Council for Science (2008) A Science Plan for Integrated Research on Disaster Risk: Addressing the challenge of natural and human-induced environmental hazards.



# A Science Plan for Integrated Research on Disaster Risk

Addressing the challenge of natural and  
human-induced environmental hazards

*Report of ICSU Planning Group on Natural and  
Human-induced Environmental Hazards and Disasters*



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# Executive Summary

The impacts of natural hazards continue to increase around the world; the frequency of recorded disasters affecting communities significantly rose from about 100 per decade in the period 1900-1940, to 650 per decade in the 1960s and 2000 per decade in the 1980s, and reached almost 2800 per decade in the 1990s. Hundreds of thousands of people are killed and millions injured, affected or displaced each year because of disasters, and the amount of property damage has been doubling about every seven years over the past 40 years. Although earthquakes and tsunamis can have horrific impacts, most disaster losses stem from climate-related hazards such as hurricanes, cyclones, other major storms, floods, landslides, wildfires, heat waves and droughts. Current evidence demonstrates that changes in the global climate will continue to increase the frequency and severity of climate-related hazards.

Globalization, population growth, widespread poverty, particularly in hazardous areas, and a changing climate will cause the risk associated with natural hazards to be even greater in the future, with more people and communities at risk. In urban regions, the complex infrastructure systems that make life and economic activity possible, the concentration and centralization of economic and political functions, social segregation and complex spatial and functional interrelationships, all contribute to the vulnerability of populations to disruptions caused by hazards.

The ICSU Priority Area Assessment on Environment and its Relation to Sustainable Development (2003) and the ICSU Foresight Analysis (2004) both proposed 'Natural and human-induced hazards' as an important emerging issue. The executive summary of the ICSU Priority Area Assessment on Capacity Building in Science (2005a) stated that a great challenge is 'a development problem...the widening gap between advancing science and technology and society's ability to capture and use them.'

It is the assessment of the ICSU Planning Group that, despite all the existing or already planned activities on natural hazards, an integrated research programme on disaster risk reduction, sustained for a decade or more and integrated across the hazards, disciplines and geographical regions, is an imperative. The value-added nature of such a programme would rest with the close coupling of the natural, socio-economic, health and engineering sciences.

The Planning Group recommends that the Research Programme be named **Integrated Research on Disaster Risk – addressing the challenge of natural and human-induced environmental hazards** (acronym: IRDR).

The Science Plan of the proposed IRDR Programme would focus on hazards related to geophysical, oceanographic and hydrometeorological trigger events; earthquakes; volcanoes; flooding; storms (hurricanes, typhoons, etc.); heat waves; droughts and fires; tsunamis; coastal erosion; landslides; aspects of climate change; space weather and impact by near-Earth objects. The effects of human activities on creating or enhancing hazards, including land-use practices, would be included. The IRDR Programme would deal with epidemics and other health-related situations only where they were consequences of one or more of the aforementioned events. Technical and industrial hazards and warfare and associated activities would not be included *per se*. The focus on risk reduction and the understanding of risk patterns and risk-management decisions and their promotion would require consideration of scales from the local through to the international level.

The increases in costs of disasters are taking place in both developed and developing countries, which suggest that reducing the risks from hazards is not simply a matter of economic growth and development. There is a great shortfall in current research on how science is used to shape social and political decision-making in the context of hazards and disasters. These issues also highlight the need for more systematic and reliable information on such events. An aim of the Programme would be to both generate new information and data and to leave a legacy of coordinated and integrated

global data and information sets across hazards and disciplines, with unprecedented degrees of access.

IRDR would leave the legacy of an enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts, such that in ten years, when comparable events occur, there would be a reduction in loss of life, fewer people adversely impacted, and wiser investments and choices made by governments, the private sector and civil society.

The IRDR Programme would have three research objectives, the first of which deals with the characterization of hazards, vulnerability and risk. The identification and assessment of risks from natural hazards on global, regional and local scales, and the development of the capability to forecast hazardous events and their consequences would be, of necessity, interdisciplinary. Understanding of the natural processes and human activities that contribute to vulnerability and community resilience will be integrated to reduce risk. This objective would address the gaps in knowledge, methodologies and types of information that are preventing the effective application of science to averting disasters and reducing risk.

The second research objective involves understanding decision-making in complex and changing risk contexts. Understanding effective decision-making in the context of risk management – what is it and how it can be improved – calls for an emphasis on how human decisions and the pragmatic factors that constrain or facilitate such decisions can contribute to hazards becoming disasters and/or may mitigate their effects.

The third research objective, on reducing risk and curbing losses through knowledge-based actions, would require integration of outputs from the first two and could only be achieved through implementing and monitoring informed risk reduction decisions and through reductions in vulnerability or exposure. Processes of human adjustment or adaptation can be used to reduce vulnerability and increase resilience.

Three cross-cutting themes would support these objectives: capacity building, including mapping capacity for disaster reduction and building self-sustaining capacity at various levels for different hazards; the development of case studies and demonstration projects; and assessment, data management and monitoring of hazards, risks and disasters.

The Planning Group has identified the major programmes and projects that already exist in the field of natural hazards and disasters and, through an extensive consultation process, the Programme would further explore these and other activities and enter into agreements as to how they might become components of the whole as partners in research.

During the first three years, the Programme would establish a team of co-sponsors and make arrangements with existing programmes so as to undertake research with shared outcomes and responsibilities. A Scientific Committee, mandated by the co-sponsors and with support from an International Project Office, would have the responsibility for building the formal linkages with partners in research. The collaborating organizations, working through a Consultative Forum, would become significant actors in the Programme.

In addition, new projects would be initiated to put in place, in a priority sense, the elements needed to fully meet the objectives over a ten-year timescale. It is recommended that the Scientific Committee, when established, create two working groups to help scope out the programme and lay the firm basis for further programme development. These would be working groups for forensic investigations of recent disaster events, and for a long-term hazards research network.

# 1 Background

As part of the development of the first ICSU Strategic Plan, the ICSU Priority Area Assessment on Environment and its Relation to Sustainable Development (ICSU, 2003) reviewed strategic options for future ICSU activities related to environmental research, and proposed 'Natural and human-induced hazards' as one of four possible new fields of work. The ICSU Foresight Analysis of 2004 equally highlighted this field as an important emerging issue. Accordingly, the ICSU Executive Board decided to appoint an ICSU Scoping Group to consider the establishment of a research programme on Natural and Human-induced Environmental Hazards. The Scoping Group immediately found itself grappling with a question that can be stated in many forms, but might perhaps be succinctly expressed as follows: *Why, despite advances in the natural and social science of hazards and disasters, do losses continue to increase?* In the past, the trends in losses have often been excused on the argument that they follow inevitably from population growth and economic development, which put more people and property at risk. However, this need not be the case: witness instances in which societal activities have greatly increased without a corresponding increase in the impacts of related hazards. One such is commercial air travel, which has generally become safer despite the marked growth in traffic. Examples like this provide opportunities for study and the drawing of valuable parallels.

The Scoping Group reported to the ICSU 28th General Assembly (ICSU, 2005b), noting that research was needed on how to translate research findings about natural hazards and human behaviour into policies that are effective in minimizing the human and economic costs of hazards. Such research required a multidisciplinary approach focused on the needs of identified customers.

The Scoping Group further recommended:

a programme of research aimed at strengthening international science to provide a firmer basis for policies to prevent natural hazards from becoming disasters. Such an objective will need:

- an international collaborative research programme lasting a decade or more;
- the combined insights of the natural, health, social and engineering sciences;
- engagement with populations living in hazardous areas, to understand better the social and cultural determinants of choice in the hazards context;
- engagement with policy-makers at regional, national and international level, to understand better the constraints on policy-making in the hazards context;
- the ability to accommodate both individual hazards and the interplay between hazards;
- a long-term perspective;
- a focus on delivering new scientific insights for the primary customers development agencies, humanitarian assistance agencies and governmental-policy-makers.

It added:

This is an ambitious undertaking, in keeping with the importance and complexity of the subject. ICSU will need to work with appropriate partners to achieve its goals.



The ICSU General Assembly endorsed the recommendation that a new programme be developed, it being understood that any such initiative should build on ongoing efforts in the geosciences and biological sciences and must expand well beyond those fields. A Planning Group was accordingly created, while at the regional level the newly established Regional Committees of ICSU also identified natural hazards and disaster risk reduction as an important component of their respective regional programmes. The Planning Group met four times (20-21 June 2006; 23-25 January, 23-24 May, 30-31 October 2007), and an Open Consultative Forum with potential partners was held on 29 October 2007. The Terms of Reference of the Planning Group are set out in Appendix I to this document, and membership of the Group is given in Appendix II.

The Planning Group concluded that the complexity of the Programme was such that it would require the full integration of natural, socio-economic, health and engineering sciences (the word 'sciences' will be used in this broad context throughout this document), each playing its role, both through excellence in the disciplines and through the interface activities that are essential to make the Programme a success. The Programme would, of necessity, involve scientists well beyond the traditional boundaries of ICSU and its Unions. The Programme would build upon the International Decade for Natural Disaster Reduction (IDNDR), benefit from advances in sciences and observing systems made since then and would avoid duplication by building partnerships with the projects of other organizations, in particular United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Meteorological Organization (WMO).

Although the approaches in the sciences vary, this Programme would need not only to be multi-disciplinary but also to approach the issues of natural and human-induced hazards and disasters from several perspectives – from the hazards to the disasters and also from the human exposures and vulnerabilities back to hazards. This coordinated multi-dimensional approach built on multi-disciplinary participation would take the proposed Programme beyond approaches that have traditionally been undertaken.

The Planning Group recognizes that to accomplish the Programme's objectives, ICSU must reach out to other groups, specifically other scientific organizations, and to policy- and decision-makers, who will need to be included, not just consulted. Further, the Programme requires a global undertaking and, in this respect, the Planning Group notes a conclusion stated in the executive summary of the ICSU Priority Area Assessment on Capacity Building in Science (ICSU, 2005a) to the effect that such efforts face a great challenge, 'a development problem...the widening gap between advancing science and technology and society's ability to capture and use them.'

Accordingly, the Programme Plan breaks new ground in that it calls for multiple starting points: natural sciences; socio-economic sciences; engineering sciences; health sciences; and the policy-making/decision-making arena. There is need for full interaction and involvement of these groups, with each being clear what it needs from the other groups. It is also necessary to work across the interfaces, with continual re-examination as the Programme proceeds. The overall goal of contributing to a reduction in the impacts of hazards on humanity would require some relatively non-traditional research approaches.

## 2 Rationale

### 2.1 Impacts of disasters – the global scene

The devastating effects of the 1995 Kobe and 2005 Muzaffarabad earthquakes, the 2004 Indian Ocean tsunami and Hurricane Katrina in the United States in 2005 are vivid reminders that natural disasters are a global issue, and can result in great loss of human lives, livelihoods and economic assets in both developed and developing countries. But while very large events are, fortunately, fairly rare, the frequency of recorded disasters has been rising rapidly. From about 100 per decade in the period 1900-1940, to 650 per decade in the 1960s and 2000 per decade in the 1980s, it reached almost 2800 per decade in the 1990s. Hundreds of thousands of people are killed and millions injured, affected or displaced each year because of disasters, and the amount of property damage has been doubling about every seven years over the past 40 years. Part of the increase in numbers of disasters reported in disaster statistics may be explained by the increasing numbers of smaller and medium-level events that are registered as being related to natural and human-induced or socio-natural phenomena (UN/ISDR, 2007), and by better reporting mechanisms.

Although earthquakes and tsunamis can have horrific impacts, most disaster losses – be they measured in terms of the number of events, lives lost, affected persons or material destruction – stem from weather-related natural hazards such as hurricanes, cyclones, other major storms, floods, landslides, wildfires and drought. In the 1990s, about three-quarters of all natural disasters were triggered by weather-related events. Since 1997, there has been a several-fold increase in weather-related economic losses.

Disasters are estimated to have caused global economic losses totalling US\$75M in 2007, US\$50M in 2006, US\$220M in 2005 and US\$150 billion in 2004, with 1995, at US\$172M, being the previous high. The high value for 2007 was despite not having particularly extreme events. However, the number of natural catastrophes recorded in 2007 was 950 (compared with 850 in 2006), the highest figure since 1974 when Munich Re began keeping systematic records. It should be noted that the majority of these losses were uninsured.

Natural disasters are capable of cancelling out development gains, and the risk to development stemming from disasters was clearly recognized by UN Member States in the Millennium Declaration (2000), with the growing trend in losses seen as a major constraint towards meeting the Millennium Development Goals.

### 2.2 Societal and human-induced changes

In many parts of the world, especially hazard-prone areas, poverty and population growth mean that more people and communities are at risk from natural hazards. Even in areas without major population growth or poverty, there have been increases in losses, demonstrating the complex nature of societal-hazards interactions. In urban regions (and particularly in very large cities), the complex infrastructure systems that make life and economic activity possible, the concentration and



centralization of economic and political functions, social segregation and complex spatial and functional interrelationships established in urban areas, all contribute to the vulnerability of populations to disruptions caused by natural hazards. The context in which natural hazard events occur is changing rapidly. In examining effective approaches to risk reduction it is necessary to understand the extent to which the increase in hazard losses can be attributed simply to the rapid growth in human numbers and the wider spread of human settlements and how much influence the manner in which the growth and/or development takes place also contributes. To what extent is the world-wide growth in disaster losses a symptom and indicator of unsustainable development?

Human interventions in the environment can also increase the numbers and types of hazards and vulnerability to natural hazards. Examples include changes in land use that increase the hazards of landslides or flooding, destruction of mangroves that increases the susceptibility of coastal areas to storm damage and removes part of the natural protection afforded coastal communities, and emissions of pollutants and greenhouse gases into the atmosphere that can increase the frequency of extreme weather events, as well as exacerbating the risk from hazards such as heat waves and wild fires.

Globalization results in a world more closely interconnected, with changing senses of responsibility towards countries and localities. The movement of people, trade, communications and financial flows are all increasing rapidly. Hazard events, even in remote places, can have repercussions at a great distance. When they occur in the centres of world trade, finance and communications the impacts can be global. Environmental disasters, wherever they occur, have become a common concern of humankind: some (though not all) would say a common responsibility.

## 2.3 Climate change

Globalization also extends in new ways to the geophysical environment. The most salient, but not the only, example is climate change. Although the impacts of climate change are highly varied from place to place, there are connections between some of the related events, such as droughts in Africa and Indonesia and the El Niño phenomenon in the eastern Pacific Ocean. The acceleration in the pace of scientific and technical advances has occurred in a time-frame that is short compared with the return frequency of the most extreme events, so that society has only a limited experience base with the new emerging vulnerabilities.

Changes in the global climate will continue to alter the risk associated with natural hazards. According to the Intergovernmental Panel on Climate Change (IPCC, 2007), climate change is accelerating. While the linear warming trend over the last 50 years (0.13°C per decade) is nearly twice that for the last 100 years, a warming of about 0.2°C per decade is projected for the next two decades. With that will come, over the 21st Century, more frequent hot extremes, heat waves and heavy precipitation events (very likely), and more areas affected by drought (likely). Widespread changes in extreme temperatures and more intense and longer droughts have been observed over the past few decades. Extra-tropical storm tracks are projected to move poleward, with consequent changes in wind, precipitation and temperature patterns. As the tropical sea-surface temperatures increase, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more instances of heavy precipitation. Glacier- and permafrost-related hazards such as glacier lake outburst, ice and rock avalanches and impacts on installation foundations are strongly connected to climate change and increasingly threaten human settlements and infrastructure. There is also the possibility of abrupt climate change occurring over relatively short periods of time, leading to increased risks of some hazards. These risks need to be accounted for in the risk analysis.



# 3 The international context and the Hyogo Framework for Action

The World Commission on Environment and Development (1987) defined sustainable development in the statement: 'Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs'. This means that societies need to look to the future and make investments now that will allow future generations to meet their needs consistent with those of present generations. To look to the future and meet the needs for sustaining development, integrated, multi-disciplinary, science-based predictions of the future are essential. It is recognized that there is a literature on the problematic nature of prediction and attention will be given to scenarios and interactive discussions about futures in appropriate balance with reliance on achieving and communicating predictions.

In 1992, the UN Framework Convention on Climate Change (UN FCCC) was signed by most countries, with its objective, as stated in Article 2, of 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure food production is not threatened and to enable economic development to proceed in a sustainable manner.' The objective is stated in terms of avoiding 'dangerous' anthropogenic interference. In the minds of most people, dangerous corresponds to, in this context, hazardous and extreme climate-related events – such as floods, droughts, severe storms and heat-waves. The dangerous nature of these events depends in good part on the exposure and vulnerability of communities and these can be controlled and reduced by human actions. Under other Articles of the UN FCCC, there are commitments, such as Article 4(g) on '...scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives...uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies.' The social consequences of response strategies include the impacts of climate-related hazards on communities.

The 2002 World Summit on Sustainable Development and the related Millennium Development Goals led to a Johannesburg Plan of Implementation (UN DESA, 2002) which includes commitments by governments to:

IV. Protecting and managing the natural resource base of economic and social development

37. An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery, is an essential element of a safer world in the twenty-first century. Actions are required at all levels to:

(h) Develop and strengthen early warning systems and information networks in disaster management, consistent with the International Strategy for Disaster Reduction;

38. Change in the Earth's climate and its adverse affects are a common concern of humankind.

(a) Meet all the commitments and obligations under the United Nations Framework Convention on Climate Change...

...build upon relevant international commitments...including the Millennium Declaration, to strengthen global disaster reduction activities for the twenty-first century. Disasters have a tremendous detrimental impact on efforts at all levels to eradicate global poverty; the impact of disasters remains a significant challenge to sustainable development.

...intrinsic relationship between disaster reduction, sustainable development and poverty eradication,...importance of involving all stakeholders...

In 2005, governments attending the World Conference on Disaster Reduction (Kobe, Hyogo, Japan) agreed that:

We can and must further build the resilience of nations and communities to disasters through people-centred early warning systems, risks assessments, education and other proactive, integrated, multi-hazard, and multi-sectoral approaches and activities in the context of the disaster reduction cycle, which consists of prevention, preparedness, and emergency response, as well as recovery and rehabilitation. Disaster risks, hazards, and their impacts pose a threat, but appropriate response to these can and should lead to actions to reduce risks and vulnerabilities in the future. (UN/ISDR, 2005a)

From the World Conference on Disaster Reduction and especially the agreed expected outcome and strategic goals, five priorities for action are stated as part of the Hyogo Framework for Action (UN/ISDR 2005b), together with some illustrative and research-specific sub-items:

*1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation*

...

2. Identify, assess and monitor disaster risks and enhance early warning

17. The starting point...lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and of the ways in which hazards and vulnerabilities are changing in the short and long term

...

*3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels*

...

(iii) Research

(n) Develop improved methods for predictive multi-risk assessments and socioeconomic cost-benefit analysis of risk reduction actions at all levels; incorporate these methods into decision-making processes at regional, national and local levels.

(o) Strengthen the technical and scientific capacity to develop and apply methodologies, studies and models to assess vulnerabilities to and the impact of geological, weather, water and climate-related hazards, including the improvement of regional monitoring capacities and assessments.

*4. Reduce the underlying risk factors*

*5. Strengthen disaster preparedness for effective response at all levels*

The Chair's Summary of the First Session of the ISDR Global Platform on Disaster Risk Reduction (UN/ISDR, 2007b), identified implicitly research questions such as: 'Some cities and local authorities have successfully implemented risk reduction programmes, and these need to be documented and widely publicised by the ISDR system. All cities and local authorities should create and implement a disaster risk reduction plan, including multi-sectoral disaster preparedness plans with strong civil society participation.' Research to identify and analyse successful risk reduction programmes is very important. Further, it was noted that: 'a core challenge in disaster risk reduction is to scale up proven practices'.

In reference to climate change, the Summary noted that 'ISDR system partners should actively disseminate and apply disaster reduction tools to support adaptation to climate change'. The UNFCCC has now had the benefit of four scientific assessments of climate change by the IPCC which has been able to draw upon the internationally-planned and coordinated scientific research programmes of the World Climate Research Programme (sponsored by WMO, ICSU and the IOC of UNESCO), the International Geosphere-Biosphere Programme (sponsored by ICSU) and other international and national programmes. For the field of disaster risk reduction, there is neither an established and ongoing scientific assessment process, like the IPCC, nor an internationally planned and coordinated scientific research programme. The Research Programme described in this document would fill that latter gap.

## 4 Scientific perspective

### 4.1 Focus on risk and disaster risk reduction

Following from the ISDR and other international agreements and statements of organizations, the focus of the Research Programme would be on disaster risk and disaster risk reduction. Risk depends not only on hazards but also on exposure and vulnerability to these hazards, making risk an inherently interdisciplinary issue. In order to reduce risk, there needs to be integrated risk analysis, including consideration of relevant human behaviour, its motivations, constraints and consequences, and decision-making processes in face of risks. This inevitably requires that natural scientists and engineers work together with social or behavioural scientists in promoting relevant decision-making in the risk management area. Moreover, the understanding of risk patterns and risk-management decisions and their promotion require the integration and consideration of scales that go from the local through to the international level.

The risk associated with environmental hazards typically depends not only on physical conditions and events but also on human actions, conditions (vulnerability factors, etc.), decisions and culture. In some cases, the physical events themselves are directly attributable to human agency (i.e. are 'human-induced'), as with many cases of small- and medium-scale flooding, landslides, land subsidence and drought in rural and urban settings related to environmental degradation and human intervention in ecosystems, as well as global climate change. These human-induced or socio-natural hazards are created at the interface of natural and human processes through processes that degrade the environment. Climate change represents a new type of human-induced modification of hazards and risks. There is need for the study of these human-induced events and how they have contributed to the past changes in occurrences of disasters and how this knowledge can be factored into risk reduction approaches. There are also hazards of low probability of occurrence but with serious consequences when they do occur, such as impact by near-Earth objects, which need to be factored into the risk analysis.

In addition, human actions determine whether or not an event beyond human control (e.g. heavy rain or an earthquake) will lead to disastrous flooding (e.g. through construction on a flood plain) or building collapse (the result of using inadequate building specifications and techniques). The seriousness of the consequences of any disaster will depend also on how many people choose, or feel they have no choice but, to live and work in areas at higher risk, as well as on organizational factors relating to protection and emergency planning, and on fundamental aspects of social equity. Furthermore, just as vulnerability to hazards is influenced by changes in the physical environment, so too will the capacity of communities to protect themselves from such hazards be influenced by societal changes and constraints. Special attention would need to be given to early-warning technologies and community advice.

The task of characterizing risk involves identification of the hazards and the exposure and vulnerabilities of places and people, and hence, assessing the level of risk and understanding how the risk can change with time. Knowledge here is still far from complete and also unevenly distributed across the world. Risks are changing as a consequence of factors such as increasing vulnerability due principally to human

activities and, for some hazards, due to climate change. Thus risk identification has not only to do with natural environmental phenomena, but requires identification of human-induced hazards and vulnerabilities and community resilience. There is an urgent need to map hazards, exposures and vulnerabilities and associated risks comprehensively on global, regional and local scales, requiring adequate long-term monitoring and baseline studies. Risk identification requires a multi-hazards approach, since communities are commonly threatened by several different hazards that may be linked to one another.

Once the hazards, vulnerabilities and risks have been identified, a key role for science is to establish measures required to reduce the vulnerability and risk, and these include anticipating future events and, as far as possible, predicting the places affected, the timing and the scale of the phenomena. The consequences of environmental hazards also need to be assessed. A major goal of the programme would be to improve the characterization and understanding of uncertainties, and improve decision-making and coping strategies in the face of such uncertainties. Models form the basis of forecasts, prediction and assessment. The programme would aim not only at investigating natural processes, but also the complex coupling of human and natural systems to model risk. New human and institutional capacities, tools and approaches would need to be developed to combine quantitative and qualitative data, and to integrate the input from many different disciplines. Model development needs to be accompanied by monitoring and measurement, together with pertinent experiments in the laboratory and field. The data and information generated as part of this Programme would be essential not only for its success but also as a legacy for future generations.

## 4.2 The need for an integrated approach – across hazards, disciplines and scales

Over the past several decades, human knowledge and understanding of natural hazards have grown dramatically. Today, far more is known about the spatial and temporal distribution of natural hazards and the location of high-exposure areas. Scientists can more accurately characterize the possible magnitude of hazard events and better estimate the probability of their occurrence at specific magnitudes. Moreover, forecasting capacity has also improved dramatically, especially for weather-related events. Far more is now known about the social dimensions of disaster, e.g. human exposure and vulnerability (and lack of resistance and resilience) to natural hazards and places where poverty and multiple stresses shape the character and distribution of losses.

Yet, despite this growth in knowledge, losses associated with environmental hazards, as indicated by measure of both insured and non-insured losses, have also risen during past decades at what looks – from some data sets – to be an exponential rate, as noted in Chapter 1. This is particularly dramatic as regards hydrometeorological events, where death rates and numbers have dropped due to more extended and effective early-warning systems and preparedness plans, yet material and livelihood losses as well as numbers of affected persons have grown considerably. The risks associated with earthquakes increase commensurately due to the ever-increasing numbers of people, production and infrastructures located in cities at seismic risk where early warnings are still impossible in any systematic and secure manner.

The data available really only allow an approximation to losses associated with large- and medium-scale events. A growing body of evidence suggests that the accumulated losses associated with small-scale, repetitive and widely distributed events may be of equal or greater magnitude. The increase is taking place in both developed and developing countries, which suggests that reducing the risks from hazards is not simply a matter of economic growth and development. What are the reasons for this? Why, despite advances in our understanding of both the natural and social sciences of risk and disasters, do losses continue to increase? As noted by the predecessor ICSU Scoping Group (2005b), there is a great shortfall in current research activities on how science is used to shape social and political decision-making in the context of hazards and disasters. These issues also highlight the

need for more systematic and reliable information on such events.

In thinking about decision-making quality, it is useful to distinguish accuracy (e.g. the proportion of correct predictions of whether or not a hazard will occur) from bias (e.g. the tendency to over- or under-predict hazard occurrences). With regard to hazards where a failure to predict an actual occurrence (a 'miss') can lead to disaster, it may be appropriate to adopt a precautionary or risk-averse bias. However, this will lead to more situations being treated as dangerous than were strictly necessary in hindsight. An abundance of such 'false-alarms' raises problems for risk communication and decision-making practice. One danger is that different publics may become habituated to warnings and no longer take them sufficiently seriously.

Another challenge is the broad range of time- and space-scales for hazards and disasters. The impacts of most disasters are on the local or national scale but there are then ramifications through to the global scale. It is important that research be able to analyse these spatial scale interactions. For development, there is a need to understand how such interactions take place, leading to more focused and successful investments in disaster risk reduction at the local scale through global initiatives. Hazards and disasters also occur across a wide range of temporal scales. An earthquake causes immediate and devastating local or regional-level damage. It can also trigger a tsunami that can cause damage in distant places hours later. A drought is a slow-onset hazard that can affect large numbers of people over a vast spatial area with complex short- and long-term socio-economic ramifications but whose starting point may be unobserved and perhaps not known even later. The response to these varying types of hazards leads to many challenges, and an objective of this Programme is to understand these connections in ways that will lead to responses contributing towards a reduction in losses.

### 4.3 The importance of data and information and the legacy of the Programme

An aim of the Programme is to both generate new information and data and to leave a legacy of coordinated and integrated global data and information sets across hazards and disciplines, with an unprecedented degree of access. One of the main contributions of the Programme could be to serve as a framework for the development of a range of modern information systems devoted to disaster risk reduction.

Data management is an important component of any science project, and in particular, for a global and complex environmental hazards research programme of the scope and complexity of the one proposed. To ensure that the diversity of data from the Programme is collected in a consistent fashion, is preserved, properly archived and made accessible to the science community requires special efforts from the onset. Excellent data management, carefully staged and professionally executed, is essential. The resulting data and information may be seen as the most important single outcome of the Programme.

# 5 The proposed research Programme

The Planning Group recommends that the Programme carry the title **Integrated Research on Disaster Risk – addressing the challenge of natural and human-induced environmental hazards** (acronym: IRDR), chosen on basis of the rationale of the preceding sections – integration, risk and disasters. This document describes the proposed IRDR Science Plan, one guided by three broad research objectives that are elaborated in what follows:

- Characterization of hazards, vulnerability and risk
- Understanding decision-making in complex and changing risk contexts
- Reducing risk and curbing losses through knowledge-based actions

The three research objectives will, when projects make successful contributions to them, lead to understanding of hazards and vulnerability and risk and enhanced capacity to model and project risk into the future; to the understanding of the decision-making choices that lead to risk and how they may be influenced; and how this knowledge can better lead to disaster risk reduction. Over the coming years, in planning and developing the partnerships with other organizations, it may be necessary to revisit these objectives. Some of the existing programmes (see Appendix III) that may become components or affiliates of IRDR, have narrower and some broader sets of objectives; they have varying degrees of inclusion across disciplines and regions of the globe.

It is proposed that IRDR be a research Programme of ten years' duration or more, in line with the recommendations of the Scoping Group to the 28th ICSU General Assembly (ICSU, 2005b). ICSU is the initial sponsor of the Programme and the International Social Sciences Council has expressed firm interest in considering becoming a co-sponsor. The United Nations International Strategy for Disaster Reduction (ISDR) has showed firm support for the new programme and is considering a more formal relationship. Discussions are also ongoing with UNESCO regarding possible co-sponsorship.

Collaboration with other organizations, as appropriate, will lead to integration across sets of objectives to avoid unnecessary duplication and to maximize research outcomes. After the presentation of the objectives below, some existing activities will be mentioned as illustrations of the type of initiative with which IRDR would make scientific alliances. Given the need to limit the size of the report, these illustrative examples will, of necessity, be brief and not all-encompassing. During the consultation process, more examples will be considered through the input of other organizations.

## 5.1 Scope

The Science Plan of IRDR focuses on natural and human-induced environmental hazards, including hazards related to hydrometeorological and geophysical trigger events: earthquakes; volcanoes; flooding; storms (hurricanes, typhoons, etc.); heat waves; droughts and fires; tsunamis; coastal erosion; landslides; aspects of climate change (for example, increases of extreme events); and space weather and impact by near-Earth objects. The effects of human activities on creating or enhancing hazards, including land-use practices, would be included. IRDR would deal with epidemics and other health-related events only where they were consequences of the aforementioned events. To make for a more focussed programme, technical and industrial hazards and warfare and associated activities would not be included *per se*; however, it is recognized that there is much to be learned from research in such areas and IRDR would seek to take advantage of that knowledge and insight. Moreover, the occurrence of natural and human-induced or socio-natural events is many times associated with the triggering of technical or anthropogenic hazards, as is the case where an earthquake leads to the rupture of oil pipelines, gas ducts, dams or sewerage systems, or to urban fires, for example. This separation of the study of natural hazards from technology and its effects will be the subject of further consideration as the Programme evolves.

Disaster risk management consists of a range of policies and practices developed to prevent, manage and reduce the impacts of disasters, and includes four elements: *Mitigation–prevention* – actions taken before or after a hazard event to reduce impacts on people and property; *Preparedness* – policies and procedures designed to facilitate an effective response to a hazard event; *Response* – actions taken immediately before, during and after a hazard event to protect people and property and to enhance recovery; and *Recovery* – actions taken after a hazard event to restore critical systems and livelihoods and return a community to pre-disaster conditions. (The Planning Group notes that this view of recovery should be modified by incorporating aspects of mitigation–prevention so as to help a community move forward to a more stable and secure existence than was the case prior to the event, since it is precisely those prior conditions that contributed to the disaster.) The Plan has, as its first priority, research activities related to mitigation and prevention of disasters and, as a second priority, research on preparedness. Hence, the primary focus of the Plan is on research activities leading to the reduction and control of disaster risk factors and the impacts of natural and human-induced environmental hazards.

The scoping exercise identified the most significant research gaps to be interdisciplinary cohesion, i.e. the intersections of the natural, socio-economic, health and engineering sciences, and the issue of how knowledge about hazards is, or can be, put to use. Public perception–decision making in the context of natural hazards, risks and uncertainty would be an important research area, as would the study of human behaviour and cultural contexts for vulnerability analysis.

## 5.2 Vision and legacy

The IRDR Science Plan envisages an integrated approach to natural and human-induced environmental hazards through a combination of natural, socio-economic, health and engineering sciences, including socio-economic analysis, understanding the role of communications, and public and political response to reduce the risk.

The legacy of IRDR would be an enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts. This would include a shift in focus from response–recovery towards prevention–mitigation strategies and the building of resilience and reduction of risk and learning from experience and avoidance of past mistakes. Through this enhanced capacity and a shift in strategic approaches, societies, in future, would benefit from a reduction in related loss of life, with fewer people adversely impacted, and wiser investments and choices made by civil society, when comparable events occur.



This legacy clearly implies a strong commitment of IRDR to development – development of science and development of broadly-based capacity. Its partners in this development must include the national and international development aid agencies as well as the national and international science institutions and funding councils. To build capacity truly around the world necessitates the involvement of all countries in a meaningful way.

An important part of the legacy would be the repository of information and data that had been acquired and that would be of continuing availability and value to the global community.

## 5.3 Research objectives

IRDR would undertake coordinated, international, multi-disciplinary research leading to more effective global societal responses to the risks associated with natural and human-induced environmental hazards.

The research objectives and sub-objectives of the programme follow. Capacity building, case studies and demonstration projects and assessment data management and monitoring are considered cross-cutting issues and are discussed in Chapter 6.

### **Objective 1: Characterization of hazards, vulnerability and risk**

This objective concerns the identification and assessment of risks from natural hazards on global, regional and local scales, and the development of the capability to forecast hazardous events and their consequences. Recognizing that risk depends on hazards, exposure and vulnerability, the research will be of necessity interdisciplinary. Understanding of the natural processes and human activities that contribute to vulnerability and community resilience will be integrated to reduce risk. The objective addresses the gaps in knowledge, methodologies and types of information that are preventing the effective application of science to averting disasters and reducing risk.

There are three sub-objectives:

- 1.1: identifying hazards and vulnerabilities leading to risks;
- 1.2: forecasting hazards and assessing risks; and
- 1.3: dynamic modelling of risk.

The natural sciences have a central role in the forecasting of natural hazards and characterizing their attendant risks, and mitigating the adverse effects. Research into the characteristics and dynamics of the solid earth, surface environments, the oceans and the atmosphere, space weather and impact by near-Earth objects will enable advances in understanding hazardous natural phenomena. Natural sciences are the basis of technological solutions to early warning, provision of advice to authorities in areas at risk and during emergencies, and the design of effective mitigation strategies to increase community resilience and protection. They provide critical information for decision-makers and the public to help save lives and avoid economic losses. However, the natural sciences cannot be effective in isolation, with no consideration given to the critical human and environmental factors that lead to disaster. Thus the social sciences have a major role in the assessment of vulnerabilities and risk, as well as developing more effective methodologies. In cooperation with projects aimed at Objectives 2 and 3, projects towards Objective 1 seek to reduce risk by focusing on an integrated understanding of how natural processes and human activities contribute to vulnerability, risk and community resilience.

## Sub-Objective 1.1: Identifying hazards and vulnerabilities leading to risks

Here key questions are:

- What are the places at risk, and what is the source of this risk?
- Who are the people most at risk?
- What is the level of risk?
- How may risk change with time?

The answers to these questions require systematic mapping and assessment of hazard, vulnerability and risk at global, regional and local scales. Long-term monitoring is essential to the understanding of natural phenomena and giving early warning of impending events. Baseline studies are needed to establish the frequency and magnitude of events in the past, as well as to identify the factors that have contributed to disasters. It is important to establish responsibility for maintaining the accurate record of disaster events. In recognition of its importance, a cross-cutting theme on Assessment, data management and monitoring is proposed (see Section 6.3).

Monitoring of natural hazards provides large quantities of different types and qualities of data, resulting in the challenge of handling very large datasets. Earth observation systems provide opportunities for comprehensive and robust monitoring of the Earth on many scales. Many parts of the developing world do not have adequate ground-based monitoring to be able to predict and anticipate hazards, and also lack the capacity to take advantage of advanced technologies, for example, the Global Earth Observation Systems.

In order to determine the consequences of environmental hazards and disasters, the undisturbed human and natural environments need to be characterized. There should also be better mechanisms in place to permit timely production and dissemination of easy-to-use, accurate and credible information to the appropriate authorities; this will require close cooperation between the natural science, engineering and technological communities. Also needed are authoritative well-defined parameters to assess impacts, such as mortality figures, consistent measurements of economic loss, degradation of life expectancy, and changes in agricultural productivity.

Under this sub-objective, the theory underlying risk, hazards and disasters terminologies and their assessment methods needs development. Three key challenges are to be developed:

1. Consistent methodologies to assess natural hazards proceeding from the probability of their occurrence and recurrence and using empirical, statistical, and deterministic approaches.
2. A commonly adopted system of natural hazard parameterization that can be applied across different hazard types to enable the hazard potential, the affected area and the impact duration to be estimated in a single measurement system.
3. A consistent procedure for building maps and databases of separate and combined hazards and risks at different temporal and spatial scales: global, regional, national, community and local levels.

## Sub-Objective 1.2: Forecasting hazards

Key questions to provide robust, credible forecasts and assess future risks are:

- How can natural hazards be forecast confidently?
- What factors contribute to future risk and related uncertainties?
- How can uncertainties be reduced?
- How can forecasts, their limitations and uncertainty be communicated effectively?

A key challenge for reliable forecasts and risk assessments is to understand uncertainty. Distinguishing and quantifying uncertainties related to natural variability and uncertainties that

reflect lack of knowledge is a formidable challenge that will be addressed by advances in theory, experimental measurements, better monitoring and improvements in modelling. Uncertainties may be reduced as a consequence of better data and improved understanding. However, the limits of forecasting in non-linear systems also need to be recognized and evaluated. Advances in forecasting are needed to identify where and when a hazardous event will happen, what its magnitude and intensity will be, and the consequences. Extreme events, including impact by near-Earth objects, present great challenges because of their rarity and, as a consequence, the paucity of data. It is vital to collect observations and data when such events happen. Advances in extreme value theory and analysis of non-stationary time series are needed. This is a matter of particular importance in hydrometeorological hazards because of climate change; the past may be an unreliable guide to the future in a more energetic earth system. The definition of extreme events is not just dependent on the natural hazard itself, because increasing vulnerability means that events of a particular magnitude can have greater consequences. The problem that the world may be taken by surprise by a major disaster in an unexpected place is of great concern. Communicating uncertainty in forecasts and risk assessments to decision-makers and the public is challenging, especially since there are limits to predictability that are not always understood by members of the public, who can have false expectations of preciseness in forecasts. Drawing on evaluated local indigenous knowledge systems in predicting hazards should also be considered as part of addressing uncertainty.

### Sub-Objective 1.3: Dynamic modelling of risk

Modelling of risk requires integration of knowledge about natural processes and human systems. Many natural hazards processes depend on complex material properties and poorly understood dynamic processes. For example, volcanic eruptions, landslides, snow avalanches and earthquakes involve complex multi-phase mixtures (gas, solid, liquid) whose properties are either poorly measured or understood. Laboratory measurements and experimental studies on natural and analogue materials will provide key information for accurate parameterizations of physical properties and dynamic processes within models, as well as validation of models.

Risk assessment and provision of evidence-based scientific advice require natural and social scientists to collaborate. Effective collaboration involves challenges of understanding and developing common language between disciplines, as well as funding mechanisms for allowing the multidisciplinary research to flourish. Modelling of risk concerns the development of holistic models incorporating natural processes, infrastructure, societal factors and behaviour. These are not separate but are interacting risk factors that need to be monitored and modelled together. Understanding the coupling of human and natural systems is the key to preventing a hazard becoming a disaster. Political, social and economic factors can lead to populations being in harm's way from floods, earthquakes or volcanoes, effects due to space weather or impacts by near-Earth objects for instance, or can limit communities' capacities for protecting themselves. Human activity, such as housing construction on flood plains, can increase risk. Likewise, evacuation or relocation of communities away from one hazard may increase exposure to others. Environment and human behaviour thus impact on each other in a dynamic, cyclical, relationship. Research projects should also work closely with local communities and authorities, so that hazards science is integrated into the societal concerns and policy development. Science can also benefit from community knowledge, when appropriate. Dynamical models of risk requires quantitative and qualitative data to be combined, as well as the identification and measurement of relevant physical, behavioural and social variables

## Objective 2: Understanding decision-making in complex and changing risk contexts

This objective is focussed on understanding effective decision-making in the context of risk management – what is it and how it can be improved. In linking with the other objectives, the emphasis is on

how human decisions and the pragmatic factors that constrain or facilitate such decisions can contribute to hazards becoming disasters and/or may mitigate their effects.

The political, institutional cultural and economic aspects of decision-making and behaviour are important and need to be explored. Many of the problems in decision-making are also political and social problems in that they involve divergent interpretations of what the problems and response options really are. There are often conflicting values and interests at work, and strikingly different opportunities to influence developments. The salience of strategic societal choices, and of competing rationalities, which cannot be subsumed within the language of risk and risk management, is recognized, so this broader context will be addressed in the Programme as the research moves beyond the management framework to lay out the complexity of the political and social challenges encountered.

There are three sub-objectives:

- 2.1: identifying relevant decision-making systems and their interactions;
- 2.2: understanding decision-making in the context of environmental hazards; and
- 2.3: improving the quality of decision-making practice.

Risk depends critically on human actions and decisions. Although many forms of human activity may increase, rather than decrease, the damage and danger from natural hazards, from the perspective of the actors themselves such decisions may often appear 'rational', and even the only practicable option under the circumstances. Projecting risk into the future will depend, in part, on the choices people make, individually and collectively (through their governments at all levels), and how they implement these choices. Projects designed to meet Objective 2 would identify the decision-making systems, by whom and where the decisions are made, and how these decision-making processes can be understood to provide the basis for intervention when required. From the background and rationale sections of this science plan, it is clear that there are barriers to good decision-making that would lead to effective risk-reduction approaches. Through this process, it is expected that improvements could be made to the quality of the decision-making process. Decision making also depends on the availability of good information. For example, telecommunications and remote sensing are domains in which gaps between operational and scientific activities are easy to identify and have consequences on the decision making. Engineering sciences have a specific role to play in the adaptation of the tools to the need of the decision-makers.

## Sub-Objective 2.1: Identifying relevant decision-making systems and their interactions

Here the key questions are:

- Whose decisions make most impact on level of risk?
- How much, and what kinds of, authority do different decision-makers have?
- How do different decision-makers and agencies interact?
- How do decisions made at local and at national or international levels impact on each other?

The answers to these questions require identification of, on the one hand, the range of responsibilities assumed within specific contexts by different actors (from individual citizens through to international agencies) for risk management and reduction, and, on the other hand, those practices, including both acts of commission and omission, that exacerbate the level of risk posed by specific hazards by increasing the vulnerability of particular populations. Importantly, many practices have the effect of displacing risk, both spatially onto more distant communities and populations, and also temporarily onto future generations. Hence, there is an inescapable ethical dimension to these questions. Regarding risk management, 'corrective' decision-making in the context of existing risk (communities located in high hazard zones, hospitals built to low seismic security standards, etc.) may be distinguished from

'prospective' decision-making that attempts to anticipate future risk and control its development. Regarding the former, how are existing risks identified and assessed by various international and national agencies and how compatible are these assessments with the views held by individual citizens and communities at risk? Where is responsibility for corrective risk management seen to lie, and how is it distributed? Are there some risks for which too many agencies appear responsible, and others for which nobody assumes responsibility? Regarding the latter, how are future risks associated with new development and investment projects identified, as well as the possible impacts of broader socio-political and environmental change? To what extent do developers and political leaders typically seek to assess systematically, or even consider, such future risks? How (if at all) are decision-makers held to account for the longer-term, or spatially distant, consequences of their decisions? The political, institutional and economic aspects of those decision-making processes and their divergent interpretations need to be examined. Strategic societal choices and competing rationalities will take the analysis beyond the contexts of risk management.

All such decisions, whether motivated by a concern for the common good or for personal profit, are made within a social context in which the interests, intentions and capacities of other actors and agencies need implicitly or explicitly to be taken into account. How well aligned are the priorities for development and/or risk reduction held by different actors (e.g. international agencies and local communities)? If such priorities diverge, is this recognized? How effective are procedures for consultation with different stakeholders?

## Sub-Objective 2.2: Understanding decision-making in the context of environmental hazards

Here key questions are:

- How do actors/decision-makers perceive the level of risk associated with any given hazard considered singly and/or in comparison to other hazards they are facing?
- What options do they believe are open to them when faced with such hazards?
- What do they perceive to be the likely consequences of these different options?
- How are disaster risks perceived in relation to more chronic risks such as unemployment, lack of income, threats to cultural and personal identity?

With respect to the first of these questions (risk perception), it is likely that anomalies will be found in the seriousness with which particular hazards may be viewed by both policy-makers and various publics. Understanding is needed on the role of cognitive appraisals and emotional reactions as motivators of behaviour. Public perceptions of risk (where these diverge from expert views) need to be understood from the perspective of people's personal experience of the hazard and their understanding or beliefs about the processes that can increase or decrease the likelihood of the hazard turning into a disaster.

To move from risk perception to risk reduction, behavioural or policy choices need to be made among available options. The range of options available will typically be restricted, both objectively and subjectively. If moving away from any area of high risk from flood or volcanic eruption involves losing the opportunity to earn a living or feed one's family, it is unlikely to be seen as a viable option, at any rate until a disaster is seen as imminent. For the poor, managing everyday chronic risks will always be a greater imperative than avoiding low-probability, albeit high-impact, risks posed by natural hazards. Even in less extreme circumstances, individuals may simply fail to consider enough alternatives, or reject them as unnecessary and/or unaffordable. The time-scale of any consequences will be important in moderating such choices. In several fields of decision-making, immediate consequences have been found to have more impact than prospects of (even large) costs or benefits over the longer term.

Costs and benefits are clearly relevant to many commercial, agricultural and industrial practices that impact on disaster risk. Problems arise whenever costs need to be incurred up-front to protect against uncertain future loss or damage (e.g. protecting buildings against earthquakes). There is need to examine the extent to which regulations are enforced and complied with, as well as reasons for non-compliance. Convenience, political expediency, corruption and economic gain are as much decision variables as good scientific information about level of risk.

Although decision-making, from this perspective, is to be understood as an essentially rational process, many different kinds of values can impinge on people's choices regarding avoidance or tolerance of risk. Attachment to place is frequently a highly charged aspect of people's personal and cultural identity, and not lightly to be set aside just because somewhere else might be rather safer.

Furthermore, while research may point to the influence of individuals' *perceptions* of the predictability and/or controllability of particular hazards (and hence why some may rationalize their reluctance to take protective action), it is important to recognize that many communities, especially in the developing world, have very little *actual* control over their level of hazard exposure. Issues of relative power and powerlessness both between and within cultures – including gender issues and the disempowerment of women in many parts of the world – must be acknowledged. Nonetheless, many at-risk communities still attempt to regulate their hazard exposure even within the limited range of options available to them, and research should examine what belief systems and practical experience are guiding their decisions, and how effective their actions are, with the aim of establishing where and how can interventions be made if required.

### Sub-Objective 2.3: Improving the quality of decision-making practice

Key research questions in terms of how to improve decision-making systems are:

- What is the quality of information available to decision-makers at all levels?
- What factors influence whether or not such information will be used?
- What factors influence whether risk communications are trusted?
- What governance structures may facilitate better decision-making practice?
- How to adapt the decision-making systems to the different levels of decision makers?

Decision-making quality depends in part on the information available and the manner in which this information is processed by individuals, groups and systems. Regarding the first of these, a major goal of the programme as a whole would be to provide better information, including early warning systems, to decision-makers for the assessment of risks and the selection of appropriate actions. This, however, raises the question as to how far lack of knowledge or access to knowledge accounts for the rising losses from disasters. In the developing world such information may often be of poor quality, unreliable, or almost entirely lacking. Where are the places that knowledge is most urgently needed and how can this best be created or made available? As noted above, the roles remote sensing and other information-generating and telecommunication systems have in distributing this information are very important and there is need for interactions between the engineering and technological communities and policy analysis researchers in order to address these issues.

However, just providing 'better' information does not guarantee that the information will be attended to, understood, trusted or seen as relevant to decisions, either at the level of public policy or individual response. To be effective, communication of risk information and recommendations must be seen as a social process, reflecting the interests of the recipients as well as those of the communicators, and facilitated by the relationships between them. There are issues and need for further study on how to warn the population of an impending event, including literature on the giving of bad news regarding medical conditions – i.e. giving it in a way that does not scare unduly but ensures that the

message is not ignored. The needs of children – since these differ from those of adults – and how children can best be prepared to respond to disasters would need to be considered.

Expertise (even when acknowledged) is no guarantee of trust if communicators are seen as serving their own interests rather than those of the audience to whom they are offering advice. Likewise, scientists should as far as possible help other stakeholders to recognize not only the scope, but also the bounds, of their expertise and hence the limits of the information they can provide. There is evidence to suggest that if communities at risk are actively involved in information collection and analyses then they are far more likely to rely on that information than if it is just provided to them from ‘outside’.

Previous decision research offers guidelines in terms of procedures for defining problems and scoping the costs and benefits of alternative solutions. These may improve decision-making quality by making decision-makers less vulnerable to motivational and cognitive biases arising, for example, through wishful thinking, selective search for information, difficulties in attending to multiple aspects of a problem, and too short a time-perspective. Both to avoid such biases and to facilitate trust and acceptance of decisions reached, governance structures should ideally seek to involve the participation of a wide range of stakeholders. This ideal, however, may often be difficult to achieve in complex environments characterized by inter-group rivalries and with poorly developed institutional frameworks for (e.g. cross-border) negotiation.

In providing an understanding of the political, institutional, cultural and economic aspects of decision making and behaviour, the social sciences will make important contributions to the management perspective and extend into the complexity of the political and social challenges encountered.

It is important to consider the range of economic, financial and political incentives for making better and sometimes worse decisions. Many of these incentives may skew decisions towards a concern with short-term profits. Prospective decision-making priorities may also be skewed geographically towards the prevention of insured rather than uninsured losses, leading to an economic devaluation of disasters in the developing as opposed to developed world (see UN/ISDR, 2005*b*: Hyogo Framework for Action Priority for Action 4, bullet point ‘Financial risk-sharing mechanisms’). Once again, non-compliance with regulations, e.g. building codes, may be motivated by short-term profit.

### **Objective 3: Reducing risk and curbing losses through knowledge-based actions**

‘Reduction of risk’ refers to all the factors that are contributing to the growing hazard and disaster losses and would be an overall objective of the new Research Programme. Objective 3 integrates outputs from Objectives 1 and 2. Since risk results from the interaction of hazards with vulnerable communities, property and facilities and ecosystems which are exposed, all these variables fall within the span of the programme. Reductions in risk can be achieved through implementing and monitoring informed risk reduction decisions (this includes modification of the hazards themselves) and through reductions in vulnerability or exposure. The latter can be achieved by the prevention or discouragement of the occupation of high-hazard-risk zones and sometimes by the relocation or protection of those at risk. Also, the processes of human adjustment or adaptation can be used to reduce vulnerability and increase resilience. Since risk is a constructed concept, the conception of reduction of loss is in the end the central objective, including attention to risk and risk management, and also to the reduction of impacts and the management of uncertainties.

The combination of factors can vary considerably from place to place, and the wide range of disasters experienced in the recent past demonstrates that there is no simple causal explanation. The central thrust of research towards Objective 3 would therefore be to use the combined understanding from many different fields of expertise into an integrated approach to the understanding of the causes of disaster in order to provide practical guidance on the reduction of risk and the curbing of losses. The approaches suggested may be described as diagnostic or forensic. At a superficial or anecdotal level

many of the reasons for past failures to reduce risks and curb losses are known. What is not well understood is how these factors work together in different ways and in different places to produce the adverse consequences with which we are more and more familiar. Research towards achieving Objective 3 would develop a new approach to understanding rising risks by bringing to bear and integrating to the extent practicable all existing knowledge of risk factor in order to provide better diagnoses and to lay the scientific basis for more effective policies and actions.

In interacting with projects contributing towards Objectives 1 and 2, these components of the Programme would need to be advised by, and draw upon, existing knowledge, and would also be helpful in the identification of knowledge gaps relating to Objectives 1 and 2. Towards Objective 1, identification and forecast of the hazards would be a major research initiative so that information on the changing characteristics of the hazards would be an input towards Objective 3. Reductions in vulnerability can be made through a variety of approaches that are usually grouped into structural and non-structural approaches, although the categorization can at times seem arbitrary. The decision-making processes leading to the choices as to which to implement, or to take no action, would be addressed under Objective 2. In order to plan in greater detail the research to be developed in relation to Objective 3, it is proposed that some initial pilot investigations be carried out by a series of case studies of recent disasters (this is further developed in Section 12.2). These would be diagnostic or forensic in that they would be carried out by multidisciplinary teams drawing upon the expertise gathered around Objectives 1 and 2. A restricted number of (perhaps 10) salient examples of recent disasters would be subject to detailed examination following a common research framework and a common template of research questions. Each case study would have merit in throwing light upon the mix of risk factors operative in that case. But the greater added value of the studies would derive from their commonalities and the possibility to carry out a meta-analysis of the studies. A pilot exercise of this kind would be an important first step in gaining the necessary experience in combining and integrating the diverse areas of knowledge that are necessary for any practical programme of risk reduction.

Such case studies would necessarily involve vulnerability assessments and the analysis of effective (and ineffective) approaches to risk reduction.

### Sub-Objective 3.1: Vulnerability assessments

In order to address the overriding question of how to develop and use knowledge for the purposes of reducing risk, assessment of the current state of knowledge and its use is required. This part of the programme could, at local and regional levels, bring public and private sector experts and leaders together with hazards researchers to develop vulnerability assessments and coping strategies (both pre-event mitigation plans and emergency response plans) and to provide input to establish government initiatives to evaluate and strengthen community resiliency nationwide. The programme would serve to mobilize within countries government agencies and external donors and international programmes to provide the resources needed for such community-based efforts (hazard maps, forecasts and outlooks, inventories of vulnerable structures, best engineering practices, templates for developing hazard plans, and other forms of information, and in some cases, some level of cost-sharing to cover the costs of implementation, etc.).

The effectiveness, at the national level, of standing National Disaster Review Boards – independent agencies to analyse the cause of major disasters and report findings and recommendations – could be examined, noting the experience of the United States with the National Transportation Safety Board, which suggests that even though reports of such agencies do not carry the formal force of law, they can carry considerable weight and drive far-reaching action on the part of government agencies and private enterprise. For groups of smaller countries it is conceivable that similar arrangements could be made on a regional or multi-national basis. Internationally, perhaps working through the UN International Strategy for Disaster Reduction (ISDR) or other bodies, one might develop a web-based database, conduct conferences, and take other measures as appropriate to disseminate the



results of national efforts with respect to these actions and foster the adoption of best practices.

## Sub-Objective 3.2: Effective approaches to risk reduction

To reduce risk it will be important to understand the roles in decision-making of those exposed or at risk and those who manage the risks in the public and private sectors at all levels. This would require identifying the relevant key actors and their relative effectiveness. There are strong research linkages with Objectives 1 and 2, and the need to build upon the assessments developed through Sub-Objective 3.1.

Approaches to risk reduction include risk-sharing and risk-spreading, and research is needed into the effective design and availability of risk-sharing and -spreading mechanisms such as insurance in reducing risk. These are instruments for political and business leaders who are quite aware of the risks posed by natural hazards. For the larger population, use of insurance and other financial mechanisms to redistribute risk or reduce their personal exposure may not be available. The roles of insurance companies and financial and policy institutions and instruments at national and international levels in reducing (or increasing or redistributing) risk need clarification.

Governments can also reduce risk through effective implementation and maintenance of warning systems and the setting and enforcing practices of codes and standards for infrastructure at local and national levels and through international cooperation. This will work only if there are resources to enforce this in the first place, and if the population has the economic means to meet the standards required. It is important that the right scientific information be available to serve as a basis for code- and standard-setting and that adequate enforcement is implemented. This focus would cover the scope from engineering/technical approaches, with economic analysis of cost effectiveness, to socio-legal-political analysis of methodologies to design and implement codes and standards, recognizing the wide range of socio-cultural and legal-political regimes that exist. In addition to these important steps, it is necessary to move to having this knowledge used in an operational sphere, where social science research is needed.

Early-warning platforms provide timely and effective information through identified institutions in a way that allows individuals exposed to the hazard to take action to avoid or reduce their risk. This ISDR definition notes the importance of timely and effective information. Research building on Sub-Objectives 1.2 and 2.2 would examine the questions of timeliness and effectiveness – for example, what are the trade-offs between ‘early with larger uncertainty’ and ‘later with less uncertainty’? Research would also examine the cost-benefit ratios of investments in these systems. A second theme of research would be on the information content in terms of its being understood and the resulting effectiveness of actions. Analysis is clearly needed of optimum electronic and other communication systems.

Another aspect would be how to build the ‘culture of prevention’. Following the Hyogo Framework for Action (UN/ISDR, 2005b), prevention involves activities to provide avoidance of the adverse impacts of hazards and a means to minimize related environmental, technical and biological disasters. Through social and technical feasibility and benefit-cost considerations, the case can be made for preventive measures and public awareness and education activities related to disaster risk reduction, that can lead to changed public attitudes and behaviour, contributing to this culture of prevention.

Part of this research focus would be to create a database of lessons learned from experience, best practices and success stories. Case studies and demonstration projects, using a common research design and a common template for data collection and analysis, would be important. This focus on building resilience needs to be considered in the context of countries having the resources to undertake the actions. The studies need to consider cases and countries over a range of development contexts, situations or levels. Special analysis for developing countries will need to be considered.

## 6 Cross-cutting themes

The overall global benefits of the IRDR Programme would be dependent on global capacity building and recognition of the value of risk reduction activities, which are likely to come through successful case studies and demonstration projects.

The Programme, would have three cross-cutting themes.

### 6.1 Capacity building

Capacity or capability can be defined as a combination of all the strengths and resources available within a community, nation or region that can reduce the level of risk, or the effects of a disaster. It includes physical, institutional, social or economic means such as financial, political and technological resources, as well as skilled personal or collective attributes such as leadership and management at different levels and sectors of the society. Capacity building aims to develop human skills and societal infrastructures within a community, nation or region in order to reduce the level of risk.

The objectives of the capacity building theme would be to:

- Map capacity for disaster reduction.
- Build self-sustaining capacity at various levels for different hazards.
- Establish continuity in capacity building.

### Mapping global capacity for disaster reduction

Similar hazards can have vastly different social consequences in different countries, regions and situations, for example in urban and rural areas. This sub-theme would assess the status of current capacity for risk mitigation at the international, regional and national levels, focusing on: institutions and coordination; effective governing systems; equity; physical infrastructure, human, financial and technology resources; and indigenous knowledge systems. Capacity would be assessed in relation to defined geographical context of hazards. The aim in mapping current global capacity for disaster reduction would be to: establish the strengths and gaps in available capacities for different risks from environmental hazards in different geographic locations and social systems; understand why there are gaps and why other communities or geographical areas experiencing the same hazards have weak capacity, i.e. understand sources of vulnerability in terms of capacity. The sub-theme would also establish past and ongoing capacity-building success stories that could be used in future capacity-building schemes. Addressing this sub-theme would help to indicate appropriate intervention strategies required to enhance capacity in disaster reduction at various levels.

The sub-theme would address the following questions:

- How is adequate capacity measured in relation to known hazards in different geographical regions?
- How does capacity account for variations in resilience to hazards?

- Are existing national and international training institutions, methods and tools adequate?
- What are the needs, gaps and deficiencies in capacity to reduce disasters?
- How do social-economic inequalities influence the capacity to manage hazards?
- Are there any capacity-building success stories? What can we learn from them?

The sub-theme would draw on ongoing or past work conducted on capacity building in risk reduction for environmental hazards. From this experience, the status of capacity building in disaster reduction at the global, regional and national scales would be established to help map the way forward.

## **Building self-sustaining capacity at various levels for different hazards**

Having established vulnerabilities related to capacity in the first sub-theme, the next task would be to investigate how interventions can be instituted to enhance capacity. A hazard may strike an entire region or several countries at once, or it might be limited to one country, or it might strike a city or a rural area within which there are socio-economic variations. Different capacities would be required to address these geographically and socially different exposures to the same hazards. Further, some hazards are more frequent than others. Different institutional frameworks and governance schemes would be needed and these would require different manpower skills, as well as different planning, information gathering, access and dissemination and resources mobilization and allocation strategies. Also critical would be mechanisms for a capacity-enabling environment, i.e. measures for institutional commitment to the development of activities for which human resources have been developed. The guiding questions for this sub-theme would include:

- How can the existing capacity be best enhanced and enabled?
- How can capacity/resilience best be transferred, expanded and disseminated among communities and nations?
- How can self-sustaining capacity for disaster-resilient communities (and nations) be built?
- In what ways can indigenous knowledge and capacities be best used, enhanced and incorporated into natural hazard management?
- How can communities be engaged to identify their own capacities to reduce vulnerability to disasters and build resilience?

Disaster risk management requires capacities at all levels: institutions, decision-makers, professionals and practitioners at national and local levels. It also involves multidisciplinary, inter-institutional and multisectoral perspectives as a subject of the socio-economic development. A capacity-building programme needs to cover the different phases of comprehensive and integrated disaster risk management. The topics for capacity activities, courses and training modules would be developed in consultation with ISDR and other appropriate organizations.

## **Establishing continuity in capacity building**

Continuity in capacity-building is essential. This can be achieved where capacity for disaster risk reduction is not externally driven, but draws on region/country/community initiatives and resources. Multinational capacity-based initiatives would require long-term programmes. Mechanisms for monitoring and evaluating to enhance and nurture capacity building for different hazards at various levels and provide timely interventions constitute an important part of an international disaster reduction strategy. The Programme would build upon existing networks and structures and would address the following:

- Capacity-enabling environment.
- Capacity for risk mapping, monitoring, early warning and information dissemination.

- Capacity for formulating and implementing disaster reduction policies backed by appropriate legal and monitoring frameworks.
- Mechanisms for mainstreaming disaster reduction into development programmes.
- Investigating and implementing innovative capacity-building schemes – e.g. learning from past success stories.

## 6.2 Case studies and demonstration projects

Over the first three years of IRDR the Scientific Committee would commission and encourage case studies to identify major research needs and gaps at the interface of natural and social sciences. The case studies would aim at analysis of crises or disasters caused by natural phenomena from which lessons can be learnt. The focus of the analysis would be to establish what was done well and what caused failure. The case studies would elucidate how well methods and approaches applied at the time had worked, where there were shortcomings in the science and procedures, learn from examples of good practice, and identify what integrated research were needed within the framework of IRDR. The proposed case studies provide important entry points for social science research and the projects are important as having value in their own right as well as for inputs into integrated models.

The case studies would involve a wide range of hazards, scales, geographical regions, cultural and economic contexts. Some would be major events, like Hurricane Katrina, where there is already a large literature and extensive analysis. The objectives would be to summarize in succinct form the results of this literature to address the implications for the key research questions that require integration of the natural and social sciences towards providing effective solutions. Disasters and crises can rarely be characterized as complete failures or successes; real situations are always complex and simple categorization is not helpful. However, there is a disproportionate emphasis in the media and public debate on failures. Relative successes would therefore be included, such as the 1991 volcanic eruption of Mount Pinatubo in the Philippines, when 300 000 people were evacuated and the loss of life was restricted to 300. Another example is the mitigation of lives lost by cyclones on the east and west coasts of India. In the 1970s tens of thousands of deaths occurred. The number of lives lost has since been reduced to a few tens for similar cyclones as a consequence of an efficient radar system combined with the development of effective communications systems.

Case studies will include social contexts from hazards affecting large mega-cities to rural communities, from the most impoverished countries that have limited resources to highly sophisticated communities in the developed world, which may be nonetheless very vulnerable, particularly economically (e.g. Tokyo). Cultural variations will be important as this is a very important facet of responses to emergencies and disasters. Many natural hazards involve processes and consequences that cross national borders, adding significant complications and making this an area where global science and regional co-operation are essential. Most response mechanisms are based on national facilities, mechanisms and institutions. Thus some case studies will assess situations where regional or global collaborations, institutions (e.g. the UN) and responses are important, such as the Asian tsunami.

IRDR would commission teams of experts and practitioners to carry out the case studies to a template that addresses the key questions to be answered. The teams should include enough expertise to cover the relevant field of natural and social sciences, as well as decision-makers. It is likely that such teams would be partly composed of those actually involved in the particularly emergency as they have the practical understanding and experience. However, it is also recognized that it is not always easy for those involved in such events to come up with objective views or assessments, especially if the events involved loss of life, controversy or debates on who was to blame. There may also be experiences, issues and views that are very important for understanding a case study, but might be sensitive and difficult to include. Thus teams may need some members who were not involved in the crisis, and the studies will need to recognize the sensitivities of what may have been traumatic experiences for the actual actors. Each case study would have a leader who can then propose a team that would need to include both natural and social scientists. Some individuals with particular

expertise in generic issues might participate in more than one team to facilitate comparison and application of consistent analysis. In many cases teams would be encouraged to involve or seek views from decision-makers and other key actors.

These case studies would be integrated with the proposed Forensic investigations against the analysis template (see Section 12.2).

The case studies would be partly selected by the IRDR Scientific Committee, with invitations to individuals or groups to set up case study teams. There would also be invitations to the community to propose case studies. The case studies would be carried out over the first three years of the IRDR programme and would be a key mechanism of identifying research to be carried over the ten-year programme. A possible timetable is: identification of cases studies and study teams (6 months); main research and analysis with interim ICSU-sponsored workshop (18 months); write-up and publication of a journal special issue or book with complementary web access (12 months); final workshop to evaluate the assessments to identify generic issues and research themes (6 months before the end of the case study project). The case study would partly rely on human and funding resources in the community, but would need some additional funds. It is likely that some new analysis would be needed in some cases, especially on social and cultural aspects.

There would be spin-offs to this project. It would engage some social scientists in the hazards field and to promote collaboration between natural and social scientists. The project would help catalyse the science community and policy-makers to help them develop better prevention, preparedness, response and recovery strategies. Funding would be sought so as to allow scientists from the developing world the resources to participate.

## 6.3 Assessment, data management and monitoring

In order to be able to determine the consequences of environmental hazards and disasters in terms of their impacts and effects, one needs baseline monitoring so as to provide the characteristics of the undisturbed environment and its populations, and episodic monitoring to provide the magnitude of the environmental hazard, and the severity of the impacts and effects that led to the hazard becoming a disaster. For the disaster prevention and recovery community to use such data it is important that a mechanism be in place to permit timely production and dissemination of easy-to-use, accurate and credible information to the appropriate authorities. As noted earlier, these assessments, data and monitoring capacities will be an important legacy of the IRDR Programme.

To be able to achieve such a goal requires both long-term ground-based and remotely sensed monitoring, pre-determined methodologies for data presentation, and identification of the gaps in our ability to rapidly provide this information to the disaster managers. This cross-cutting theme would have two objectives:

- Guidelines for consistent data management and assessments of hazards, risk and disasters.
- Applying local assessments globally and global assessments locally.

### **Guidelines for consistent data management and assessments of hazards, risk and disasters**

There are many assessments of environmental hazards and environmental risks to be found in the published literature and on the Web. Re-insurance companies such as Munich Re provide such information, as does the Centre for Research on the Epidemiology of Disasters (CRED) (see Appendix III). Sometimes there are inconsistencies between the various assessments that arise because of the use of different data sources, different frameworks, different metrics, or different scales. Sometimes the assessments differ because of a lack of consistency in the management of the data on which the assessments are based. Guidelines to minimize such inconsistencies are needed in all areas of data

management and in environmental hazard and risk assessment. One example is that cost-benefit studies indicating the costs of damage caused by environmental hazards and the possible benefits of information to assist with early-warning for disaster prevention produce widely varying figures in relation to the costs and benefits. Such studies need international guidelines related to the conduct of cost-benefit analyses in this context. Recognizing the need for multi-disciplinary data and information, it is essential that social, natural and engineering scientists with expertise in this area be engaged in the debate about data consistency and sensitivities, perhaps through workshops.

It is considered important to develop the theory underlying hazards, risk and disasters terminology as noted in Sub-Objective 1.1 and their assessment and data management methods. The ICSU Committee on Data for Science and Technology (CODATA) (Appendix III) has the type of expertise in data systems that the Programme could draw upon. In considering risk in this context, it is important to note that it depends on vulnerability and exposure and these ideas are implicit in the approach. Three key issues need to be addressed prior to implementing a single (global) assessment and data management system (see Objective 1 above):

1. To develop a consistent procedure to assess different natural hazards proceeding from the probability of their occurrence and recurrence and using statistical, deterministic and combined approaches.
2. To develop a commonly adopted system of hazards parameterization that can be applied across different hazards types. This would permit an estimation of the hazard energy (destructive force) as well as the affected area and the impact duration in a single measurement system.
3. To develop a consistent procedure of building maps of separate and combined hazards at different temporal and spatial scales: global, regional, national, community and local levels.

ICSU and others co-sponsor systematic observing programmes for the oceans (Global Ocean Observing System, GOOS), the climate (Global Climate Observing System, GCOS), the land (Global Terrestrial Observing System, GTOS), and for the Earth's shape, gravity field and rotational motion (Global Geodetic Observing System, GGOS), which are partners in the Integrated Global Observing System (IGOS).

## **Applying local assessments globally and global assessments locally**

A well-planned monitoring system is required at all levels from global to local scales. Earth observations and earth observation systems now operate at many different spatial scales that can range from detailed microzonations, to large-scale, space-based remote sensing. The monitoring, prediction, early warning and mitigation of hazards occurring at local, regional and global levels depend on an ability to mesh the observations at different scales, and to integrate the observations with disaster prevention, mitigation and recovery systems.

It is desirable to specify accurately and consistently the types of observations to be preferred at different monitoring scales; the type of information and the way it should be exchanged at different observation levels.

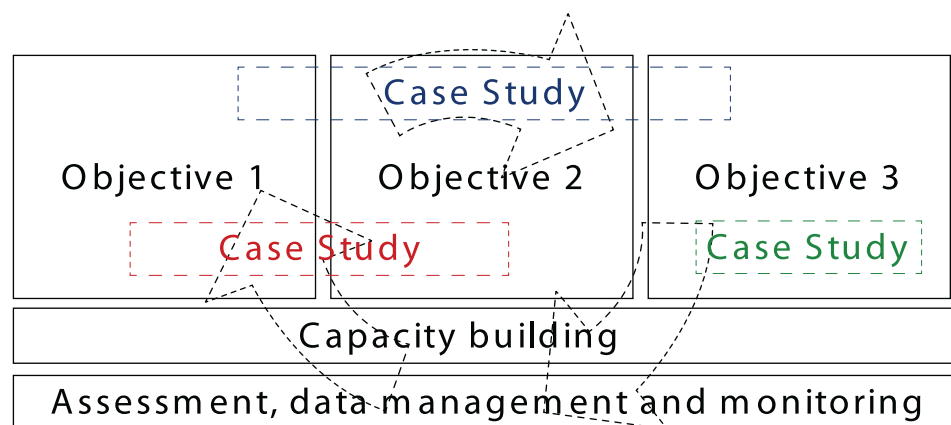
Systematic attempts to undertake such activities may be expected to identify scientific gaps, and remedying such gaps will be an important component of this cross-cutting theme. These gaps could be in theoretical knowledge, observation systems, methodologies, capacity, or in linkages amongst practitioners.

The use of remote-sensing and/or space-based products is a particular focus of a number of initiatives. The International Society for Photogrammetry and Remote Sensing (ISPRS) develops appropriate tools and methodologies for disaster management using remote sensing and GIS technologies. One of the ten IGOS themes is Geohazards, 'to respond to the scientific and operational geospatial information needs for the prediction and monitoring of geophysical hazards, namely earthquakes, volcanoes and land instability'. The Group on Earth Observations (GEO) and their Global Earth

Observation System of Systems (GEOSS) are inter-governmental initiatives to develop comprehensive, coordinated and sustained Earth observation. One of its themes is 'Reducing loss of life and property from natural and human-induced disasters'. The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) is a recent programme to 'Ensure that all countries have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle'.

## 7 Linkages within the research Programme

It is recognized that research activities may contribute to more than one of the objectives or sub-objectives. For example, mapping of risk would, in addition to the cross-cutting themes, require interplay between projects contributing to Sub-Objective 1.1, on identifying and characterizing hazards, and Sub-Objective 3.1, on vulnerability assessments. Forecasting risk would require interplay across many projects due to the need for projections of hazards, vulnerability and exposure, and the latter two, at least, would require projections of the evolution in decision-making. Future implementation, or not, of risk reduction activities (Sub-Objective 3.2) would depend on outcomes of research focussed on Objectives 2 and 1. The integrated programme, focusing on these scientific objectives, would provide society with the scientific basis for characterizing, identifying and forecasting risk, for making effective decisions and, hence, for reducing risk. The interactions along the objectives and the cross-cutting activities are shown schematically below in Figure 1. As a schematic, the three boxes labelled 'Case Study' are meant to be indicative of various case studies, crossing over the three research objectives.



**Figure 1.** How the IRDR research projects, case studies and other activities would contribute across the research objectives.



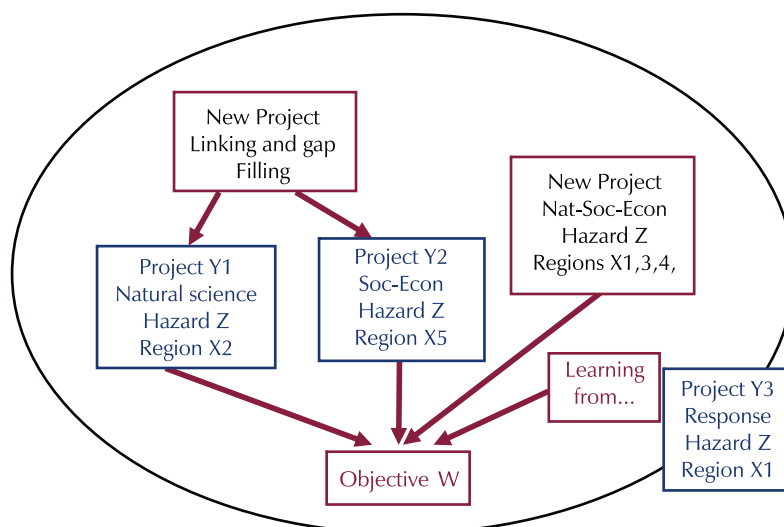
# 8 Schematic structure of the Programme

IRDR would be constructed to meet its research objectives through a set of research activities that would evolve over time. It is recognized that there are, through many organizations, existing research activities with partially similar objectives, and the Programme would be designed to build upon these activities and to initiate new ones so as to make an overall, multi-disciplinary, coherent research programme.

## 8.1 Interactions with existing international programmes and projects

This draft Science Plan has identified the major programmes and projects that exist in the field of natural hazards and disasters (see Appendix III) and, through an extensive consultation process, the Programme would further explore these and other activities and enter into agreements as to how they might become components of the whole.

Figure 2 gives a schematic example with respect to the designation of the set of research activities. For example, to accomplish Objective W in the realm of Hazard Z, the Programme would build an appropriate relationship with existing Projects Y1 and Y2, both focussed on Hazard Z but in different geographical areas X2 and X5, and with different disciplinary foci. The Programme would seek to develop new projects across the missing disciplines and regions. It would also need to have a project to fill the gaps in the existing projects and to link them with the remainder of the Programme. Further, there may be projects outside the foci of the Programme, such as Project Y3 with the focus on response to environmental hazards, for example, from which the Programme can draw benefits, and vice versa. A 'learning from' mechanism will need to be instituted, perhaps in the form of joint seminars, preparation of reports or other means.



**Figure 2.** Building a research programme: a schematic example.

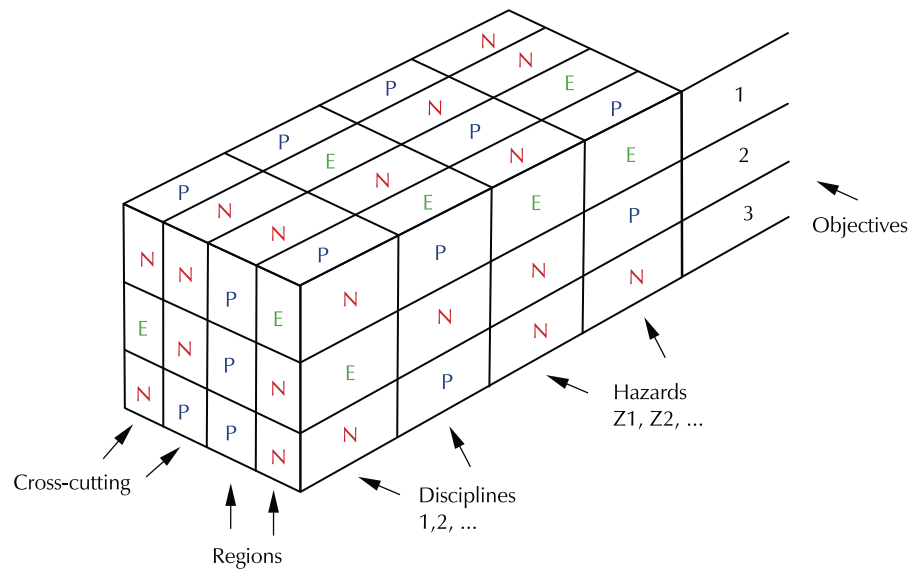
In the broader context, the Programme would need to be able to

cover all appropriate disciplines from all relevant hazards in all regions. This is an enormous undertaking and will need to be approached in a progressive way. In effect, this means analysis of a multi-dimensional matrix, indicated schematically in Figure 3. For each element there needs to be a survey, consultation and analysis, leading to conclusions that: E – there are existing programmes that adequately meet the programme’s research needs; P – there are existing programmes, but which only partly meet the needs; all N – there are no programmes and a new one is needed.

**E:** Existing programmes that adequately meet research needs.

**P:** Existing programmes that partly meet research needs.

**N:** No programmes exist. New programme is needed.



**Figure 3.** Analysis array of research areas by discipline, region, hazards, objectives and cross-cutting themes.

In undertaking the analysis, the sense of what is adequate would need to be weighed in terms of capacity and priority issues. If there were only a single P programme in the area and it fully met the needs, then the strategy would be to incorporate the programme, or come to an agreement with it such that confidence were gained that the research products would be delivered on a realistic and reasonable schedule. There would be need to ensure full and open exchange of research results. It is likely that there would be elements where there are several programmes that collectively correspond to a P rating; the challenge would then be multi-dimensional in bringing such programmes together in way that achieves the objectives.

## 8.2 Examples of interactions with existing international programmes and projects

The International Strategy for Disaster Reduction (ISDR), established under the aegis of the UN Office for the Coordination of Humanitarian Affairs, provides an overall intergovernmental mechanism for programmes on disaster risk reduction. ICSU has been a member of its Inter-Agency Task Force. The central task of ISDR is to coordinate the global implementation of the Hyogo Framework for Action 2005-2015 (UN/ISDR, 2005*b*), and the Hyogo Framework for Action provides an overall target for the research within the proposed Programme. The Chair of the Planning Group represented ICSU at the First Session of the UN Global Platform for Disaster Risk Reduction, held on 5-7 June 2007, and serves as a member of the UN ISDR Scientific and Technical Committee (ISDR-STC) advising the UN Global Platform.

As summarized in Appendix III, there are many existing international programmes and projects dealing with some of the aspects of natural hazards and disasters. These projects usually have a focus on or within a single discipline, most often within the natural sciences, and on one or a small range of hazards. Further, they often have a geographical focus. In that sense, IRDR would address all the issues and would need to draw upon the expertise and scientific outputs of many of these existing programmes. In the following sections, examples are provided, put in the context of the scientific objectives and cross-cutting themes of the new Programme. These examples are illustrative and, of

course, cannot be usually prescribed to a single objective.

## Objective 1: Characterization of hazards, vulnerability and risk

The five Geo-Unions of ICSU – IUGG, IUGS, IUSS, IGU and ISPRS – collaborate on a number of issues, including natural hazards and have established the International Year of the Planet Earth (IYPE), which has identified four broad, overlapping research questions:

- How have humans altered the geosphere, the biosphere and the landscape, thereby promoting and/or triggering certain hazards and increasing societal vulnerability to geohazards?
- What technologies and methodologies are required to assess the vulnerability of people and places to hazards and how might these be used at a variety of spatial scales?
- How does our current ability to monitor, predict and mitigate vary from one geohazard to another? What methodologies and new technologies can improve such capabilities, and so help civil protection locally and globally?
- What are the barriers, for each geohazard, that prevent governments (and other entities) from using risk and vulnerability information to create policies and plans to reduce both?

Through its Union Associations, IUGG promotes and coordinates studies of geophysical and hydrometeorological hazards, dynamics of the geophysical processes resulting in extreme hazard events, and forecasting and prediction of these hazards. IUGG established a Commission on Geophysical Risk and Sustainability (GeoRisk) to study the interaction between hazards, their likelihood and their wider social consequences as a result of the vulnerability of societies. The International Geographical Union (IGU) has a Commission on Hazards and Risks that takes as its starting point the fact that disasters arise from interactions between natural phenomena and societal conditions.

The International Union of Geological Sciences (IUGS) and UNESCO collaborate as partners in the International Consortium on Landslides, the International Geoscience Programme (IGCP), International Consortium on Landslides (ICL) and the Scientific Committee on the Lithosphere. Some of the initiatives within this realm are the Global Earthquake Potential, Global Seismic Hazard Assessment Programme Earthquakes and Megacities Initiative. The World Organization of Volcano Observatories (WOVO) is the foremost international body dealing with volcanic eruptions, and is run under the auspices of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI).

IUGS is engaged in research on endogenous (earthquakes, volcanoes) and exogenous (landslides, collapses, rockfalls, earth subsidence, karst, mudflows, erosion, permafrost) geological hazards through the study of development mechanisms, distribution regularities and mapping of these processes.

The World Climate Research Programme (WCRP) aims to develop the fundamental scientific understanding of the physical climate system and climate processes needed to determine to what extent climate can be predicted and the extent of human influence on climate. The WCRP emphasis on ensemble forecasting naturally leads to analysis of risk. The WCRP Extremes cross-cutting approach will be central to the addressing of climate hazards and extremes. The Global Energy and Water Cycle Experiment (GEWEX) is focused on the understanding and modelling of the occurrence, evolution and role of extremes within the climate system and to contribute to their better prediction with an initial focus on droughts and extended wet periods.

UNESCO has research programmes on natural hazards and provides intergovernmental coordination and policy support in the establishment and operation of monitoring networks and early warning and risk mitigation systems for natural hazards, with particular emphasis on earthquakes, tsunamis, floods and landslides. The UN Decade on Education for Sustainable Development (led by UNESCO), contributes to the achievements of the ISDR Joint Work Plan relative to Priority 3 of the Hyogo Framework for Action. The Intergovernmental Oceanographic Commission (IOC) of UNESCO promotes the concept of 'end-to-end' tsunami warning systems, in cooperation with ISDR and WMO.

The WMO Natural Disaster Prevention and Mitigation Programme contributes to different stages of disaster risk reduction, including prevention, preparedness, response and recovery and reconstruction, through research, monitoring, detecting, analysing, forecasting, and the development and issuance of warnings for weather-, water- and climate-related hazards (the source of nearly 90% of disasters caused by natural hazards). The WMO World Weather Research Programme's THORPEX is a ten-year international study aiming to reduce and mitigate natural disasters by transforming timely and accurate weather forecasts into specific and definite information in support of decisions that produce the desired societal and economic outcomes. The Organization's Associated Programme on Flood Management promotes the concept of Integrated Flood Management which takes an integrated, rather than fragmented, approach to flood management, aiming to maximize the net benefit from floodplains while minimizing the loss to life and economic damage caused by flooding.

The OECD Global Science Forum with a public-private partnership, including Munich Re, has a project, called the Global Earthquake Model, to develop a global, open-source earthquake model that would generate information of the highest standard through cooperation between many of the world's top earthquake experts beginning in early 2008. The International Seismological Centre in the UK is an example of an institution that could contribute to the global effort.

## **Objective 2: Effective decision-making in complex and changing risk contexts**

The International Human Dimensions Programme on Global Environmental Change's (IHDP) now completed Institutional Dimensions of Global Environmental Changes has provided important analysis of governance and the IHDP is now initiating the scientific planning for an Integrated Risk Governance Project. The ongoing project on Global Environmental Changes and Human Security is also relevant. The British Psychological Society has recently set up a working party on disasters, crises and traumas, recognizing that the role of psychology is not only to assist in managing the psychological impact of disasters but also to play a key part in understanding how people behave (or do not behave) in the events leading up to a disaster; and engaging in planning at all stages. The European Federation of Psychological Associations (EFPA) is working on planning responses to disasters and terrorism at a European level and has recommended that a group be set up to perform psychological autopsies on recent disasters in order to develop a better understanding of how people behaved during the event.

## **Objective 3: Reducing risk and curbing losses through knowledge-based actions**

The goal of the Global Risk Identification Programme (GRIP) is a reduction in natural hazard-related losses in high-risk areas so as to promote sustainable development. The International Disaster and Risk Conference (IDRC), Davos is a global, technical and operational gathering of leading experts in the natural, social and engineering sciences, governments, private sector, civil society, IGOs, NGOs and risk management professionals, to be a bridge between practice, science, policy-making and decision-making in the search for sustainable solutions to the complex risks facing society today.

### **Capacity building**

The Global Change System for Analysis Research and Training (START), presently co-sponsored by the WCRP, IGBP and IHDP, has ongoing projects to build capacity and regional networks in Africa, Asia and Oceania. The Inter-American Institute for Global Change Research has capacity building and research activities in the western hemisphere.

The World Bank Global Facility for Disaster Reduction and Recovery (GFDRR) is a partnership that recognizes disaster reduction as a critical dimension of the global poverty reduction agenda.

The ProVention Consortium is aimed at reducing disaster risk in developing countries and to make disaster prevention and mitigation an integral part of development efforts,

## Assessment, data management and monitoring

The Committee on Data for Science and Technology (CODATA) has the expertise in data systems that the Programme can draw upon, and ICSU's current review of its data centres will contribute positively to the development of this aspect of the Programme. One of the ten themes established so far in the Integrated Global Observing Strategy (IGOS), is Geohazards: 'respond to the scientific and operational geospatial information needs for the prediction and monitoring of geophysical hazards, namely earthquakes, volcanoes and land instability'. The Group on Earth Observations (GEO) is an inter-governmental initiative to develop comprehensive, coordinated and sustained Earth observation. One of its themes is 'Reducing loss of life and property from natural and human-induced disasters'. The International Society for Photogrammetry and Remote Sensing (ISPRS) is developing appropriate tools and methodologies for disaster management using remote sensing and GIS technologies.

The Centre for Research on the Epidemiology of Disasters (CRED) promotes research, training, and information dissemination on disasters, with a special focus on public health, epidemiology, structural and socio-economic aspects.

## 8.3 Role of ICSU regional programmes and Regional Offices

The Regional Committees of ICSU have all identified natural hazards and disaster risk reduction as an important component of their respective regional programmes.

The Regional Office for Asia and the Pacific (ICSU ROAP) has now established an ICSU Asia-Pacific Strategic Planning Group on Hazards and Disasters (STRAPGHAD).

The ICSU Regional Office for Africa (ICSU ROA) is now moving into implementation of its science plan on Natural and Human-induced Hazards and Disasters in which five flagship projects were proposed. The Science Plan has received endorsement of a broad scientific community from Africa and beyond, and the approval of the ICSU Regional Committee for Africa. The implementation of the ICSU ROA science plan on hazards and disasters was launched at the International Workshop on Natural and Human-Induced Hazards and Disasters in Africa (Kampala, Uganda, 21-22 July 2007). Two major projects, for which proposals will be developed further, were retained at the Kampala workshop, namely: (i) Project HD1, Geohazards in Africa and linkage with the International Year of Planet Earth (IYPE); and (ii) Project HD2, Hydro-meteorological Hazards in Africa: Vulnerability and Resilience.

The ICSU Regional Office for Latin America and the Caribbean (ICSU ROLAC) has also formed a Scoping Group on Natural Hazards.

In the area of natural hazards – as with all other fields – the ICSU Regional Offices will take every opportunity to collaborate with partners – and especially the respective regional components of other international programmes and organizations. These initiatives provide an opportunity for the combined development of regional components for the Research Programme, and in particular its outreach activities. The Programme, ICSU and other partners and collaborating organizations will work together to ensure that duplications and gaps are avoided.

## 9 Mechanisms for guidance and oversight of the Programme

The International Council for Science (ICSU) has initiated the planning of the IRDR Programme and provided oversight. For an initiative of the interdisciplinarity and complexity of a hazards research programme, there is need for a broad base of scientific involvement and for agency support to make a difference. The International Social Sciences Council (ISSC) has expressed a readiness to consider co-sponsorship of the Programme, and the presence of ISSC would certainly strengthen the involvement of the social science community in the planning and execution of the proposed programme.

The trigger events for the largest fraction of disasters are hydrometeorological. The World Meteorological Organization (WMO), which has had a representative at the meetings of the Planning Group, is the main UN lead body for these issues and its member organizations have large scientific and technological capacity in this area. The United Nations Educational, Scientific and Cultural Organization (UNESCO) is the main UN agency involved with geophysical hazards and has also been represented at the meetings of the Planning Group. The Intergovernmental Oceanographic Commission (IOC) of UNESCO, which is a co-sponsor with ICSU and WMO of the World Climate Research Programme, has major programmes on tsunamis and other ocean hazards. There are significant advantages in having the WMO and UNESCO and its IOC as co-sponsors: for their S&T capacities, for the access to the information, data, services and research of their member organizations and because they have major roles in delivering the benefits of the research from the Programme. They have natural and formal ties to all governments.

The International Strategy for Disaster Reduction (ISDR) is the UN lead agency on natural hazards and a representative has participated in the meeting of the Planning Group; a close relationship has been established through ICSU's participation in the UN Global Platform and ISDR Scientific and Technical Committee (ISDR-STC).

Following the examples of the International Polar Year (co-sponsors: ICSU and WMO) and the World Climate Research Programme (co-sponsors: ICSU, WMO and IOC), an agreement among the co-sponsors would be negotiated that would agree on the definition of the Programme (based on this document), the terms of reference, structure and functions of the Programme guidance, oversight and consultation mechanisms and financial arrangements.


It is proposed that the new research Programme be guided by a Scientific Committee (SC) of eight members, each of whom would serve a three-year term, renewable once. Members and Chair of the SC would be selected by mutual agreement between the joint sponsoring organizations of the Programme, on the basis of their standing in the international scientific community and their commitment to the strategic objectives of the Programme, with due consideration being given to disciplinary, geographical and gender balance.

A Consultative Forum attended by representatives of component and complementary programmes and initiatives would be created and convened regularly.

As has been described in Chapter 8, the Programme would need to interact with a wide variety of existing international programmes. To effect this interaction, the SC would need to have mechanisms of on-going involvement with these programmes. Where certain projects are key ingredients of the Programme, nominated representatives on the SC or joint working groups or other formal mechanism might be needed. In some other cases, this would be done by having observer status at appropriate meetings (as is done amongst the Global Environmental Change Programmes). In other cases, regular communication would be sufficient. As the Programme is constructed and executed, there would be an ongoing challenge to maintain these linkages in an effective and time-efficient way.

Further planning and development of the IRDR would be serviced by a small Secretariat within an International Project Office (IPO). The Project Office would be created in early 2009, and its location and establishment would be the subject of negotiations with interested partners, as well as the completion of an MoU between ICSU and the host organization. In addition to supporting the work of the Scientific Committee, the Secretariat of the Office would help promote the Programme and disseminate its scientific results to target audiences at various levels.

# 10 Interactions with stakeholder groups



The IRDR Programme being proposed is a very complex and challenging one, not least because of the many international initiatives and activities already existing in the field of natural hazards and disasters (see above and Appendix III). There are several stakeholder groups, these include: the international and national scientific programmes either already ongoing or potentially to be initiated, on hazards research and their sponsors; international and national organizations who are involved in development, humanitarian assistance and similar issues; and, in general, governments, private sector and civil society. Each requires a special and defined approach, which will need to be flexible and probably evolve as the Programme progresses. Consultation amongst potential collaborators and co-sponsors on the international stage is of the utmost importance if the new Programme is to fulfil its role of building upon, consolidating and complementing research being carried out elsewhere. Broad consultation with international organizations and associations in the field of natural hazards and their management – many within the ICSU family – will continue in the months to come. A one-day Consultation Forum was held with representatives of both the science and funding communities (29 October 2007, Paris). Appropriate ICSU Union or Association general assemblies would be used as opportunities to present and discuss the evolution of the Programme and to present the scientific results as they are obtained. A mooted joint ISSC-ICSU session on Hazards and Disasters at the May 2009 World Social Science Forum would serve part of the purpose of more fully involving the social sciences communities.

Initial contacts have been made with national funding agencies through informal discussions at the International Group of Funding Agencies (IGFA) for global environmental change research, potential major funders of aspects of this Programme.

Additionally, bilateral discussions will continue with international organizations to further identify and define the contributions that they could specifically make to the Research Programme. Such discussions will serve to make the consultative process more inclusive and will address any remaining concerns about overlap with ongoing activities. There is also special need to consult, and then work with, the development agencies, humanitarian assistance agencies (including UN bodies and NGOs); and governmental policy-makers. Other stakeholder groups (e.g. people living in areas vulnerable to natural hazards) will need a new and different approach, to be developed through appropriate consultation and, where appropriate, with the aid of the ICSU Regional Offices, or those of other co-sponsors.

It is proposed that a Consultative Forum be established, through a series of informal forums during the first three years and then, based on the input from that process, an ongoing forum to continue thereafter. Use of other forums would also be appropriate. The ISDR Global Platform meetings, to be held bi-annually, might provide one such opportunity, and special sessions may be



possible. The International Disaster and Risk Conference (IDRC) is a major event held periodically, mostly in Davos, Switzerland, involving both governments and a broad range of civil society and business, and discussions with the organizers have indicated that this event could be used for consultation processes. As the formal and informal sponsorship and partners are clarified and confirmed, the variety of broad stakeholder consultation forums will be apparent and considered for use by the Programme. A guiding principle should be that the creation of new stand-alone forums should be avoided, unless necessary.

# 11 Added value of an internationally integrated, multidisciplinary, all-hazards research programme

The Hyogo Framework for Action provides an internationally-agreed-upon template for disaster risk reduction. As noted earlier, it calls for all-hazards approaches, people-centred systems and overall risk assessment. The assessment of the Planning Group is that, despite all the present activities ongoing on natural hazards, there is an imperative for a research programme, sustained for a decade or more, that is integrated across the hazards, the disciplines and the geographical regions, wherein would lie its value-added nature. Part of IRDR's value would be in filling the gaps and bringing together some of the as-yet un-connected initiatives. The coupling of the natural sciences' examination of hazards with the socio-economic analysis of vulnerability and mechanisms for engaging policy decision-making processes will be a major value added.

Although research has been undertaken on decision-making processes in the risk and disaster theme, this has neither been systematic or sufficient in itself. Few case studies exist and the topic seems to be more led by premises as to cost-benefit and project-planning principles than by understanding of the multiple factors of a cultural, economic, social and political nature that may intervene in any particular decision. Few research endeavours exist as regards decision making and policy formulation which seek to integrate, from the beginning, social and physical science aspects; normally one or the other is added on as a foreseen relevant aspect but methodologically the needed integration of both perspectives is not achieved. Hazards need to be taken as having a given dimension, detailed to the extent that is scientifically justified. This information must be examined and considered in the light of cultural, economic, social and political processes which serve to modify or put in context the natural science information and thus influence decision-making. Scientific information needs to be combined to more adequately understand how information and knowledge is considered, incorporated and acted on, or not.

Hyogo Priority 4 is to 'reduce the underlying risk factors'. Significantly, the 'risk factors' so identified are all socio-political and economic (basic, root causes of disaster) and the research proposed would enhance understanding of these by considering the role of decision-making at all levels, from intergovernmental and multinational organizations down to the individual citizen. A unifying assumption for the research proposed is that it is possible to make sense of decision-making at all these levels by starting with an analysis of the anticipated incentives and constraints to action as perceived by decision-makers, together with the personal and societal values that can lead them to prioritize certain outcomes.

The legacy of IRDR would be an enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts. The legacy will be the development of science and development of broadly-based capacity. The legacy will also be the repository of information and data that have been acquired and that will be of continuing availability and value to the global community.

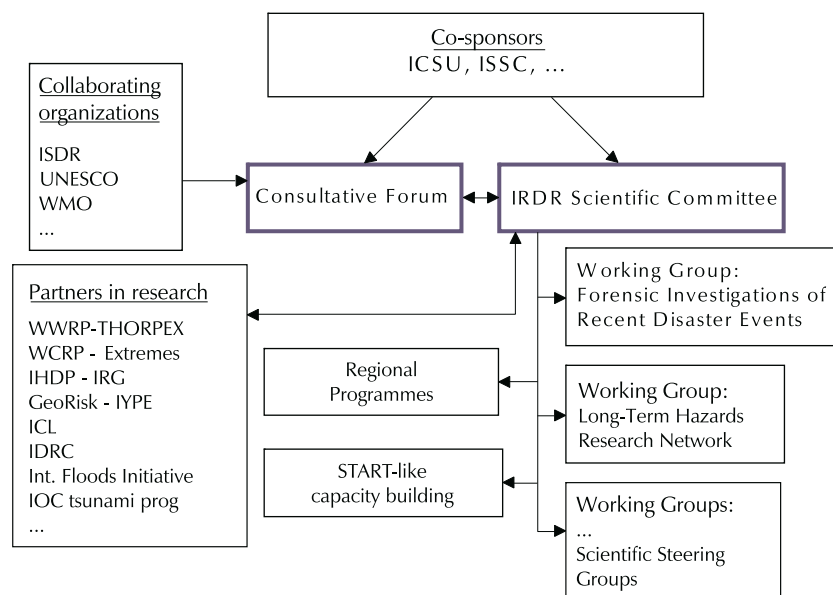
This would represent value-added for the scientific community, both in producing better forecasts as well as in knowing how to communicate them and persuade decision-makers to use the information. It would also bring value-added for the policy-making community in that there would be improved uptake by communities of their decisions and a better understanding of how to use scientific information. Communities would benefit through a better appreciation of the variety of forms of cultural adaptation to hazards and their relation to direct experience of natural events. It should also be construed where possible in an action-research framework whereby the stakeholders at the community level are part and parcel of research and action.

# 12 Moving ahead

During its first three years, IRDR would be focused on building partnerships and undertaking scientific analysis to put in place longer-term projects towards meeting its declared scientific objectives with the aim of meeting its overall vision and leaving the desired legacy. In the following sections, some targeted research for those first three years is identified. Possible criteria for evaluation are suggested.

## 12.1 The first three years and possible criteria for evaluation

The proposed initial structure of IRDR is shown schematically in Figure 4. During the first three years, the Programme would establish a team of co-sponsors and make arrangements with existing programmes so as to undertake research with shared outcomes and responsibilities. The Scientific Committee and the Consultative Forum, mandated by the sponsors and with the support from the International Project Office, would have the responsibility for building the formal linkages with partners in research. The collaborating organizations, working through the Consultative Forum, would become significant actors in the Programme.



**Figure 4.** Proposed schematic structure for the IRDR Programme

In addition, new projects would be initiated to put in place, in a priority sense, the elements needed to fully meet the objectives over a ten-year timescale. It is recommended that the Scientific Committee, when in place, create two Working Groups to scope out the programme and lay the firm basis for further programme development. These would be Working Groups for:

- Forensic investigations of recent disaster events, and a
- Long-term hazards research network.

The case studies discussed earlier would be linked to the forensic investigations.

## 12.2 Forensic investigations of recent disaster events

One of the underlying questions that began the momentum towards the proposed new IRDR initiative launched by ICSU was the conundrum: why when so much more is known about the science and technology of disasters (the exception being some regions in the developing world) are the losses from extreme events continuing to rise at a rapid rate? There has been a substantial expansion of knowledge about the potential magnitude and frequency of natural events and the places in which they are more likely to occur. Sometimes the growth in losses is attributed to the growth of the human population and increasing wealth, including the material property exposed to nature's extremes. This is certainly part of the explanation for increasing losses.

It might be expected, however, that the effective application of new and better knowledge and stronger technology would allow for a decrease in losses or at least stabilization, even as population and wealth increase. To some extent this has happened in developed countries, where it seems (subject to some limitations in the available data) that losses have just about kept level with economic growth; in other words, they are a more or less constant proportion of GDP. Surely, given the available science and technology, we could do better. In the developing countries the 'success' rate has been even less satisfactory, and there are indications that, in the highly vulnerable and exposed countries at least, losses are increasing faster than wealth, and serve as an impediment to development and a barrier to the achievement of the Millennium Development Goals. In developing countries it is not enough to say that we could do better; we must do better.

After a major disaster event it sometimes happens that an enquiry is made into the causes. When such an enquiry is conducted it typically focuses heavily on either the geophysical and atmospheric processes or the technological and structural aspects of the damage. It may also examine the emergency preparedness and the disaster relief and rehabilitation response. Sometimes the enquiry may extend to the effectiveness of existing policy or make recommendations for future policy alterations. These efforts rarely seem to probe very deeply into the underlying and sometimes long-term causes of the disaster. Nor are the enquiries usually carried out at arms-length from those most intimately involved; this is understandable because those most involved and on the spot have the most intimate knowledge of what occurred. One consequence appears to be that enquiries sometimes tend to leave certain questions unanswered or even not asked. Is it the case, as some would have it, that in the aftermath of a disaster there may be reluctance to risk the creation of more distress by probing too deeply into the causes?

The IRDR initiative therefore intends that more penetrating studies be carried out as a first step in the decade-long programme. These studies would search for other and additional, wider and more fundamental explanations for the current rise in disaster losses. These might extend from the inadequacy of the science in some instances, to the use and application of the science and available technology, to poor building standards, planning and design, or to any number of other considerations, including how and why important decisions were made or management options chosen. Possibly there might be new factors operating, such as the effects of modern technology and communications, or the globalization of the world economy. For the moment these are hypotheses to be explored. It is planned and expected that within the early scope of IRDR these hypotheses and ideas can be more rigorously put to the test than appears to have been the norm in recent years.

The proposal is that in the first (three-year) phase of IRDR a series of in-depth, post-disaster, multi-disciplinary investigations be carried out, with the primary objective of describing the limits to existing knowledge and identifying a set of key research questions. The investigations might be described as 'forensic', to suggest the qualities of serious, all-encompassing, arms-length, careful and detailed analysis that we would wish to see, as for example is common practice following any major international transportation or airline 'accident'. The use of the word 'forensic' should not be taken to imply that lessons and insights can only be derived from 'failures' or cases where mistakes were made. It would also be important to conduct forensic investigations of success stories to help accumulate evidence of good practices or other success factors.

Clearly the organization, implementation and wider utility of such an exercise will depend on the way it is designed and the non-partisan and professional integrity with which it is executed. IRDR might therefore propose to develop a common 'template' or methodological design for the studies. Such a template would serve two main purposes. First, it would help to guide the studies by specifying crucial topics to be investigated, with suggestions of the sorts of questions that might be asked. Second, by moulding the studies into a similar pattern it could facilitate a type of meta-analysis, looking at all the case studies, or groups of them, as a set. The purpose of the meta-analysis would be to generate insights, interim research results and further research directions that could not be obtained from singular case-by-case anecdotal studies. To some extent these purposes might be in conflict. In-depth investigation of particular disasters requires the research teams to be able to follow the evidence wherever it leads. On the other hand the requirements of meta-analysis are such that maximum comparability of the case studies is to a degree necessary. Finding the right balance to this and other design questions is not a simple task.

One important issue to be addressed in the design of the set of forensic studies therefore is the question of the hazard classes to be selected. Given the broad range of IRDR, it may be advisable to have studies of earthquake events, tropical cyclones, droughts and so forth in separate categories for some purposes.

Other questions that require further consideration include the following:

- What are the parameters that would suggest a particular disaster be investigated or included in the list of forensic studies?
- How many case studies should be carried out?
- Should they be limited to a single type of hazard, e.g. natural hazards, or should a wider range of initiating events be included, such as industrial accidents, pollution episodes, environmental degradation and deterioration, and so forth? This may depend to some extent upon a more precisely stated or developed set of objectives for the forensic case studies.
- What should be the geographical distribution of the case studies?
- Would the case studies be limited to locally well-defined and limited disasters such as those involving large cities or dense populations? Alternatively, would widespread disasters such as droughts and famines or events impacting multiple countries (e.g. tsunamis) be eligible for inclusion?
- How much time and financial resources would be required?
- When would studies be initiated in relation to the time of the event? Long enough after the disaster event so as to be far enough removed from the immediate confusion and uncertainties, but close enough in time not to lose the opportunity of access to substantive and accurate recall or documentation?
- Under what or whose authority would the studies be carried out and how would a sufficient degree of 'arms-length' character be guaranteed? In particular, how could the forensic case studies be organized and structured so as to be understood, accepted and respected by a wider recipient audience? How could the full cooperation of the authorities or other entities most immediately affected by or involved in addressing the disaster event be secured?

Considering that the design exercise itself is not a simple one and, considering the diversity of expert perceptions and multidisciplinary research interests and traditions which must be brought to bear, it is suggested that the fashioning of a template and its preliminary testing should itself be the subject of some research collaboration. The Working Group would be selected and appointed to refine the concept (which is only sketched out here) and subsequently design the template. It would then be presented to a workshop attended by an international group of researchers and of professional disaster managers and relevant decision-makers. It would be up to the workshop to adopt the template and/or to suggest possible improvements including field trials.

At first acquaintance this procedure might seem to be slow, exacting and cumbersome. In its defence, however, it should be recognized that the problem being posed – why are disasters getting large and more frequent? – admits no simple answers. The period 1990-1999 was designated by the United Nations as the International Decade for Natural Disaster Reduction (IDNDR). Since then,

numerous other efforts have been mounted, including world disaster conferences and the establishment of the ongoing International Strategy for Disaster Reduction and the Hyogo Framework. It is not the intent of the IRDR initiative to replace these worthwhile efforts, but to build upon them; to seek to add strength to their work; and to produce new understanding and insights that will permit more effective disaster reduction. The Planning Group would provide further guidance for the Working Group to consider.

## 12.3 Long-term hazards research network

The two-tiered development of case studies (some number of rapid assessments, plus a smaller number of in-depth forensic case studies) will be of considerable value in and of itself. However, there is a need to assess the feasibility of, and lay the groundwork for, a network of long-term hazard research sites around the world. The creation of such a global network of sites would allow for enduring (decades) place-based, longitudinal studies of natural hazard risk, while leading to progressive building of resiliency across that same network. It would provide a mechanism for reaching out to communities located in the most vulnerable areas and including them in the science agenda. It would also provide a context for comparative analysis (e.g. across time, culture, technology, economic development, hazard, and geography) of public policies and practices associated with risk and recovery that can be used worldwide to lower risk yet further. At each site, collaborative multi-disciplinary teams of scholars, local practitioners, policy officials and private enterprise would comprehensively monitor and record a community experience with recurring hazards over time, make a sustained, ongoing effort to understand the strengths and shortcomings of current disaster risk reduction practice at that site, and to translate that understanding into increasingly effective future action. Note that the monitoring would not only include enhanced monitoring of the natural system, using, for example, the new capabilities that GEOSS portends, but also document the social and economic parameters governing the vulnerability of the community, or conversely, its resilience with respect to natural extremes, and the changes these over time. The global network of long-term hazards research will provide a framework for the full engagement into the IRDR programme of the ICSU Unions and various other organizations working on different aspects of hazards research in different geographical locations. The case studies already described would be instrumental in helping develop criteria for the selection and establishment of such sites, the variables to be measured, and so on. Ecological research, specifically the Long-Term Ecological Research (LTER) and the National Ecological Observatory Network (NEON) programmes, offer analogies and potential models.

Criteria might include considerations such as the following:

- Most, if not, all sites might be located in urban or rapidly urbanizing environments to maximize the positive impact of research and policy.
- Sites might feature strong partner organizations with an acknowledged record of successful multidisciplinary endeavours. Local involvement and commitment to long-term monitoring, research, and appropriate changes in practice over time would be essential. This should not be strictly a research endeavour. It has to build capacity at the same time – communities and societies have to learn, benefit while doing. For the most part, participating organizations would be on site.
- A commitment to further understanding the dynamics of longer-term recovery issues (both at select sites in depth and across the entire project). The social dynamics of the recovery process remain poorly understood at any useful level and require detailed long-term study.
- Provide for, or at least take steps toward, the standardization of data collection and sharing across the hazards community.
- A possible area of study could be the barriers to research uptake by officials and practitioners – a well identified problem in the hazards community but one whose dynamics are still poorly understood.
- Uniqueness (the degree to which a given site expands the parameter space of the mix of natural and social factors contributing to risk provided by other sites).

Each long-term hazard research site would be a microcosm consisting of one (or more) hazards, a particular culture, level of economic development, etc. The aggregated whole of the different sites would then be a parameter space that would foster the understanding of the role of each of these contributors to risk, vulnerability and mitigation. The study of 'changing conditions' (political, social, environmental) would be a major rationale for the longitudinal studies. This would address a major deficiency in most existing hazards research efforts, which tend to look at discrete problems or efforts within a relatively short time horizon.

NEON may ultimately prove to be a better template than LTER. It is a network of nationwide sites that combines local collaborators with a central management structure to facilitate the collection and diffusion of information (as well as project management and logistics). It may be worth exploring the formality of relationships and the financial arrangements between the centre and research nodes to include some initial thoughts on how the project might look in the future. LTER sites, whose loosely affiliated centres are discrete in the project goals and management, will also be worth looking into further – LTER has a long-recognized history of success.

Long-term, sustained funding will be a challenge and will need to come from a variety of sources, both public and private, both national and local. One model that might be used is Project Impact in the United States, where national-level funding was highly leveraged by local contributions, both in-kind and monetary.

The question of site differentiation will need to be addressed.

- Will all the sites have a basic research package to provide for comparative analysis or will each one be focused on a specific set of issues tailored to the particular context and partner strengths? Or some combination?
- Will the type of disaster risk (earthquake vs. hurricane, for example) be a factor for differentiation or will we seek commonality?
- How proximate should the risk be for a community to be considered?

The establishment of such a network has the potential to change culture with respect to hazards, replacing a mind-set focused on emergency-response, followed by rebuild-as-before, with a societal approach based on building resilience in advance, learning from experience, and not repeating mistakes. It might well be that this embryonic cultural shift, emerging initially at the long-term research sites, and then spreading, would be a great legacy of the IRDR.

## 12.4 Criteria for evaluation and milestones

Criteria for evaluation would be: sponsors in place and active; partnerships agreed to and functioning; and the new projects in place which would have a viable and strong scientific team, with appropriate geographical representation and are funded adequately to meet their objectives, within the overall framework of the Programme's objectives. The establishment of the Working Groups and the development and completion, through the Forensic Investigations, of several case studies in the first three years is to be expected.

As part of the first three-year mandate, IRDR would convene stakeholder consultation forums both to receive input and to review the programme, but also to lead to an ongoing stakeholder forum process. The Consultative Forum would be used as a major part of the evaluation process. In ten years, it would be appropriate for the sponsors, together with the then ongoing consultative forum, to review the programme and the investments made to see how well this vision and legacy has been achieved.



## 12.5 Conclusions

This report is provided by the Planning Group as a basis for further discussion and consultation across a broad spectrum of organizations and activities, with the intention of using the feedback to further develop and implement an effective Programme on Integrated Research on Disaster Risk and addressing the challenge of natural and human-induced environmental hazards.

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# APPENDIX I

## Terms of Reference for the ICSU Planning Group on Natural and Human-induced Environmental Hazards and Disasters

1. The Planning Group should formulate a set of detailed objectives for an ICSU Hazards Programme based on a review of ongoing and planned relevant activities. In conducting such a review, ICSU Scientific Union and National Members should be consulted. Interests of the ICSU Interdisciplinary Bodies and Joint Initiatives should also be explored. The report should clearly demonstrate the added value of an ICSU Programme in the area.
2. The Planning Group should take the report on hazards to the ICSU 28th General Assembly as a point of departure, i.e. desired outcomes in terms of how scientific knowledge is used by policy-makers at international, national and/or local level, and in terms of how scientists interact with policy-makers and other stakeholders in the context of natural hazards – and to ensure that these objectives complement and advance existing initiatives within and beyond the ICSU community.
3. To make proposals for broad areas of research to be targeted in the first three years of an ICSU Hazards Programme, to present possible criteria for evaluation, and to define the milestones that should be reached during the life span of the Programme.
4. To stimulate, encourage and organise debate among a wide range of interested parties on the possible objectives and content of an ICSU Hazards Programme, In particular, to consult the proposed target audiences – development agencies; humanitarian assistance agencies (including UN bodies and NGOs); and governmental policy-makers – about how an ICSU Hazards Programme might best meet their needs.
5. To make proposals for how stakeholder groups other than scientists and policy-makers (e.g. people living in areas vulnerable to natural hazards) can contribute to setting the agenda for an ICSU Hazards Programme and can be involved in its progress.
6. To propose a mechanism for guidance and oversight of the Programme.
7. To report to the CSPR by July 2007.

*Approved by CSPR, 16-17 February 2006*

# APPENDIX II

## Membership of the ICSU Planning Group on Natural and Human-induced Environmental Hazards and Disasters

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invited to the meetings of the  
Planning Group as observers:*

- Secretariat of the  
International Strategy for  
Disaster Reduction (ISDR)
- United Nations Educational,  
Scientific and Cultural  
Organization (UNESCO)
- World Meteorological  
Organization (WMO)

# APPENDIX III

## International collaboration on Natural Hazards

There exist a number of important programmes designed to undertake research on particular aspects of natural hazards, or on the management and mitigation of natural disasters. It is important that any new international initiative launched by ICSU take account of the work currently being carried out or planned, and that it seek to complement and build on that work. Equally, the concerned organizations or structures may wish to become active partners in the process. This Appendix provides a brief summary of the main international players in the field of natural hazards, and their major programmes or initiatives, with special emphasis on ICSU family members, the UN system and relevant intergovernmental and non-governmental organizations and consortia. The aim is to give a flavour of current work rather than be comprehensive; for this reason, readers are directed to relevant websites for further information.

### 1 ICSU and the ICSU family

ICSU itself was an active participant in the UN-led International Decade for Natural Disaster Reduction (IDNDR, 1990-1999). It established a committee to oversee its own engagement with IDNDR and to advise ICSU members on harmonizing their activities related to natural disasters. Associated projects included: drought assessment and famine (coordinated with IGU); reducing volcanic disaster (with IAVCEI); global seismic hazard assessment (with IASPEI and ILP); tropical cyclone disasters (with IUTAM and WMO); and engineering for disaster reduction (with the World Federation of Engineering Organizations, WFEO). After the Decade, ICSU replaced its IDNDR committee with the Committee on Disaster Reduction, charged with representing ICSU in the UN International Strategy for Disaster Reduction (ISDR), the successor initiative to IDNDR (see below). The 28th ICSU General Assembly in 2005 decided to discontinue the ICSU Committee on Disaster Reduction and to begin the planning of a new programme.

#### World Summit on Sustainable Development

At the World Summit on Sustainable Development (WSSD), Johannesburg, South Africa, 26 August-4 September 2002, where ICSU played an important part in putting science on the agenda, government leaders adopted a Summit Plan of Implementation that drew strong connections between international development and natural hazards, and in which they stated the need for an 'integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery'. In the same document, they also called for proper financial support for the ISDR, and put forward a series of more specific proposals concerned mainly with S&T capacity building and the applications of science that were later to be picked up at the Kobe Conference and promoted in the Hyogo Framework. ([www.icsu.org](http://www.icsu.org))

#### Committee on Data for Science and Technology (CODATA)

At its 25th General Assembly (Beijing 2006) CODATA established a new Task Group for the development of a CODATA Comprehensive Information System on Natural Disaster Mitigation (CISDM). The CISDM Task group will work on the major natural hazards and disaster mitigation, establishment of a natural disaster database, both historic and real-time, and will set up an integrative S&T model system for disaster preparedness and disaster mitigation in one or two developing countries or regions. During 2007-2008 the group is to organize a survey on disaster data resources worldwide and set up a portal of the CISDM.

CODATA has recently taken the lead on GEOSS Task DA-06-01: 'Furthering the practical application of GEOSS data sharing principles'. As part of this effort, CODATA is addressing the issue of open access to remote sensing and other environmental and socioeconomic data needed not only for immediate disaster response but also for disaster prevention, recovery and reconstruction. ([www.codata.org](http://www.codata.org))

#### Committee on Space Research (COSPAR)

COSPAR was established by ICSU in 1958 to provide the world scientific community with the means to exploit the possibilities of satellites for scientific purposes, and exchange of results on a cooperative basis.

COSPAR has interdisciplinary Scientific Sub-Commissions (SSC) devoted to Earth's atmosphere, oceans and land. Natural and human-induced hazards and disasters are part of each SSC. The atmosphere, oceans, and land SSC support tropical storms and hurricanes, harmful algal blooms and oil spills, and earthquakes and tsunamis, respectively. COSPAR has recently become a Co-chair of the Group on Earth Observations (GEO) Science and Technology Committee.

([cosparhq.cnes.fr](http://cosparhq.cnes.fr))

#### International Astronomical Union (IAU)

In addition to various studies carried out on Near-Earth Objects by its national members, the International Astronomical Union has had a long-established international expert Working Group (WGNEO) on the field. This has now been replaced by an Advisory Committee on Hazards of Near-Earth Objects, reporting to the IAU Executive Committee.

The Advisory Committee is charged with: maintaining liaison with, and advising on coordination of, NEO activities worldwide, on reporting of NEO hazards, and on research relevant to NEOs. When a close approach to Earth by an asteroid is predicted, the Committee advises the IAU on the reliability of the prediction. The results of their evaluations, as well as other related public statements, are all linked from the NEO Committee website. ([www.iau.org](http://www.iau.org))

#### International Geographical Union (IGU)

The IGU has Commissions on 36 varied topics, including: hazards and risks; land degradation and desertification; land use and land cover change; and population and vulnerability. The Commission on Hazards and Risks takes as its starting point the fact that disasters arise from interactions between natural phenomena and societal conditions; it therefore focuses particularly on the vulnerability of ecosystems, societies and individuals. It carries out comparative international geographical studies to contribute to the creation of an interdisciplinary language of hazards, risks and vulnerability. One of four IGU Task Forces is devoted to vulnerability.

The International Association for Engineering Geology and the Environment, an affiliate of the IGU, has established a committee on landslides and engineered slopes, whose objectives include the development and application of the relevant science and engineering expertise. ([www.igu-net.org](http://www.igu-net.org))

### **Scientific Committee on the Lithosphere/International Lithosphere Programme (SCL/ILP)**

Established by ICSU in 1980 at the instigation of IUGG and IUGS, the SCL/ILP promotes and directs research on first-order problems in modern integrated solid earth science centred on the lithosphere.

It includes:

- the Global Earthquake Potential project (to produce a reliable estimate of earthquake potential valid throughout the world that would be useful as a source model for seismic hazard calculations);
- the Global Seismic Hazard Assessment Programme (launched in 1992 by ILP and ICSU in the context of IDNDR to create a global seismic hazard map based on advanced methods in probabilistic seismic hazard assessments, and completed in 1998); and
- the Earthquakes and Megacities Initiative (creating a network of large metropolises exposed to the threat of earthquakes in order that they can share their experiences and coordinate their activities to increase capacity for disaster preparedness, response and recovery. Themes include the evaluation of seismic exposure, impact on society, economic consequences, preparedness and emergency response capabilities.)

Since the ICSU 28th General Assembly in 2005, responsibility for SCL/ILP has been taken over by IUGG and IUGS. ([sclilp.gfz-potsdam.de](http://sclilp.gfz-potsdam.de))

### **International Society for Photogrammetry and Remote Sensing (ISPRS)**

ISPRS has established a working group on Hazards, disasters and public health, for the development of appropriate tools and methodologies for disaster management using remote sensing and GIS technologies, including the generation of vulnerability and hazard zone maps for various types of disaster (forest fires, cyclone, floods, drought, volcanoes, earthquake, landslides) and the integration of remotely sensed data observation and communication strategies with enhanced predictive modeling capabilities for disaster management, and applying remote sensing data products to public health and other environmentally-induced events that may affect people. It will run until 2008. ([www.commission8.isprs.org/wg2](http://www.commission8.isprs.org/wg2))

### **International Union of Geodesy and Geophysics (IUGG)**

The objectives of the IUGG are the promotion and coordination of physical, chemical and mathematical studies of the Earth and its environment in space. IUGG is not only dedicated to the scientific study of the Earth but also applications of the knowledge gained by such studies to the needs of society, such as geographical information systems, climate change, water quality, and reduction of the effects of natural hazards. The IUGG XXIV General Assembly (July 2007) devoted a Union session Symposium to Early warning of natural hazards, at which were discussed applications of remote sensing in mapping, monitoring and early warning of various natural hazards. ([www.iugg.org](http://www.iugg.org))

### **International Association of Seismology and Physics of the Earth's Interior (IASPEI)**

One of eight semi-autonomous associations of IUGG, IASPEI promotes the study of earthquakes and other seismic sources, the propagation of seismic waves, and the Earth's internal structure, properties, and processes. It currently has commissions on a range of earthquake issues (Earth structure and geodynamics; Earthquake sources - prediction and modelling; Tectonophysics; Earthquake hazard, risk, and strong ground motion; and Seismological observation and interpretation) relevant mainly to scientific aspects of the theme of natural hazards.

IASPEI projects include:

- Earthquakes and Megacities Initiative
- International Handbook of Earthquake and Engineering Seismology
- Manual of Seismological Observatory Practice
- Global Seismic Hazard Assessment Programme (GSHAP)

([www.iaspei.org](http://www.iaspei.org))

### **International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)**

IAVCEI is the primary international focus for research in volcanology and related disciplines, and efforts to mitigate volcanic disasters. Among its active commissions are those on cities and volcanoes (to provide a linkage between the volcanology community and emergency managers, and to promote applied research involving the collaboration of physical and social scientists and city officials); mitigation of volcanic disasters (focused on the preparation of hazard maps as a tool for designing monitoring systems, emergency plans and socio-economic development strategies for a given region); and the international volcanic health hazard network (to produce and disseminate protocols and volcanic health hazard information to volcano observatories, scientists, governments, emergency managers, health practitioners and the general public). ([www.iavcei.org](http://www.iavcei.org))

The World Organization of Volcano Observatories (WOVO) is the foremost international body dealing with volcanic eruptions, and is run under the auspices of IAVCEI. Members are institutions that are engaged in volcano surveillance and, in most cases, are responsible for warning authorities and the public about hazardous volcanic unrest. ([www.wovo.org](http://www.wovo.org))

IASPEI and IAVCEI have a joint working group on Subduction zones located in developing countries, which organized a workshop on earthquake and volcanic hazard mitigation at the IASPEI General Assembly in October 2005. That Assembly also saw workshops on Tsunamis: case studies, warning system and hazard assessment, and Effects of earthquakes on megacities.

### **International Association of Hydrological Sciences (IAHS)**

IAHS promotes the study of all aspects of hydrology through discussion, comparison and publication of research results and through the initiation of research that requires international cooperation. Its International Commission on Surface Water (ICSW) is responsible for promoting research in surface water hydrology and its interaction with other aspects of the hydrological cycle. The primary objectives of activities are to advance knowledge of the dynamics and statistics of surface water hydrology and to encourage the transfer of this knowledge to the international scientific hydrological community and the water industry to improve the design and operation of hydrological systems. Core activities include flood and drought prediction, mitigation and forecasting, with high priority given to interdisciplinary research, including socio-economic aspects.

One of the IAHS Working Groups, Predictions in Ungauged Basins (PUB) is an IAHS ten-year research project (2003-2012) for reducing predictive uncertainty in hydrology. It promotes better understanding of hydrological process and tries to replace model calibration by physical knowledge as much as possible. PUB also seeks to assemble the technology to provide the best prediction to ungauged or information-poor basins. ([iahs.info](http://iahs.info))

### **International Association of Meteorology and Atmospheric Sciences (IAMAS)**

IAMAS provides the scientific community with platforms to present, discuss and promote the newest achievements in meteorology, atmospheric science and related fields. It also facilitates and coordinates research which requires international cooperation. ([www.iamas.org](http://www.iamas.org))

### **International Association of Cryospheric Sciences (IACS)**

IACS promotes all scientific aspects related to the cryosphere and actively supports the transfer of knowledge. A variety of local-scale hazard types are due to cryospheric components and their ongoing changes: snow avalanches, ice avalanches, development of glacier lakes due to ice shrinkage and the high risk of their outbursts (GLOFs) (all three can be triggered by earthquakes and can, thus, reach regional scale impact), floods due to extreme melt-water peaks, mudflows and rock avalanches due to permafrost degradation and volcano–ice interactions. They all provide considerable risk for down-valley settlements and infrastructure. Land ice melt is one of the governing drivers for sea-level rise and ice-stream dynamics are the key for understanding the instability of the Greenland and the West Antarctic ice sheets. IACS faces the respective scientific challenges and provides respective organisational support by running, among five Divisions, its Divisions I, ‘Snow and Avalanches’, and II ‘Glaciers and Ice Sheets’, by hosting the Working Group on ‘Glacier and Permafrost Hazards in Mountains’ (GAPHAZ) jointly with the International Permafrost Association (IPA) and by hosting the World Glacier Monitoring Service that collects and compiles worldwide data of glacier mass changes that provide the basis for determining the respective impact on sea level. An Inter-Association Commission on ‘Volcano–Ice Interactions’ is in formation, jointly with IAVCEI. ([www.cryosphericsscience.org](http://www.cryosphericsscience.org))

### **Commission on Geophysical Risk and Sustainability (GeoRisk)**

GeoRisk was established by the IUGG Bureau in August 2000 to study the interaction between hazards, their likelihood and their wider social consequences as a result of the vulnerability of societies. It is maintained by all seven IUGG Associations. Projects include a series of symposia (four to date) on geohazards, risks and sustainable development in cities, intended both to explore scientific issues and to raise awareness among policy-makers; and production of a ‘Webcyclopedia’ of urban risk and sustainability giving information ordered by city, hazard and risk. Participants in a NATO Advanced Workshop in June 2002 organised jointly by GeoRisk and Euroscience agreed the Budapest Manifesto, which stressed the need for scientists to work with local communities in evaluating risk from natural hazards and ways to respond to risk. These principles were included in the research agenda for the Hazards theme of the International Year of Planet Earth (see below). ([www.iugg-georisk.org](http://www.iugg-georisk.org))

### **International Union of Geological Sciences (IUGS)**

IUGS promotes the development of the earth sciences through support of broad-based scientific studies relevant to the entire earth system, and applies the results of these and other studies to preserving the Earth’s natural environment, using natural resources wisely and improving the prosperity of nations and the quality of life. Through a number of affiliated organizations (International Associations of Engineering Geology, Hydrogeology, Permafrost, etc.), IUGS is engaged in the investigation of both endogenous (earthquakes, volcanoes) and exogenous (landslides, collapses, rockfalls, earth subsidence, karst, mudflows, erosion, permafrost) geological hazards through the study of development mechanisms, distribution regularities and mapping of these processes. IUGS and UNESCO collaborate as partners in the International Consortium on Landslides (ICL, see below), the International Geoscience Programme (IGCP), IGOS (see below), the Scientific Committee on the Lithosphere/International Lithosphere Programme (SCL/ILP, see above) and the GeoIndicators Initiative. Several IUGS Affiliated Organisations also have interests relevant to hazards issues.

([www.iugs.org](http://www.iugs.org))

The Presidents of the five Geo-Unions of ICSU – IUGG, IUGS, IUSS, IGU and ISPRS – collaborate on a number of issues, including natural hazards. The GeoUnions Science Initiative in this area has been working closely with the International Year of the Planet Earth team to develop key research questions (see below).

### **International Year of the Planet Earth (IYPE)**

The United Nations General Assembly declared 2008 as the International Year of Planet Earth, and a sequence of activities for IYPE are being planned and promoted by IUGS, IGU, ILP, INQUA, IUGG, IUSS, UNESCO and others to run 2007-2009. With the subtitle Earth sciences for society, IYPE sponsors multidisciplinary international research within a number of society-relevant, broadly based themes, and raises awareness among decision-makers and the public of the importance of earth sciences to society at large. One of the themes is Hazards – minimizing risk, maximizing awareness, under which four broad, overlapping research questions have been identified:

- How have humans altered the geosphere, the biosphere and the landscape, thereby promoting and/or triggering certain hazards and increasing societal vulnerability to geohazards?
- What technologies and methodologies are required to assess the vulnerability of people and places to hazards and how might these be used at a variety of spatial scales?
- How does our current ability to monitor, predict and mitigate vary from one geohazard to another? What methodologies and new technologies can improve such capabilities, and so help civil protection locally and globally?
- What are the barriers, for each geohazard, that prevent governments (and other entities) from using risk and vulnerability information to create policies and plans to reduce both?

The IYPE Science Plan envisages a major international conference on Natural and Human Induced Environmental Hazards and Disasters in 2008 under the auspices of ICSU, IYPE and UN-ISDR to explore the linkages between the key research questions of IYPE, the priorities of the Hyogo Framework for Action, and the science themes of this new Research Programme. ([www.esfs.org](http://www.esfs.org))

### **International Union for Quaternary Research (INQUA)**

INQUA seeks to improve understanding of environmental change during the Quaternary (the past 2.6 million years), the most recent period of Earth history. The Union’s mission is to promote improved communication and international collaboration in basic and applied aspects of Quaternary research. It achieves its goals mainly through the activities of five commissions. With regard to natural hazards and risk, research supported by the Palaeoclimate Commission (PALCOMM) plays a key role in helping evaluate the possible future course of climate change on our planet. Several of the projects of the Terrestrial Processes and Deposits (TERPRO) Commission are concerned directly with natural hazards and risk, for example the ‘Dark Nature’ Project, which examined the impacts of natural disasters on society, and the ‘INQUA Scale’ Project, which developed a novel earthquake macrointensity scale based on identifiable effects of earthquakes on

the natural environment.

In addition to its own research activities, INQUA actively collaborates with other organizations and programmes, including for example, the International Glaciological Union, the Past Global Changes (PAGES) programme of the International Geosphere-Biosphere Programme (IGBP), and the International Geoscience Programme (IGCP). INQUA is also a partner in the IYPE programme and provides financial support. It works with the other ICSU geo-unions (IGU, ISPRS, IUGG, IUGS and IUSS) on natural hazards and other issues of common interest. ([www.inqua.nlh.no](http://www.inqua.nlh.no))

#### **Scientific Committee on Antarctic Research (SCAR)**

SCAR is an inter-disciplinary committee of ICSU charged with the initiation, development and coordination of high-quality international scientific research in the Antarctic region, and on the role of the Antarctic region in the Earth system. It has an important function to provide scientific advice to the Antarctic Treaty System.

The main interest SCAR has in natural hazards and disasters concerns: (i) the likelihood of rapid climate change and its effects on the Greenland and or West Antarctic Ice Sheets ice sheets, and thence on sea-level; and (ii) the likelihood of gradual climate change leading to a tipping point at which the disintegration of those ice sheets becomes rapid and extensive. Either scenario may produce a rise in sea-level of one to several metres; even if the process were gradual it would constitute a major natural disaster for coastal populations. ([www.scar.org](http://www.scar.org))

#### **Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)**

As one of ICSU's Interdisciplinary Bodies, SCOSTEP has organized and conducted international solar-terrestrial research programmes for over three decades. In recent years its main research programmes have been focused on space weather. SCOSTEP currently sponsors the Climate and Weather of the Sun–Earth System (CAWSES) programme, an international initiative established in 2004 with the aim of significantly enhancing understanding of the space environment and its impacts on life and society. The main functions of CAWSES are to coordinate international activities in observations, modelling and applications crucial to achieving this understanding, to involve scientists in both developed and developing countries, and to provide educational opportunities for students at all levels. CAWSES is the main ICSU programme dealing with space weather research and application. ([www.scostep.ucar.edu](http://www.scostep.ucar.edu)) ([www.bu.edu/cawses](http://www.bu.edu/cawses))

#### **International Union of Radio Science (URSI)**

The objective of URSI is to stimulate and co-ordinate, on an international basis, studies and research, applications, scientific exchange and communication in the fields of radio, telecommunication and electronic sciences.

URSI has ten scientific Commissions organized to advance research, applications and exchange of information in various fields of radio science. One such is devoted to Waves in Plasmas, and has, as one of its goals, encouragement of the application of studies of waves in plasmas, particularly to solar/planetary plasma interactions, space weather, and the exploitation of space as a research laboratory. ([www.ursi.org](http://www.ursi.org))

## **2 ICSU Regional Offices**

### **ICSU Regional Office for Asia and the Pacific (ICSU ROAP)**

The inaugural conference for ICSU ROAP held in Kuala Lumpur on 18-19 September 2006 was devoted to Natural and Human-induced Environmental Hazards and Disasters, which had been identified as the principal priority of the Regional Office. An ICSU Asia-Pacific Strategic Planning Group on Hazards and Disasters (STRAPGHAD) has been established to help plan a regional programme, whose focus will be on geophysical and hydrometeorological hazards. Access to data has been identified as an issue, as has the need for a regional inventory. One role of the regional programme could be to link and integrate ICSU-related programmes (such as IYPE). Two Science Plans on Hazards and Disasters have so far been prepared, reflecting identified priorities: one deals with Earthquakes, Floods and Landslides, a second is devoted to the Special Vulnerability of Islands.

([www.icsu-asia-pacific.org](http://www.icsu-asia-pacific.org))

### **ICSU Regional Office for Africa (ICSU ROA)**

A Second Regional Consultative Forum hosted by Regional Office in Johannesburg on 25-27 September 2006 examined a draft plan on Natural and Human-induced hazards and disasters in Sub-Saharan Africa – one of four priority actions of the Regional Office – prepared by a regional planning group set up for the purpose. The implementation of the ICSU ROA science plan on hazards and disasters was subsequently launched at the International Workshop on Natural and Human-Induced Hazards and Disasters in Africa (Kampala, Uganda, 21-22 July 2007). Two major projects were retained at the Kampala workshop, namely: (i) Project HD1. Geohazards in Africa and linkage with the International Year of Planet Earth (IYPE); and (ii) Project HD2. Hydro-meteorological Hazards in Africa: Vulnerability and Resilience. ([www.icsu-africa.org](http://www.icsu-africa.org))

### **ICSU Regional Office for Latin America and the Caribbean (ICSU ROLAC)**

The ICSU Regional Committee for Latin America and the Caribbean, meeting in October 2006, decided that Hazards and natural disasters would be one of four priorities for the newly founded Regional Office in Rio de Janeiro, Brazil. A Scientific Planning Group in Natural Disasters (SPGND) was formed, and at its second meeting in Montevideo (March 2008) SPGND presented recommendations and proposals on key scientific aspects that need to be addressed in establishing a science plan in prevention and mitigation of risks and disasters in the region. ([www.icsu-lac.org](http://www.icsu-lac.org))

## **3 World Climate Research Programme (WCRP)**

The WCRP established by ICSU and WMO (also sponsored by the IOC of UNESCO) aims to develop the fundamental scientific understanding of the physical climate system and climate processes needed to determine to what extent climate can be predicted and the extent of human influence on climate. WCRP studies are specifically directed to provide scientifically founded quantitative answers to the questions being raised on climate and the range of natural climate variability, as well as to establish the basis for predictions of global and regional climatic variations and of changes in the frequency and severity of extreme events.

The **Global Energy and Water Cycle Experiment (GEWEX)** is the scientific focus in WCRP for studies of atmospheric and thermodynamic processes that determine the Global hydrological cycle and water budget and their adjustment to global changes such as the increase in greenhouse gases. One



of the programmes within this is GEWEX–WISE (World Integrated Study of Extremes <http://www.meteo.mcgill.ca/wise>) to understand and model the occurrence, evolution and role of extremes within the climate system and to contribute to their better prediction that is initially focusing on droughts and extended wet periods. ([www.wmo.int](http://www.wmo.int))

## 4 Earth observation initiatives

ICSU is actively involved in a series of interlocking initiatives addressing various aspects of Earth observation. The overall objective relates to the global agenda for sustainable development and sound environmental management but, within this, there is a specific focus on natural hazards.

Since the early 1990s, ICSU and others have been co-sponsoring systematic observing programmes for the oceans (Global Ocean Observing System, GOOS [1991]), the climate (Global Climate Observing System, GCOS [1992]), the land (Global Terrestrial Observing System, GTOS [1996]), and the Earth's shape, gravity field and rotational motion (Global Geodetic Observing System, GGOS [2003]).

([www.ioc-goos.org](http://www.ioc-goos.org)) ([www.wmo.ch/web/gcos/gcoshome.html](http://www.wmo.ch/web/gcos/gcoshome.html)) ([www.fao.org/gtos](http://www.fao.org/gtos))

GCOS, GOOS, GTOS and GGOS, together with ICSU itself and other organizations, are partners in the Integrated Global Observing Strategy (IGOS), established in 1998. The role of IGOS is to address strategic issues across all the main observing systems and to guide their priority-setting. IGOS has defined a number of themes to facilitate the coherent definition and development of an overall strategy for observing selected fields of common interest among IGOS Partners. One of the ten themes established so far is Geohazards, 'to respond to the scientific and operational geospatial information needs for the prediction and monitoring of geophysical hazards, namely earthquakes, volcanoes and land instability'. The GeoHazards Theme was scoped in 2001, and a preliminary prospectus published in April 2004. The Theme established its own funded secretariat in late 2004 and has its own website ([igosg.brgm.fr](http://igosg.brgm.fr)). The overall aim is to bring together active practitioners from a range of geohazard disciplines and techniques in order to stimulate collaboration and identify priorities for earth observation. IGOS GeoHazards sees its main target audiences as responsible civil authorities, scientists in monitoring and advisory agencies, and research scientists. It has undertaken two tasks: developing a GeoHazData system to provide a metadata editor for, and a global inventory of, hazard maps; and GeoHazNet designed as a Community of Practice to bring together key researchers and data users. ([www.igospartners.org](http://www.igospartners.org))

The Group on Earth Observations (GEO) is an inter-governmental initiative, the planning of which was launched in July 2003 in response to the WSSD commitment to develop comprehensive, coordinated and sustained Earth observation. At the 3rd Earth Observation Summit in February 2005, a 10-year implementation plan (starting January 2006) for the Global Earth Observation System of Systems (GEOSS) was approved. It defines nine societal benefits, of which the first is 'Reducing loss of life and property from natural and human-induced disasters'. Its overarching vision for disasters is 'to further enhance coordination among operational observing systems with global coverage. These need to be capable of supporting effective disaster warnings, responses and recovery...collaborative framework to permit free exchange and efficient use of data, together with support for continuity of operations for all essential systems.' The plan sets out activities on 2-, 6- and 10-year timeframes for each of the defined benefits. ([www.noaa.gov/eos.html](http://www.noaa.gov/eos.html))

## 5 The United Nations system

### International Strategy for Disaster Reduction (ISDR)

ISDR was established within the UN Office for the Coordination of Humanitarian Affairs as the successor initiative to IDNDR. Its four primary functions are: policy and strategy; advocacy; information and networks; and partnerships for applications. Its policy framework was set by the Yokohama Strategy and by the 'Geneva statement': A Safer World in the 21st Century: Risk and Disaster Reduction, emanating from the final IDNDR forum in July 1999. One of the overarching themes of the framework is to locate the goal of reducing vulnerability to natural disasters within the context of sustainable development strategies. The central task of ISDR is to coordinate the global implementation of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters adopted at the World Conference on Disaster Reduction in Kobe, Japan, working with a range of international bodies, Member States and other stakeholders.

#### *Global Platform for Disaster Risk Reduction*

The Global Platform for Disaster Risk Reduction represents a major new impetus in the pursuit of the aims and objectives of the Hyogo Framework, and its establishment took place at an inaugural conference hosted by ISDR on 5-7 June 2007 in Geneva. The Platform provides a forum for devising strategies and policies to reduce disaster risk, monitoring progress, and identifying gaps in policies and programmes and recommending remedial action. It also aims at ensuring complementarity of action at all levels of implementation through increased cooperation and coordination. The Platform will build on and expand the membership of the Inter-Agency Task Force on Disaster Reduction; hereon participation will be open to Member States. An extensive consultative process has been launched by ISDR to consider practical ways of strengthening the ISDR system, with a background document available on its website. ([www.unisdr.org](http://www.unisdr.org))

#### *World Bank Global Facility for Disaster Reduction and Recovery (GFDRR)*

Approved by the World Bank Board in 2006, the GFDRR is a partnership that recognizes disaster reduction as a critical dimension of the global poverty reduction agenda. This is an operation essentially supporting the ISDR in the implementation of the Hyogo Plan of Action, organized on a three-track basis in order to achieve its global objectives at the global, regional and country levels.

Track 1: Support to ISDR's global and regional processes to enable leveraging of country resources for ex-ante investment in prevention, mitigation and preparedness activities, particularly in low- and middle-income countries. Includes regional and subregional initiatives in benchmarking of risks and resilience, regional/subregional EW strategies, promoting/strengthening partnerships in DRR, particularly with universities, scientific and technological institutions, the private sector, research organizations and professional bodies; establishing a virtual clearinghouse for DRR. Standardizing hazard risk management tools, methodologies and practices; reporting on good practices in DRR, developing country-owned and country-driven risk assessment methodologies, country-based damage and needs assessment techniques. US\$ 5 million available per year.

Track 2: Provision of technical assistance to low- and middle-income countries to mainstream DRR in strategic planning, esp. Poverty reduction Strategies. Grants totalling US\$350 million (US\$4 million per country).

Track 3: Accelerated Disaster Recovery in Low-Income Countries – to meet immediate needs (but on condition that pre-disaster preparedness instruments

(Track 2) have been put in place.

([www.unisdr.org/eng/partner-netw/wb-isdr/wb-isdr.htm](http://www.unisdr.org/eng/partner-netw/wb-isdr/wb-isdr.htm))

#### *GFDRR/ISDR Global Partnership with Universities, Academic Institutions, Research Organizations*

An initiative that seeks to create a 'network of networks' to provide a platform for sustained cooperation in research, innovation and education as a means of meeting the overarching goals of the Hyogo Framework for Action: effective integration of disaster risk considerations into sustainable development policies, planning and programming; and strengthening institutions, mechanisms and capacities at all levels.

Universities and research centres were present at the first meeting in Geneva in December 2006.

#### **United Nations Environment Programme (UNEP)**

UNEP has a strong focus on the interplay between environmental issues and natural disasters. In its various initiatives responding to the Indian Ocean tsunami, for example, it has stressed the need to respect environmental requirements during reconstruction and has documented the role of mangroves and coral reefs in protecting some parts of Sri Lanka from the worst effects of the tsunami. It is surveying the environmental consequences throughout the affected region and offering practical assistance in the reconstruction efforts.

More generally, UNEP is active in assessing the impact of deforestation and other practices on vulnerability to natural disasters. Its Global Environment Outlook project, initiated in response to Agenda 21, has delivered systematic scientific assessments of vulnerability to natural disasters for many regions of the world.

UNEP, the UN Office for the Coordination of Humanitarian Affairs and the Global Fire Monitoring Center are mandated to coordinate action to combat large international forest fire emergencies. The GFMC, established at Freiburg in 1998, monitors, forecasts and archives information on vegetation fires at global level. It is a designated activity of ISDR, facilitates the ISDR Global Wildland Fire Network and serves as Secretariat of the ISDR Wildland Fire Advisory Group. ([www.gfmc.org](http://www.gfmc.org))

UNEP has established a finance initiative to work with a range of financial institutions throughout the world on interactions between environmental and financial performance. This includes detailed assessment of the financial aspects of natural disasters. ([www.unep.org](http://www.unep.org))

#### **UNESCO**

UNESCO has in place scientific and engineering programmes in earth, water, ecological and oceanographic sciences that contribute to the study and mitigation of natural hazards. It works to provide intergovernmental coordination and policy support in the establishment and operation of monitoring networks and early warning and risk mitigation systems for natural hazards, with particular emphasis on earthquakes, tsunamis, floods and landslides. It also promotes multi-stakeholder strategies for enhancing disaster education and awareness as an intrinsic part of the UN Decade on Education for Sustainable Development (led by UNESCO), especially in communities at risk located in Africa, LDCs and SIDS. As an active promoter of the Cluster/Platform on Knowledge and Education, UNESCO contributes to the achievements of the ISDR Joint Work Plan relative to Priority 3 of the Hyogo Framework for Action.

UNESCO supports regional partnerships and networks devoted to the collection and dissemination of relevant information and knowledge on hazards, vulnerabilities and risk mitigation capacities. Attention is paid to gender-sensitive and socio-culturally relevant approaches and to the promotion of local and indigenous practices for risk reduction, the use of formal and informal channels to mobilize and sensitize community leaders, women, youth and children, and to the dissemination of guidelines for the protection of schools and cultural heritage at risk.

UNESCO is involved in numerous collaborative initiatives related to aspects of hazards such as: the International Consortium on Landslides; an International Flood Initiative (IFI) to be located at a new International Centre for Water Hazard and Risk Management at Tsukuba, Japan (with WMO, the UN University, ISDR and IAHS – see below); IYPE; and a coalition on education to integrate disaster reduction education into school programmes and to make school buildings safer.

Through its **Intergovernmental Oceanographic Commission (IOC)**, UNESCO promotes the concept of 'end-to-end' tsunami warning systems, in cooperation with ISDR, WMO, in the Indian and Pacific Oceans, as well as expanding early warning systems to Africa, the South Pacific, the Mediterranean, NE Atlantic and the Caribbean. Emphasis is given to mitigation, educational recovery, restoring biological and cultural diversity, and integrated water management. ([www.unesco.org](http://www.unesco.org))

#### *International Centre for Water Hazard and Risk Management (ICHARM)*

ICHARM is a UNESCO water centre within IHP and is serving as a centre of excellence to develop and help implement best practicable strategies for the globe, regions, nations and localities for reducing water-related disaster risks, especially in the first-phase, flood-related disasters. It is serving as the secretariat of International Flood Initiative (IFI), and has assumed responsibility for the risk management chapter of the *World Water Development Report*. It is engaged in research, training and information networking. Research and development of flood alert system, community flood defence, future flood risk assessment, flood preparedness indices are some on-going activities. It has an academic flood master course offered for practitioners in developing countries.

([www.icharm.pwri.go.jp](http://www.icharm.pwri.go.jp))

#### **World Meteorological Organization (WMO)**

##### *WMO Natural Disaster Prevention and Mitigation Programme*

Through the coordinated network of National Meteorological and Hydrological Services (NMHSs) of its 188 Member States, WHO contributes to different stages of disaster risk reduction, including prevention, preparedness, response and recovery and reconstruction, through research, monitoring, detecting, analysing, forecasting, and the development and issuance of warnings for weather-, water- and climate-related hazards (source of nearly 90% of disasters caused by natural hazards).

The Natural Disaster Prevention and Mitigation (DPM) Programme, established in 2003, has conducted detailed country-level and regional-level surveys to map scientific and technical capacities, requirements and opportunities in support of disaster risk reduction at national and regional levels. Through an organization-wide coordinating framework building on the activities of its 10 WMO scientific and technical programmes, eight technical commissions, NMHSs of its Member States and strategic partnerships with other agencies, WMO is working to assist its Members towards the protection of lives, livelihoods and property. The strategic priorities of WMO for disaster risk reduction are: (i) early warning systems; (ii) hazard information and analysis for risk assessment and informed

decision-making; (iii) capacity development and training programmes; (iv) better integration of NMHS products and services in disaster risk reduction structures, planning and operations; and (v) public outreach programmes.

As a partner in the ISDR System, WMO is working with other agencies such as UNESCO, UNDP, IFRC, the World Bank, OCHA and UNOSAT towards development of activities to provide coherent and coordinated assistance to its Member States for strengthening their capacities in disaster risk reduction and implementation of the Hyogo Framework for Action 2005-2015. ([www.wmo.ch/disasters](http://www.wmo.ch/disasters))

#### **THORPEX**

THORPEX is a ten-year international global atmospheric research and development programme that is a component of the WMO World Weather Research Programme. THORPEX aims to reduce and mitigate natural disasters by transforming timely and accurate weather forecasts into specific and definite information in support of decisions that produce the desired societal and economic outcomes by:

1. Extending the range of skilful weather forecasts to timescales of value in decision-making (up to 14 days) using probabilistic ensemble forecast techniques.
2. Developing accurate and timely weather warnings in a form that can be readily used in decision-making support tools.
3. Assessing the impact of weather forecasts and associated outcomes on the development of mitigation strategies to minimize the impact of natural hazards.

([www.wmo.ch/thorpex](http://www.wmo.ch/thorpex))

#### **Inter-governmental Panel on Climate Change (IPCC)**

In 1988, WMO and the United Nations Environment Programme (UNEP) established the IPCC with the goal of assessing both available scientific information on climate change, and its environmental and socio-economic impacts. The Third Assessment Report of IPCC in 2001 concluded that the duration, location, frequency and intensity of extreme events are likely to change, with more hot days and heat waves and fewer cold and frost days over nearly all land areas, and increases in the amplitude and frequency of extreme precipitation events over many areas. IPCC is currently finalizing its Fourth Assessment Report 'Climate Change 2007' which will be released in 2007. The reports by the three Working Groups provide a comprehensive and up-to-date assessment of the current state of knowledge on climate change. The Synthesis Report integrates the information around six topic areas. ([www.ipcc.ch](http://www.ipcc.ch))

#### **Food and Agriculture Organization (FAO)**

Through its Global Information and Early Warning System (GIEWS) FAO keeps the world food supply/demand situation under continuous review, is able to issue reports on the world food situation (publications include: Food Outlook, Crop Prospects and Food Situation), and provide early warnings of impending food crises in individual countries, including those provoked by natural hazards. GIEWS uses many sources of information on weather and other natural conditions for agriculture, as well as on economic, social and political factors. Sources include meteorological information, agencies operating satellites for earth observation, news services such as Reuters, Associated Press, other news organizations, information from national institutions available through publications or web sites, various reports and studies.

For countries facing a serious food emergency, FAO/GIEWS and the World Food Programme also carry out joint Crop and Food Supply Assessment Missions (CFSAMs). Their purpose is to provide timely and reliable information so that appropriate actions can be taken by the governments, the international community, and other parties. ([www.fao.org/giews](http://www.fao.org/giews))

#### **United Nations University (UNU)**

The United Nations University's Institute for Environment and Human Security (UNU-EHS) in Bonn, Germany, explores threats to human security arising from natural and human-induced hazards. The Institute carries out research, capacity building and policy-relevant advisory activities relating to the broad interdisciplinary field of 'risk and vulnerability'.

The research and training activities of UNU-EHS in its initial 2004-2005 biennium focussed on flood plains, deltas and coastal zones, with emphasis on urban agglomerations. Drought and its impact on rural communities have been an added priority from 2006 onwards. With GFMC joining UNU-EHS as an associate Institute in 2005 the global wildland fire problem is being addressed cooperatively.

UNU-EHS is a partner in the inter-agency initiative, the International Flood Initiative (IFI), with UNESCO, WMO, UN-ISDR and the International Association of Hydrological Science. Launched on the occasion of the Kobe Conference in January 2005, the initiative aims at minimizing loss of life and reducing damage caused by floods. ([www.ehs.unu.edu](http://www.ehs.unu.edu))

#### **United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER)**

UN-SPIDER is a new United Nations programme that seeks to: «ensure that all countries have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle». Whereas there have been a number of initiatives in recent years that have contributed to making space technologies available for humanitarian and emergency response, UN-SPIDER is the first to focus on the need to ensure access to and use of such solutions during all phases of the disaster, including the risk reduction phase which will significantly contribute to an increasing reduction in loss of lives and property.

The new programme achieves this by focusing on being a gateway to space information for disaster management support, serving as a bridge to connect the disaster management and space communities and being a facilitator of capacity-building and institutional strengthening, in particular for developing countries.

UN-SPIDER is being implemented by the United Nations Office for Outer Space Affairs (UNOOSA) as an open network of providers of space-based solutions to support disaster management activities. Besides Vienna (where UNOOSA is located), the programme will also have offices in Beijing, China and Bonn, Germany.

The UN-SPIDER programme will, within its outreach activities, ensure the participation of expert speakers in relevant conferences and meetings, provide support to regional and international seminars and workshops and organize its own workshops and expert meetings. It maintains a Calendar of Events with upcoming conferences, meetings and events relevant to the area of space-based solutions for disaster management and emergency response, and issues an on-line UN SPIDER Newsletter. ([www.unoosa.org/oosa/unspider/index.html](http://www.unoosa.org/oosa/unspider/index.html))

## 6 Other major international initiatives

### European Union (EU)

The overall aim of EU research policy is to promote scientific excellence and innovation to advance knowledge and understanding, and to support the implementation of related European policies.

The European Commission (EC) has been supporting research related to natural hazards and disasters since the late 1980s through its successive Framework Programmes (FP) for Research and Technological Development.

In the present FP7 programme, different specific programmes are addressing, through yearly calls for research proposals (see web links), focused and/or complementary topics related to natural hazards research issues.

In summary, multinational and interdisciplinary research is focusing in an integrated framework on the assessment of «hazards, vulnerability and risks» of geological and climate-related hazards including their socio-economic components. Furthermore, research efforts are also focussing on the use of Earth observation (GEO, GMES) or on Information and Communication Technologies (ICT) in support of risk and crisis management. Further initiatives are also being taken in the field of common infrastructures research.

Overall information on FP7: [http://cordis.europa.eu/fp7/home\\_en.html](http://cordis.europa.eu/fp7/home_en.html)

In FP7 , under 'Cooperation'

- Information and Communication Technologies (ICT): see <http://cordis.europa.eu/fp7/ict/>
- Environment (including climate change): see [http://cordis.europa.eu/fp7/environment/home\\_en.html](http://cordis.europa.eu/fp7/environment/home_en.html)
- Space (Global monitoring for environment and security-GMES aspects): see [http://cordis.europa.eu/fp7/cooperation/space\\_en.html](http://cordis.europa.eu/fp7/cooperation/space_en.html)

In FP7 , under 'Facilities'

- Infrastructures: see [http://cordis.europa.eu/fp7/capacities/research-infrastructures\\_en.html](http://cordis.europa.eu/fp7/capacities/research-infrastructures_en.html)

### ProVention Consortium

Launched in February 2000 to reduce disaster risk in developing countries and to make disaster prevention and mitigation an integral part of development efforts, ProVention is a global coalition of governments, IGOs, academic institutions, private sector and civil society organizations. It works closely with World Bank Hazard Risk Management operation, and functions as a network to share knowledge and connect and leverage resources aimed at reducing disaster risk.

ProVention is currently hosted by the International Federation of Red Cross and Red Crescent Societies, an international humanitarian organisation headquartered in Geneva. The International Federation, as Host Organisation, undertakes the management of the Secretariat and responsible for administering ProVention project funds.

#### *Advisory Committee*

To oversee and support the Secretariat by providing ongoing guidance and advice on major strategic, policy and organisational decisions, the governance structure includes an Advisory Committee, comprised of representatives of the founding organisation, host organisation, donors and nominated Consortium partners. The Advisory Committee gives strategic advice and direction to the Secretariat, overseeing the implementation of the work programme and approving the annual budget. The Advisory Committee and Secretariat solicit expert technical advice from independent project reviewers to ensure high quality technical appraisal of ProVention project activities and accountability in project approval and decision making.

#### *ProVention Forum*

The critical dialogue and agenda setting that has taken place in the past during ProVention meetings has been broadened and expanded to include a wider range of ProVention partner organisations as part of an annual ProVention Forum. Through the Forum, ProVention seeks to enable broader participation, identify critical gaps in disaster risk management, and generate cutting-edge ideas and catalyse collaborative initiatives in order to help drive the global risk reduction agenda. The Forum dialogue directly informs the evolving ProVention work programme.

Since the creation of ProVention in February 2000, many organisations have been active partners in the Consortium, including international financial institutions (regional development banks and the World Bank), agencies of donor governments, international and regional organizations, universities and research centres, NGOs, networks and the private sector (insurance).

#### *ProVention's thematic priorities*

A set of five thematic priorities have been identified by ProVention as key areas of strategic focus where the Consortium can add most value. The strategic direction follows the original focus of ProVention and further develops the following core ProVention themes:

- Mainstreaming Risk Reduction
- Risk Analysis & Application
- Reducing Risks in Recovery
- Risk Transfer & Private Sector Investment
- Expanding Risk Research & Learning.

([www.proventionconsortium.org](http://www.proventionconsortium.org))

### Global Risk Identification Programme (GRIP)

The goal of GRIP is reduced natural hazard-related losses in high risk areas to promote sustainable development. Its objectives are an improved evidence base for disaster risk management and the increased adoption of disaster risk management as an alternative to over-reliance on emergency management at global, regional and national scales; the programme is being pursued by ProVention with UNDP support and WMO involvement. Following the Preparatory phase 2005-2006, a Programme Steering Committee being set up, composed of representatives of

international organizations and governments providing direction, guidance and advice to the Coordinating Team (UNDP and UNEP staff).

GRIP works with international and local expert institutions and authorities in various aspects of risk and loss assessment in five areas. Project activities will be phased in over five years, with an early emphasis on capacity development. ([www.gri-p.net](http://www.gri-p.net))

#### **International Institute for Applied Systems Analysis (IIASA)**

The IIASA Risk and Vulnerability (RAV) Programme conducts conceptual and applied analyses that contribute to decreasing the risk and vulnerability of societies and ecosystems, and to promote their adaptation and resilience to stresses imposed by global change phenomena. Its research is relevant mainly, but not exclusively, to developing countries.

- The specific goals of the Programme are to:
- advance the conceptual and methodological development of risk and vulnerability research;
- carry out selected risk and vulnerability assessments;
- undertake integrative stakeholder-led case studies; and
- develop interactive tools to provide training on vulnerability and adaptation.

Its Research Plan (2006-2010) is grouped into themes on Adaptation and Development, Governance and Fairness, and Water and Resilience.

([www.iiasa.ac.at/Research/RAV/index.html](http://www.iiasa.ac.at/Research/RAV/index.html))

#### **International Disaster and Risk Conference (IDRC), Davos**

IDRC is a global, technical and operational gathering of leading experts in the natural, social and engineering sciences, governments, private sector, civil society, IGOs, NGOs and risk management professionals. It seeks to be a bridge between practice, science, policy-making and decision-making in the search for sustainable solutions to the complex risks facing society today. Co-organized by ISDR, UNESCO, Global Alliance for Disaster Reduction and the Global Disaster Information Network, IDRC is hosted at the Swiss Federal Institute for Snow and Avalanche Research (SLF), Zurich.

The 2008 Davos Conference (25-28 August) will have as its theme: 'Public-private partnership – key for integral risk management and climate change adaptation'. ([www.idrc.info](http://www.idrc.info))

#### **Organization for Economic Cooperation and Development (OECD)**

The OECD's Global Science Forum initiated in 2008 a project to develop a global, open-source earthquake model that will generate information of the highest standard through cooperation between many of the world's top earthquake experts. The project was conceived in the form of a public-private partnership, and will develop a global scientific network of specialists to be coordinated by the Swiss Seismological Service at the Swiss Federal Institute of Technology in Zurich, the Geo Research Centre in Potsdam, and the US Geological Survey. Munich Re is supporting the development of an expert model that in its initial stage will adopt a uniform approach towards representing earthquake risk worldwide and include regions which previous approaches virtually ignored or failed to observe in sufficient detail. ([www.oecd.org](http://www.oecd.org))

#### **Global Alliance for Disaster Reduction (GADR)**

GADR is based at the University of North Carolina Charlotte, and is an association of more than 1000 experts on disaster reduction and related aspects of sustainable development, representing regional, national and international organizations and institutions, among which are the United Nations, the World Bank, national and regional environmental and disaster mitigation agencies, institutes and relief organizations.

The general objectives of GADR are to:

- Mobilize intellectual and material resources to address several issues that will enable businesses and public agencies to mitigate the impacts of natural and technological hazards.
- Serve as a catalyst for ongoing national and international projects by providing opportunities for expansion of technical and political capacity, building of multinational networks, convening of forums and conferences, and capacity enhancements for centres of excellence to implement programmes to reduce the impacts of disasters.
- Bring about major shifts in disaster control from disaster impact focus to disaster prevention in all disciplines, national and regional infrastructure plans, and educational programmes.

([www.gadr.giees.uncc.edu](http://www.gadr.giees.uncc.edu))

#### **Global Disaster Information Network (GDIN)**

GDIN is a voluntary, independent, self-sustaining, non-profit association of nations, organizations, and professionals from all sectors of society, including NGOs, industry, academia, governments and international organizations, with an interest in sharing disaster information. ([www.gdin.org](http://www.gdin.org))

#### **Pacific Science Association (PSA)**

The PSA, a regional, non-governmental organization that seeks to advance science and technology in support of sustainable development in the Asia-Pacific, is establishing a task force on natural disaster reduction. ([www.pacificscience.org](http://www.pacificscience.org))

#### **EARLY Warning Conferences**

ISDR, in collaboration with Germany, has been organizing International Conferences on Early Warning. The third conference in March 2006, addressed different hazards associated water, air and earth; mega events in early warning; multi-hazard approaches; and people, politics, and economics of early warning.

([www.ewc3.org](http://www.ewc3.org))

#### **Centre for Research on the Epidemiology of Disasters (CRED)**

CRED, based at the Université de Louvain, promotes research, training, and information dissemination on disasters, with a special focus on public health, epidemiology, structural and socio-economic aspects. It aims to enhance the effectiveness of developing countries' disaster management capabilities as well as fostering policy-oriented research.

CRED's goals are:

- to promote research and provide information to the international community that ensures sufficient preparedness and improved responses to disasters and populations in danger;
- to train field managers, relief officers, doctors and health professionals in the management of short and long-term disaster situations;
- to introduce emergency preparedness and response in development programmes of disaster-prone countries; and
- to develop autonomy of developing countries to improve their own preparedness for and response capacities for emergencies and critical situations.

([www.cred.be](http://www.cred.be))

#### **International Consortium on Landslides (ICL)**

The International Consortium on Landslides, created at the Kyoto Symposium in January 2002, is an international non-governmental and non-profit scientific organization, supported by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Meteorological Organization (WMO), the Food and Agriculture Organization of the United Nations (FAO), the United Nations International Strategy for Disaster Reduction (UN/ISDR), ICSU, the World Federation of Engineering Organizations (WFEO) and intergovernmental programmes such as the International Hydrological Programme of UNESCO; the Government of Japan; and other governmental bodies.

ICL objectives are:

- to promote landslide research for the benefit of society and the environment, and capacity building, including education, notably in developing countries;
- to integrate geosciences and technology within the appropriate cultural and social contexts in order to evaluate landslide risk in urban, rural and developing areas including cultural and natural heritage sites, as well as contribute to the protection of the natural environment and sites of high societal value;
- to combine and coordinate international expertise in landslide risk assessment and mitigation studies, thereby resulting in an effective international organization which will act as a partner in various international and national projects; and
- to promote a global, multidisciplinary programme on landslides.

ICL is organizing the first World Summit on Landslides in Tokyo, Japan in November 2008.

#### **International Programme on Landslides (IPL)**

IPL aims to conduct and foster international cooperative research and capacity building on landslide risk mitigation, notably in developing countries. Protection of cultural and natural heritage will be addressed for the benefit of society and the environment.

IPL Membership is made up of those organizations that support the objectives of ICL intellectually, practically and financially. The activities of IPL include the following:

- Fundamental research on landslides
- Global data base and landslide hazard assessment
- Landslide risk mitigation
- Cultural and societal application
- Capacity building, communication and information

([icl.dpri.kyoto-u.ac.jp](http://icl.dpri.kyoto-u.ac.jp))

#### **Insurance industry**

Several major international insurance companies have significant involvement in natural and human-induced environmental hazards and disasters, and invest heavily in risk assessment, analysis and resilience. Notable amongst these are Swiss Re, Munich Re and Lloyds of London all of whom regularly publish valuable news alerts, fact files, analyses or data on fatalities, injuries, loss of, and damage to buildings, infrastructure and property (both insured and uninsured).

([www.swissre.com](http://www.swissre.com)) ([www.munichre.com](http://www.munichre.com)) ([www.lloyds.com](http://www.lloyds.com))



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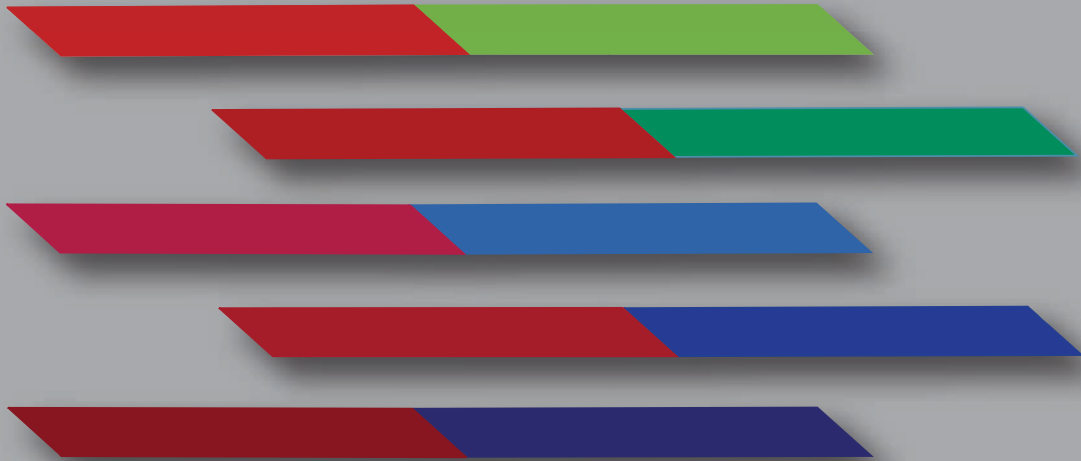
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# Integrated Research on Disaster Risk



## STRATEGIC PLAN 2013 - 2017



# About

IRDR (Integrated Research on Disaster Risk) is a decade-long research programme co-sponsored by the International Council for Science (ICSU), the International Social Science Council (ISSC), and the United Nations International Strategy for Disaster Reduction (UNISDR). It is a global, multi-disciplinary approach to dealing with the challenges brought by natural disasters, mitigating their impacts, and improving related policy-making mechanisms.

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### Global Impacts of Disasters

Over recent decades, our knowledge and understanding of natural hazards has grown dramatically. Far more is known today about the distribution of natural hazards and the location of high-exposure areas. Scientists can more accurately characterise the possible magnitude of hazard events and better estimate the probability of their occurrence at specific magnitudes. Forecasting capacity has also dramatically improved, especially for weather-related events. Far more is now known about the social dimensions of disasters, for instance, human exposure and vulnerability (and lack of resistance and resilience) to natural hazards and places where poverty and multiple stresses shape the character and distribution of losses.

So why is it that, despite this growth in knowledge, losses associated with environmental hazards have also risen at a seemingly exponential rate? The frequency of recorded disasters has been rising rapidly: 100 per decade during the period 1900-1940; 650 per decade in the 1960s; 2000 per decade in the 1980s (ICSU 2008); and reaching almost 4800 per decade in the 1990s to more than 7,200 in the 2000s (IFRC 2000, 2010). Hundreds of thousands of people are killed and millions injured, affected or displaced each year because of disasters, and the amount of property damage has been doubling about every seven years over the past 40 years (ICSU 2008, pg. 9), with dramatic increases seen in the 2000s. For instance, Japan's 2011 catastrophic earthquake, tsunami and nuclear event resulted in US\$210 billion in property losses; in 2005 Hurricane Katrina's impact on the United States resulted in US\$125 billion in losses; the 2008 Sichuan earthquake in China resulted in an overall US\$85 billion in losses; while Hurricane Sandy's effects on both the Caribbean and the United States in 2012 resulted in US\$50 billion in overall losses (Munich Re 2012).

The situation is particularly dramatic with regards to weather-related events, such as hurricanes, cyclones and other major storms, floods, landslides, wildfires and drought. In the 1990s, about three-quarters of all disasters were triggered by weather-related events. While death rates and numbers have dropped due to more extended and effective early-warning systems and preparedness plans, material and livelihood losses, as well as numbers of affected persons, have grown considerably. Since 1997, there has been a several-fold increase in weather-related economic losses (ICSU 2008, pg. 9).

### **Integrated Research on Disaster Risk (IRDR): addressing the challenge of natural and human-induced environmental hazards**

The International Council for Science (ICSU), in both its Priority Area Assessment on Environment and its Relation to Sustainable Development (2003) and Foresight Analysis (2004), identified natural and human-induced hazards as an important emerging field for research and a priority area for the Council.

In light of the above, the ICSU Executive Board appointed a Scoping Group to consider the establishment of a research programme on natural and human-induced environmental hazards. The Scoping Group reported to the ICSU 28th General Assembly that research was needed on how to translate research findings about natural hazards and human behaviour into policies that are effective in minimising the human and economic costs of hazards. The Group's recommendation, endorsed by the ICSU General Assembly, called for the development of a new programme that would be based on ongoing efforts in the geo- and biological sciences, and that also expands beyond these fields.

A multi-disciplinary Planning Group was convened and, after two years of consultations, its findings were presented at the ICSU's 29th General Assembly in October 2008. The ICSU membership unanimously decided that a new, major, interdisciplinary programme, entitled Integrated Research on Disaster Risk (IRDR), be established and that a Scientific Committee (SC) be set up for its governance. In November 2008 and May 2009 respectively, both the International Social Science Council (ISSC) and the United Nations International Strategy for Disaster Reduction (UNISDR) agreed to join the ICSU in co-sponsoring the IRDR programme.

IRDR is a decade-long international and interdisciplinary research programme created to address the major challenges of natural and human-induced environmental hazards. The complexity of the task is such that it requires the full integration of research expertise from the natural, socio-economic, health and engineering sciences, as well as policy-making coupled with an understanding of the role of communications, and public and political responses to reduce the risk.

Although the approaches in the sciences vary, the IRDR programme approaches the issues of natural and human-induced hazards and disasters from several perspectives: from the hazards to the disasters, and from the human exposures and vulnerabilities back to the hazards. This coordinated and

multi-dimensional approach takes the IRDR programme beyond approaches that have traditionally been undertaken.

Part of the IRDR's value is in filling the gaps and bringing together some of the as yet unconnected initiatives. The coupling of the natural sciences' examination of hazards with the socio-economic analysis of vulnerability and mechanisms for engaging policy decision-making processes is a major value added.

The main purposes of the programme are to:

- Characterise hazards, vulnerability, and risk by identifying hazards and vulnerability leading to risks, and forecasting, assessing, and dynamic modeling
- Understanding decision-making in complex and changing risk contexts by identifying decision-making systems, their contexts, and their interactions, and improving the quality of decision-making practice.
- Reducing risk and curbing losses through knowledge-based actions through vulnerability assessments, and the analysis of effective approaches to risk reduction.

IRDR addresses technological events, epidemics and other health-related events only where they are consequences of natural events.

### **Mission**

The IRDR mission is to develop trans-disciplinary, multi-sectorial alliances for in-depth, practical disaster risk reduction research studies, and the implementation of effective evidence-based disaster risk policies and practices.

### **Vision**

Guided by the ICSU's (2008, pg. 18) Science Plan for Integrated Research on Disaster Risk, the IRDR programme "envisages an integrated approach to natural and human-induced environmental hazards through a combination of natural, socio-economic, health and engineering sciences, including socio-economic analysis, understanding the role of communications, and public and political response to reduce the risk."

## Legacy

The legacy of the IRDR programme “would be an enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts. This would include a shift in focus from response–recovery towards prevention–mitigation strategies, and the building of resilience and reduction of risk, and learning from experience and avoidance of past mistakes” (ICSU 2008, pg. 18). Through this enhanced capacity and a shift in strategic approaches, in future, societies would become more resilient thus safer, benefitting from a reduction in related loss of life, with fewer people adversely impacted, and wiser investments and choices made by civil society, governments and businesses when natural events occur.

An important part of the legacy would be the repository of coordinated and integrated global data and information sets across hazards and disciplines that would be of continuing availability and value to communities at all levels, from local to global.

## Strategic Goals and Activities of the IRDR Programme, 2013-2017

The vision of the IRDR programme is being pursued through the principal goals and strategic activities proposed in the IRDR Science Plan (ICSU 2008) and in the IRDR Strategic Plan (2013-2017), as detailed in the table below. The successful implementation of these actions will depend on the support of the implementation of this plan and active collaboration, cooperation and partnership with organizations that have similar existing research activities, and policy- and decision-making processes.

Attainment of these goals will lead to a better understanding of hazards, vulnerability and risk; the enhanced capacity to model and project risk into the future; greater understanding of the decision-making choices that lead to risk and how they may be influenced; and how this knowledge can effectively lead to disaster risk reduction.

The overall global benefits of the IRDR programme are dependent on the recognition of the value of risk reduction activities, which are likely to come through evidence-based case studies and successful demonstration projects; assessments, data management and monitoring of hazards, risks and disasters; and capacity building, including mapping capacity for disaster risk reduction and building self-sustaining capacity at various levels for different hazards.

Goals	
1.	<p><b>Promote integrated research, advocacy and awareness-raising.</b>  <i>This goal is concerned with developing and promoting integration and collaboration within the disaster risk reduction community to avoid unnecessary duplication and to maximise research outcomes.</i></p>
1.1.	Promote original knowledge generation and transfer through integrated approaches in research, education and policy-making in the academic sector and in collaboration with public and private sectors and civil society organisations.
1.2.	Implement the Assessment of Integrated Research on Disaster Risk (AIRDR) project to provide a baseline of the current state of the science in integrated research on disaster risk to measure effectiveness of multiple programmes, use it to identify and support a



## Goals

long-term science agenda for the research community and funding entities, and to provide scientific evidentiary basis in support of policy and practice.

- 1.3. Advance capacity building for young scientists and future endeavours to develop international science leadership in the field of disaster risk reduction.
- 1.4. Ensure disaster risk reduction research programmes and policies are integrated across disciplines, and contribute to enhancing policy-making and capacity building for the effective reduction of disaster risk.

## 2. **Characterisation of hazards, vulnerability, and risk.**

*This goal looks at identifying hazards and vulnerability leading to risks from natural hazards on global, regional and local scales; the development of the capability to forecast hazard events and assess risks; and dynamic modeling of risk. It also addresses the gaps in knowledge, methodologies and types of information that are preventing the effective application of science to averting disasters and reducing risk.*

- 2.1 Develop and implement the Disaster Loss Data (DATA) project to identify what data and quality are needed to improve integrated disaster risk management by bringing together loss data stakeholders.
- 2.2 Integrate knowledge about the natural processes, incremental decisions, historically derived national and international structural and institutional forces, and social and cultural practices, beliefs and perceptions that shape the resilience and vulnerability of communities, in order to bring about a paradigm and cultural shift in the ways disasters and their underlying root causes are understood and risks managed.
- 2.3 Develop an understanding of how emerging communication and other technologies and the globalisation of the world economy influence resilience, vulnerability, risks and hazards.

## Goals

### 3. **Understanding decision-making in complex and changing risk contexts.**

*This goal focuses on understanding effective decision-making in the context of risk management – what it is and how it can be improved. It looks at identifying relevant decision-making systems and their interactions; understanding decision-making in the context of environmental hazards; and improving the quality of decision-making practices.*

- 3.1 Develop the Risk Interpretation and Action (RIA) project to promote the study of how and why people’s interpretations of the risks of various natural hazards relate to their actual choices and behaviour.
- 3.2 Understand decision-making processes and how these shape resilience and vulnerability and contribute to hazards becoming disasters and/or mitigate their effects.
- 3.3 Clarify the key concepts and theoretical assumptions concerning the processes underlying interpretation of risk and decision-making under uncertainty.
- 3.4 Promote better integration of social and behavioural sciences in disaster risk research, especially in regard to decision-making, and make such knowledge more accessible to a range of disciplines and to practitioners in the field of natural hazards.

### 4. **Reducing risk and curbing losses through knowledge-based actions.**

This goal brings together the outcomes of Goals 2 and 3. It will be accomplished through the implementation of vulnerability assessments and effective approaches to risk reduction.

- 4.1 Develop and implement the Forensic Disaster Investigations (FORIN) project to promote methodologies and case studies (10) globally to identify and address the root causes of disasters.
- 4.2 Identify and work with international organisations to develop and implement global standard indicators and other measures of disaster risk and the effectiveness of disaster risk reduction at national and regional levels.

## Goals

### 5. **Networking and network building.**

*This goal focuses on the development, strengthening of and collaboration within the IRDR network at global, regional and national levels.*

- 5.1 Ensure that the implementation of the IRDR programme is well integrated with co-sponsors' main programmes (ICSU, ISSC, UNISDR), to both benefit from their contribution and leverage their support to advance IRDR objectives, including, but not limited to, UNISDR's Global Assessment Report on Disaster Risk Reduction, ICSU's Future Earth and the ISSC's World Social Sciences Forum.
- 5.2 Strengthen and establish at least three IRDR Regional Committees (RCs) and National Committees (NCs) per year.
- 5.3 Strengthen and establish IRDR International Centres of Excellence (ICoE).
- 5.4 Support SC members and their bi-annual meetings, including the recruitment of new SC members.
- 5.5 Host and organise an IRDR conference every two years.

### 6. **Research Support**

*This goal focuses on enhancing the support for research and the utilisation of findings.*

- 6.1 Develop IRDR researchers and research institutions database to facilitate the promotion of interdisciplinary and policy-oriented science.
- 6.2 Facilitate the coordination of interdisciplinary science through the development and maintenance of an events calendar for IRDR-related and similar events.
- 6.3 To leverage political commitment from existing international mechanisms to ensure that integrated disaster risk reduction research programmes have access to priority funding from development as well as humanitarian, public and private funding sources.
- 6.4 Develop and strengthen the IRDR IPO and staff capacity and process, including enhancing IRDR communications and networking to facilitate information sharing and closer collaboration among IRDR partners.

## Implementation of the IRDR Programme

To support the above goals and objectives the IRDR will conduct this programme through the following implementation mechanisms.

### Research Working Groups

Ad hoc Working Groups that focus on different aspects of disaster risk reduction will assist the overall IRDR programme meet the above research, advocacy and networking objectives. The Working Groups bring together diverse disciplines and formulate new methods to address the shortcomings of current studies on natural hazards.

### **Assessment of Integrated Research on Disaster Risk (AIRDR) Working Group**

Assessment of Integrated Research on Disaster Risk (AIRDR) undertakes the first systematic and critical global assessment of research on disaster risk. The goals of AIRDR are to provide a baseline of the current state of the science in integrated research on disaster risk to measure the effectiveness of multiple programmes, use it to identify and support a longer-term science agenda for the research community and funding entities, and to provide scientific evidentiary basis in support of policy and practice.

### **Disaster Loss Data (DATA) Working Group**

The Disaster Loss Data (DATA) Working Group is meant to study issues related to the collection, storage, and dissemination of disaster loss data. The DATA Working Group has identified needs for:

- Education of users regarding data biases and issues of social loss data;
- Comparable and accessible human disaster loss data to support research and policy;
- Identification of existing loss database projects (from national to regional to global);
- Increased downscaling of loss data to sub-national geographies for policy makers; and
- Definition of a loss and creation of a methodology for assessing loss.

To meet these needs, DATA intends to establish an overall framework for disaster loss data for all providers, establish nodes and networks for databases, conduct sensitivity testing among existing databases, and create mechanisms for archiving loss data.

### ***Forensic Investigations of Disasters (FORIN) Working Group***

In its initial phase, the Forensic Investigations of Disasters (FORIN) Working Group developed a framework to guide investigations across regions and hazards. This framework is intended to act as a standardised but flexible template for conducting such investigations.

This approach for studying natural hazards aims to uncover the root causes of the disasters through in-depth investigations that go beyond the typical reports and case studies conducted after disasters. Thoroughly analyzing cases, including both success stories and failures, will help build an understanding of how natural hazards do—or do not—become disasters. FORIN has identified a diverse range of objectives:

- **Policy:** conduct analyses with inputs from multiple disciplines, stakeholders, and policy makers in order to guide policy and encourage coherence across all key disciplines.
- **Management:** focus attention on the link between research findings and improved policy formulation and application in practice, and develop and maintain a bank of high-quality case studies publicly available through the IRDR website, <http://www.irdrinternational.org/>.
- **Scientific research:** advance methodological diversity and implement science-based results, and build a strong interdisciplinary capacity of young researchers.
- **Development:** substantiate that generic causes have local manifestations, promote a ‘learning culture’ among all stakeholders, and foster wider dialogue between analytical researchers and implementing practitioners, building a common discourse in the process.
- **Disaster risk reduction:** promote sustainable risk management and risk reduction through science-based research, relate the research to the Hyogo Framework of Action (HFA), provide wider emphasis on reducing human consequences, and develop case studies that illustrate ‘risk-drivers.’

### ***Risk Interpretation and Action (RIA) Working Group***

The focus of the Risk Interpretation and Action (RIA) Working Group is on the question of how people—both decision-makers and ordinary citizens—make decisions, individually and collectively, in the face of risk. There are several broad fields of work that are relevant to this question, but many of these have progressed somewhat independently of each other, typically within the framework of

single academic disciplines. This has led to a number of discontinuities in how the issue of risk reduction is conceptualized, as well as gaps in the areas where research activity (and funding) is presently concentrated. The result is a number of unanswered questions that involve diverse fields:

- How can risk reduction policies and practices be generalised across hazards or to combinations of hazards, as well as across cultures?
- How much emphasis should be placed on risk forecasting versus communication?
- Why and when do local citizens' evaluations of risk diverge from scientific forecasts?
- How do people's decisions, perhaps due to social norms and perceived or actual constraints on their freedom of choice, diverge from their evaluations of such risks?
- Within policy and planning, what priority is given to protection and restoration of existing infrastructure, rather than redesign for greater resilience or prevention?

To answer these questions fully, the RIA Working Group hopes to advance interdisciplinary research on human decision-making and how it relates to hazards, and encourage organisations to support this area of disaster risk research.

### ***Societal and Economic Research and Applications (SERA) Working Group***

In partnership with the World Weather Research Programme (WWRP) of the World Meteorological Organisation (WMO), the IRDR established a working group on Societal and Economic Research and Applications (SERA). SERA is co-chaired by representatives from the IRDR and WWRP, with additional membership from each programme and suitable expertise.

SERA's primary purpose of the SERA working group is to advance the science of the social and economic application of weather-related information and services. This will be accomplished in part through the development, review and promotion of societal and economic-related demonstration projects focused on high-impact weather and information. Close collaboration and joint efforts are to be developed with the other IRDR working groups.

### IRDR National Committees (NCs) and Regional Committees (RCs)

IRDR National Committees (NCs) and Regional Committees (RCs) support and supplement the IRDR's research initiatives, and help to establish or further develop crucial links between national disaster risk reduction programmes and activities within the IRDR international framework. First, NCs and RCs are encouraged as mechanisms to mainstream integrated research into disaster risk reduction efforts at national, regional and institutionalised bases to enhance the coordination and cooperation among multi-stakeholders for the sustainability of integrated research, and to improve the capacity of countries and regions in the field of disaster risk reduction.

Second, these Committees serve as focal points to promote IRDR-related research initiatives of host countries, and to enhance the links between national and international disaster risk research programmes and activities. In particular, close collaboration and integration with national DRR platforms and national climate change adaptation committees, where appropriate, should be encouraged.

Third, the Committees will partner with the IRDR Science Committee (SC), the International Programme Office (IPO) and IRDR partners in pursuit of IRDR objectives, the identification of research priority, the development of the research plan, and the implementation of programmes and other activities to achieve IRDR goals.

In support of the IRDR programme, the NCs and RCs will undertake the following activities:

1. Foster and support participation in IRDR on the part of institutions and individual scientists.
2. Serve as the national or regional focal points for IRDR.
3. Foster networking and collaboration among domestic, regional and international disaster risk reduction science and technology activities.
4. Improve scientific knowledge and enhance the integration of science in disaster risk reduction planning, policies and programmes domestically, regionally and internationally.
5. Support efforts to update and report on national and regional disaster risk reduction activities aligned with the HFA's strategic priorities, with emphasis on the science and technology activities and engage in the discussions for the post-2015 regime on disaster risk reduction, and contribute to the national or regional discussions for other relevant global negotiations (climate change adaptation, earth systems, etc.).

6. Provide scientific advice to policy-makers, taking into consideration national and regional disaster risk reduction initiatives.
7. Assist in fundraising for IRDR activities and projects.

### IRDR International Centres of Excellence (ICoE)

IRDR International Centres of Excellence (ICoE) are established to provide regional and research foci for IRDR. Each ICoE research programme embodies an integrated approach to disaster risk reduction that directly contributes to the IRDR Science Plan (ICSU 2008) and its objectives as well as this IRDR Strategic Plan (2013 – 2017).

Each ICoE will collaborate to provide global contributions towards achieving the IRDR legacy and, in particular, enable regional scientific activities through geographically-focused contributions based on more localised inputs and by being visible centres of research to motivate participation in the IRDR programme.

In order to comply with the objectives of the IRDR Science Plan (ICSU 2008) and its own objectives, ICoEs are broadly mandated to:

- Conduct integrated research on disaster risk at local, regional, and global scales, meeting the objectives of each Working Group.
- Provide specifically-designed technical cooperation on disaster risk and reduction management for policy and decision-making.
- Provide technical support for formulating regional, national or local disaster risk reduction programmes based on integrated research.
- Promote IRDR research by conducting regular trainings, workshops or other activities for disaster managers, decision-makers, and junior researchers.
- Facilitate and participate in IRDR events.
- Contribute to disaster risk researchers' network or platform.



In support of the IRDR Strategic Plan (2013-2017), the research programme is guided by the following mechanisms:

### Co-Sponsors

The IRDR is jointly sponsored by the International Council for Science (ICSU), the International Social Science Council (ISSC) and the United Nations International Strategy for Disaster Reduction (UNISDR), hereafter referred to as the Co-Sponsors. The Co-Sponsors establish the governance arrangements for the IRDR, appoints the Chair and Members of the IRDR Scientific Committee (SC) and the Executive Director of the International Programme Office (IPO), receive and approve reports from these officers, and assist in promoting the programme and mobilising resources for it.

### Scientific Committee (SC)

The Scientific Committee (SC) is the IRDR's principal governing body set up by and on behalf of the Co-Sponsors. Its responsibilities are to define, develop and prioritise plans for IRDR, to guide its programming, budgeting and implementation, to establish a mechanism for oversight of programme activities, and to disseminate and publicise its results. The SC approves plans for the inclusion of projects and initiatives under the IRDR umbrella, and assures liaison and facilitates cooperation with relevant national, regional and international programmes, organizations and institutions actively involved in natural hazards and disaster risk management. The SC also adopts and applies guidelines for the establishment of IRDR-designated NCs, RCs and ICoEs, and strives to mobilise funds for implementation of the overall IRDR programme and activities related to the Committee and its Working Groups.

### International Programme Office (IPO)

The execution of IRDR programme promotion, coordination and related functions is undertaken by the IRDR International Programme Office (IPO). The Secretariat is composed of an Executive Director and a number of supporting scientific and administrative personnel, all of whom are formally employed by the IPO's host institution.

The IPO is located in Beijing, China, hosted by the Institute of Remote Sensing and Digital Earth (RAD), Chinese Academy of Sciences (CAS). Operational funds are provided by the China Association of Science and Technology (CAST).

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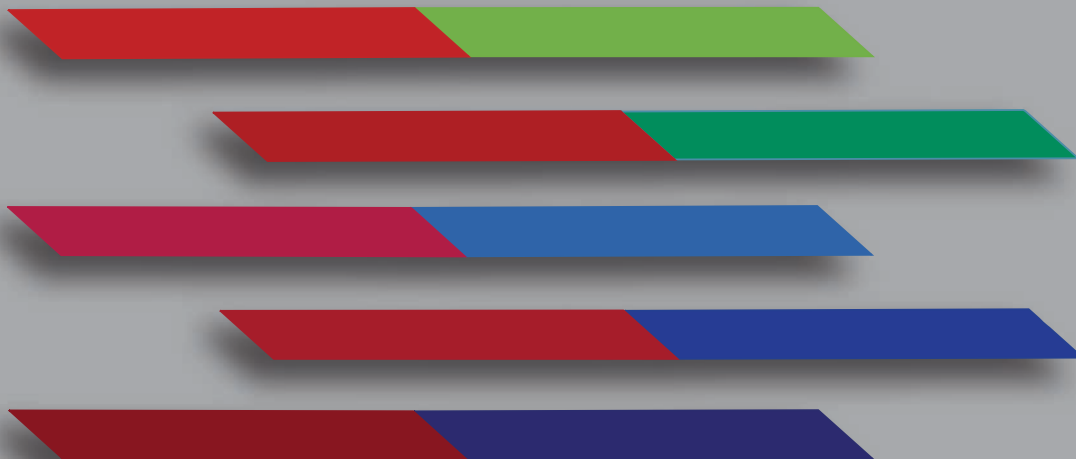
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## List of Acronyms

AIRDR	Assessment of Integrated Research on Disaster Risk Working Group
CAS	Chinese Academy of Science
CAST	China Association of Science and Technology
DATA	Disaster Loss Data Working Group
FORIN	Forensic Investigations of Disasters Working Group
HFA	Hyogo Framework for Action *
ICoE	International Centre of Excellence
ICSU	International Council for Science
IPO	International Programme Office
IRDR	Integrated Research on Disaster Risk
ISSC	International Social Science Council
NC	National Committee
RADI	Institute of Remote Sensing and Digital Earth of CAS
RC	Regional Committee
RIA	Risk Interpretation and Action Working Group
SERA	Societal and Economic Research and Applications Working Group
UNISDR	United Nations International Strategy for Disaster Reduction
WMO	World Meteorological Organisation
WWRP	World Weather Research Programme

\* Full title: Hyogo Framework for Action (2005-2015): Building the Resilience of Nations and Communities to Disasters



## **DRAFT: Project plan and time frame of Working Group DATA “Disaster Loss Data and Impact Assessment”**

Chair: Angelika Wirtz  
 Co-Chair: Susan Cutter  
 IRDR core team:  
 Kuniyoshi Takeuchi,  
 Chamhuri SIWAR

In line with the IRDR Scientific Plan, Objective No. 3 “Reducing Risks and Curbing Losses through knowledge-based actions” the working group “Disaster Loss Data and Impact Assessment – DATA” has been established.

### **The data landscape is complex and the community that is dealing with loss data is rapidly growing.**

When human, monetary, or environmental losses occur as a result of a disaster, extensive loss data are collected and stored by different organizations, but the thoroughness and accuracy of the data varies from country to country and even among local entities. Government agencies, private companies, and other organizations may collect and manage data related to their own areas of interest using their own standards and procedures, without significant collaboration with other groups. This results in gaps, inconsistent overlaps, and biases that ultimately affect the quality of research conducted and policies made based on the data.

DATA will bring together stakeholders from different disciplines and sectors to reconcile some of these data issues, and to develop synergies and collaborations in the production and utilization of disaster data. The working group intends to establish an overall framework for disaster loss data for all providers, to establish nodes and networks for databases, and conduct sensitivity testing among existing databases.

To this effect, the Data Working Group has identified the following specific project areas:

- Identify what data and quality are needed to improve integrated disaster risk management
- Bring together loss data stakeholders and develop and utilize synergies
- Develop recognized standards, minimize uncertainty
- Educate users regarding data interpretation and data biases
- Ensure increased downscaling of loss data to sub-national geographical levels for policy-makers
- Define “losses” and create a methodology for assessing it.

### **Timeframe:**

#### **November 2011:**

- Draft of project plan
- Identification of possible members/organizations (ca. 20 incl. IRDR members). Formal invitation by Salvano Briceno and Wirtz/Cutter
- Cutter/Wirtz write paper about “the Complexity about Disaster Data Landscape” (working title)

#### **March 2012:**

- Planet under Pressure, London (26-29 march 2012): Presentation of IRDR-DATA

#### **May 2012:**

- Kick-off meeting of working group (2-3 days). Possibly in Vienna under the umbrella of the Austrian Ministry of Life.
- Goal: Team building, identifying strengths of members, finalize and agree upon project plan, specifying concrete working plan according to overall project plan of DATA, including, time frame, milestones, responsibilities. Identifying goals and objectives for students workshop 2012.

### June 2012 (4-6)

Rio+20 - communication on web, participation of IRDR or DATA members. How can we get active here?

### July 2012:

Meeting Wirtz and Cutter in Munich

### Aug/ Sept/ October 2012:

Students workshop in Munich (ca. 20 students, and few Working Group members. ) 2 days. Working on max. 2-3 topics according to project plan, in preparation of 2<sup>nd</sup> DATA Working Group meeting in Taipei (March 2013)

### November 2012:

IRDR Meeting in China. Report about progress of DATA. Side meeting with core team and those who are interested in.

Or – to be discussed: 2<sup>nd</sup> DATA-Working group meeting.

### März 2013:

Taipei: DATA-Working Group Meeting (2-3 days). Presentation at University Taipei ( NatCatSERVICE & Insurance and Working Group DATA)

### May 2013

Geneva: Global Platform. Active participation of IRDR. Presenting of working groups, current state, activities, results, outlook

## Project Plan:

### Literature Research

Provides overview about Papers related to Disaster losses and damages, Databases, Normalization of loss data, Definition, What is available “The gaps of data - the needs of data”

### Overview of existing loss databases

See survey from CRED

### Definitions and Terminology

Overview of already accomplished actions. Identify missing issues.

### Loss Assessment – Economic Impact (direct, indirect, secondary)

Prepare an overview of applied methodologies to assess losses.

Many different methodologies are currently applied: Examples – ECLAC, Munich Re, Swiss Re, Desinventar, Pielke, Modelling losses (GEM, Pager, Joint Research Center Italy), professional Modelling Organisations (EQE Cat, RMS).

We cannot come to one single methodology, however, we can provide an overview and make the different methodologies more transparent.

### Bring together stakeholder

Bring different disciplines that are dealing or working with disaster loss data together – have an interdisciplinary and integrated approach. Stakeholders are for example: data provider, data collector, data platforms, data user, governments, economic knowledge, emergency management.

**From bottom to top**

Disaster loss data are needed from local, to national, to regional, to global level. Where are the nodes and where can we utilize synergies?

**The need of data**

Work out the requirements of data. What data are needed and perhaps not yet available to do Disaster Risk reduction? Examples: situation at the time of the disaster, like war, civil war, population, vulnerability information etc.

**Disaster Classification**

It is necessary to differentiate between extensive/intensive, high frequent/low frequent, high impact/local routine events. Is it possible to establish an internationally agreed disaster scale – like Hurricane Saffir-Simpson scale, or tornado scale?

**Members:**

The Working Group DATA brings together stakeholders from different disciplines that are dealing and working with disaster loss data. There should be a number of ca. 20 members. The following names or organizations have been identified and are to be discussed with IRDR.

**Organisations/Programmes:**

IRDR	Wirtz, Cutter, Kuniyoshi Takeuchi, Chamhuri Siwar
CoData	Bob Chen
WDS	Takashi Watanabe

**Platforms:**

GLIDE ADRC	Takahiro Ono
UNDP GRIP	Carlos Villacis
UN ISDR	Julio Serges

**Databases:**

Global:	
EmDat	Regina Below
Swiss Re	Lucia Bevere

National	NN
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Local	NN
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**Loss Assessment:**

ECLAC	Ricardo Zapato
Worldbank Global Facility	Hemang Karelia

**Automatic Generator:**

European Joint Research	NN (Rudari)
GDACS	Ehrlich

**Aid Organisations,NGO:**

IFRC	Frederic Zanetti
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<b>Science</b>	NN
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<b>Emergency Management</b>	NN
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<b>Government</b>	NN
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## **FORIN. Forensic Investigations of Disaster.**

### **DRAFT WORK PLAN**

**24. February 2012.**

The FORIN Project is an activity of the Integrated Research on Disaster Risk Programme (IRDR) co-sponsored by ICSU, ISSC, and UN. ISDR. Details of the IRDR and of the FORIN Projects may be found at [www.irdrinternational.org](http://www.irdrinternational.org)

The fundamental aim of FORIN is to develop, disseminate and implement a radical new approach in disaster research that will seek to identify and explain the underlying causes of disasters including the growth in magnitude and frequency of very large disaster events. It is intended that this research paradigm will lead to greater in-depth understanding and more enlightened and effective disaster risk reduction practices and policies.

The methodology is built around case studies and in keeping with the objectives of IRDR the FORIN Case Studies will be “integrated” – that is more than an assembly of different disciplinary approaches.

Many of the attributes of FORIN have already been described by a small ad-hoc Working Group and published in a paper “Forensic Investigations of Disaster”, Working Paper No. 1. which is available on the above website.

This Work Plan is organized into four sections. The first simply states the List of Proposed Activities. The second provides an Elaboration of Activities, and the third sets out a Preliminary Schedule and Budget. In the fourth and final section some of the longer term aims are briefly described.

### **I. List of Proposed Activities over a 5 year period. .**

1. Integrated research Projects
  - 1A. Core Sponsored Case Studies.
  - 1B. Contributed Case Studies.
2. Fellowships, Training and Workshops.
  - 2A Orienting, Training and Development Workshops. (Advanced Institutes)
  - 2B. Fellowship Programme.
  - 2C. Research Workshops.



3. Publications and Reports
  - 3A Journal articles.
  - 3B Working papers.
  - 3C Book length reports.
4. Synthesis and Publication of Results, and International Conference.
5. FORIN Project Management.

## **II. Elaboration of Activities.**

### 1A. Core sponsored Case Studies.

At the centre of the FORIN Project it is proposed to develop a small number of major or core projects to examine a selection of recent disasters through the FORIN lens. Candidates could include such recent (last 10 years) events as earthquakes in Haiti, Chile and Christchurch New Zealand, tropical cyclones (Katrina), floods in Thailand and Pakistan, and also the tsunami and flooding its nuclear consequences in North East Japan (Fukushima), and others.

Each project would be conducted over a period of approximately three years and would require an overall project director and an interdisciplinary and integrated team of research staff, some of whom might be supported on fellowships (see 2B below)

It would be advantageous if the director and research team could be based at a research institution preferably with a reputation and recognized capacity for research in disasters. The estimated cost for each core project is \$250,000. The selection of core projects would be made by donor or sponsoring organizations working in collaboration with the FORIN Project and IRDR, as well as a home institution and country. While these core projects would form the centrepiece of the FORIN project they would not be established at the outset but would be preceded by a number of preparatory activities described below.

### 1B Contributed Case Studies.

A number of research individuals and groups have expressed their interest in pursuing the application of the FORIN approach. It is therefore proposed that such researchers be collectively organized into groups providing Contributed Case Studies. Such case studies would in some instances precede the core projects and produce some further input into their design. It is anticipated that much of the cost of the contributed case studies would come from their own sponsors.

### 2A. Orienting, Training and Development Workshops.

In order to engage more of the disaster research community (from many disciplines and specialities) it would be helpful to organize a series of workshops at which the elements of the FORIN approach could be presented and debated and further elaborated. Initially such workshops would be required to orient research groups to the central concepts of FORIN including the essential notion of “integrated” studies. One such workshop to be held in Taipei (March 2012) is now in

preparation. There should be at least one such workshop associated with each of the Core Case Studies and initially with the Contributed Case Studies as well. One initiating or “launch” workshop will be held once the preparatory steps have been taken.

#### 2B Fellowship programme.

To support the research projects and their staff and to help to contribute to the costs of workshops a fellowship programme will be established. The number and value of individual fellowships will depend upon the rate of development of the FORIN Project and initial funding.

#### 2C Research Workshops.

Once the workshops for Core and Contributed Case Studies are completed it is important that they be followed up with meetings and reports to monitor progress and ensure that the integrated nature of the FORIN approach is being effectively followed. Such mechanisms are required both within and between (across) projects. The number and cost of individual workshops remains to be worked out, and will depend upon the timing of the Case Studies..

#### 3A. Journal articles.

One important product of the FORIN Project will be a series of articles in refereed journals, reporting on results, and the development of theory and methodology. One such proposed article under consideration is a refinement and elaboration of FORIN Working Paper No. 1. [Authors to be determined.]

#### 3B. Working papers.

In addition to journal articles the FORIN project should sponsor a series of Working Papers that report on work in progress and to facilitate the exchange of ideas and methods. These could be posted on the IRDR website as in the case of Working Paper No. 1.

#### 3C Book length documents and reports.

It is anticipated that each of the Core Case Studies and some of the Contributed Case Studies would lead to the production of book length reports. These might be stand alone reports or managed as part of a FORIN series. One publisher has expressed interest in such a series. [discussions in progress led by Tony Oliver Smith]

The FORIN Working Paper No. 1 itself has the potential to be elaborated into a book. This would involve, for example, the preparation of expanded text on specific research methodologies that are described very briefly in WP No. 1. Such a volume could be designed to serve as a guide for subsequent Case Studies adopting the FORIN approach. [Authors and/or editors are to be identified.]

#### 4. Synthesis and Publication of Results and International Conference.

At the close of the approximately five year period of this project it is anticipated that a synthesis volume would be produced. This would include reports from specific projects and an

overall synthesis aimed at both the policy and the scientific communities. It would carry a “Summary for Policy Makers” in the IPCC style. If this pattern were to be followed the SPM could become the centrepiece of an international conference perhaps attached to or associated with an established international disaster platforms. An interim report could be presented at an expected conference in 2015 when it will be time for the renewal or revision of the Hyogo Framework.

#### 5. FORIN Project Management.

A project of this length and scale requires considerable management. This should involve an overall project director or manager with support staff to be determined. Such a capacity might be co-located with the existing IRDR IPO in Beijing or at an alternative host institution.

### **III. Preliminary Schedule and Budget.**

#### Year 1,

This is a “setting up” year. It requires more detailed budget preparation and a more detailed Work Plan. An essential early step would be the selection and appointment of an overall FORIN Director, perhaps initially on half salary and potentially shared with RIA and AIRDR. The Project Management Office and staff would be established. Year 1 would also require at least one workshop (see 2 A above) and the establishment of a fellowship programme.

Preliminary cost estimate. \$150,000.

#### Year 2.

This would require a number of the activities listed and described above to be continued and strengthened and the case studies to be initiated. This process could begin at any time with Contributed Case Studies and with the Core Case Studies to follow.

Preliminary estimate cost \$250,000

#### Year 3.

At this stage the FORIN project would reach its peak level of activities with a world wide distribution of Contributed and Core Case Studies underway, and a full range of fellowships, publications and workshops.

Costs at this stage would depend heavily upon the number of Core Case Studies and would be in the order of \$500,000, plus the shared cost contributions and contributions in kind. .

#### Year 4.

Year 4 would be the second year of full activities, and Core and Contributed Case Studies would be approaching completion with associated report writing and “outreach” and communications.

Year 5.

It is projected that Year 5 would be the final year of the FORIN Project, and would be devoted to the synthesis of results, and publications and an international conference and related communications.

Costs at this stage would depend on the scale of these activities. Total costs for the 5 year FORIN Project would be in the order of \$1,000,000.00 plus additional and shared and in-kind contributions.

#### **IV. Longer – Term Plans and Objectives.**

The fundamental aim of FORIN as stated at the outset is to develop, disseminate and implement a radical new approach in disaster research. The purpose of FORIN also extends well beyond the domains of research. The intent is that the FORIN approach will give rise to a new mode of practice in disaster risk management and policy. The precise nature of this change cannot begin to be specified until the FORIN Project is well underway and results are beginning to take shape. The intent however is that it will advance the understanding of the root causes of disasters at all levels of governance from local to national, regional, international and global, and in the private sector and civil society. The extent to which such institutions become engaged in the FORIN enterprise and make use of its findings will be an important measure of the project's success. The growing number of major disasters can no longer to be seen as a series of independent events having consequences largely confined to their location. The underlying causes of disaster are linked to each other in ways that are not yet clearly visible. And the consequences of major disasters are increasingly felt in remote locations far from their place of occurrence. Sooner or later disasters will be recognized as a common human responsibility and the FORIN Project aims to be a step in that direction.

Draft prepared by

Ian Burton.  
Kuniyoshi Takeuchi  
Allen Lavell.  
Tony Oliver Smith .  
Others.

## RIA Working Group Work Plan 2013-2016

### The Risk Interpretation and Action Working Group (RIA)

*RIA focuses on the question of how people - both decision-makers and ordinary citizens - make decisions, individually and collectively, in the face of risk. We have four priority areas of interest:*

1. *Decision-making for uncertainty*
2. *Early warning systems*
3. *Adaptive management and resilience*
4. *Individual perceptions and risk behaviour*

Understanding decision-making in complex and changing risk contexts, risk governance and institutional development is the goal. Understanding how people interpret risks and choose actions based on their interpretations is vital to any strategy for disaster reduction. In this working group's first activity, the group reviews and synthesizes relevant literature to develop a conceptual framework to guide future research in this area. The group stresses that risks in the context of natural hazards always involve interactions between natural (physical) and human (behavioural) factors. Decision-making under conditions of uncertainty is inadequately described by traditional models of 'rational choice'. Instead, attention needs to be paid to how people's interpretations of risks are shaped by their own experience, personal feelings and values, cultural beliefs and interpersonal and societal dynamics. Furthermore, access to information and capacity for self-protection are typically distributed unevenly within populations. Hence trust is a critical moderator of the effectiveness of any policy for risk communication and public engagement. RIA activities aim to make these concepts and theories more accessible to a range of disciplines and to practitioners in the field of natural hazards and *to promote better integration of behavioral and social sciences in disaster risk research especially in regard to decision making.*

### OBJECTIVES AND STRATEGIC PLAN

The objective of the RIA working group is to build a community of practice on risk perception, communication and decision-making. It is a response both to the mushrooming supply of science approaches to risk perception and communication and to three specific demands from the policy and science communities (mapping onto the agendas identified above):

1. The shift from deterministic to probabilistic risk forecasting requires close working between scientists and policy makers to improve modelled risk interpretation, communication and action.
2. Unresolved challenges of communicating risk through early warning efforts including science-society communication and emergency response planning.
3. Resilience capacity and action rest upon knowledge production, management and learning. Approaches are needed to better identify, understand, and model knowledge environments for those managing and living with disaster risk.

Strong scientific and practice communities associated with psychology, institutional economics, organisational sociology and risk communication largely operate in parallel. These rich, but independent knowledge resources offer a grand opportunity for learning and synthesis to reduce the duplication of research and overcome barriers to integrated risk management rooted in a multiplicity of disciplinary languages.

The RIA community will be interdisciplinary, international and integrative. It builds on an existing core network of internationally recognised scientists and practitioners active across the disciplines

identified above, but the community will be open to all disciplinary traditions; natural, social, behavioural and from the humanities with interests in risk communication. The goal is to develop further this core group, expand into a self-organised community and promote the co-ordinated development of new approaches, methods and experience in communicating risk and development between natural, engineering, and social science, practitioners and those at risk.

Trans-disciplinary communication and integration of policy and academia will be facilitated through a series of connected international workshops and publications and policy briefs and through the practical implementation of RIA research and policy learning through independently funded research projects.

RIA benefits from the methodologies of FORIN, DATA, AIDR and SERA, which each provide mechanisms for moving the RIA agendas forward. In this regard RIA members will contribute to the development of:

FORIN guidance and contribute to FORIN reports to emphasise the role of science-policy communication in decision-making for uncertainty, in the success and failure of early warning and in the extent to which adaptive management and learning systems have been embedded in disaster risk management and development action.

DATA indicators for resilience that can capture the distribution of knowledge and learning as a determinant of adaptive capacity and action. The RIA team will be available to offer guidance in this task.

AIDR will include work on risk communication, resilience building and early warning where this has been undertaken using an integrated scientific approach. The RIA team will be available to offer guidance in this task.

SERA has an interest in the communication and maximisation of social benefit from weather-related information and services. The RIA team will be available to explore distinct communication tools used by partners of the World Weather Research Programme.

## **WORKPLAN**

RIA's four areas of interest are cross-cut by three work priorities.

1. *Integrating new science with policy planning:* Work focuses on facilitating the interaction of science with research-users. This can include workshops to bring humanitarians or development professionals together with climate science to explore how best information can be exchanged, or bringing risk managers together to consider risk communication strategies in different country and organisational contexts, or working with local stakeholders to examine science and other knowledge interactions and its effect on action.
2. *Community building:* providing an international focal point for pure and applied research, and for risk management professionals working on risk perception, communication and governance including that associated with resilience building and assessment. Activities include maintenance of an open access www portal as part of the IRDR site and workshops (especially those that can piggyback on existing international and national conferences)
3. *Research leadership:* Championing risk perception, communication and governance concerns through the research process. This includes providing expertise for integrated research activities and grant submission and providing guidance to research funders.

Each year is open to work tasks related to these areas of interest and work priorities.

Particular areas of interest are prioritised for each year, this is to focus resource. There is flexibility in the plan to include other areas of interest and many work tasks will be integrative of more than one area. Prioritising reflects the different stages of academic and policy development of each area of interest, and contextual cycles such as the post-2015 agenda. Work related to DATA, FORIN, AIRDR and SERA will be ongoing and interact with RIA specific tasks, for example where a FORIN study can be used to highlight a particular area of interest in the production of risk and disaster.

Annual work plans are set out below. Work for 2013-14 is already underway (more detail is available from the 2013 work plan), subsequent work plans are indicative only.

### 2013-14

	<i>Decision-making for uncertainty</i>	<i>Early warning systems</i>	<i>Adaptive management and resilience</i>	<i>Individual perceptions and risk behaviour</i>
Integrating new science with policy planning	x		x	x
Community building	x	x	x	x
Research leadership	x		x	x

#### **Adaptive Management and Resilience**

- RIA Workshop: Social learning, community resilience and disaster risk reduction, King's College London, Department of Geography, 14-15 May 2013 (lead: Mark Pelling)

#### **Early Warning Systems**

- Annual Conference of Society for Risk Analysis, Symposium on RIA themes – June 2013, Trondheim, Norway. (lead: Dick Eisner)

#### **Decision-making for uncertainty**

- Annual Conference of Society for Risk Analysis, Symposium on RIA themes – June 2013, Trondheim, Norway . (lead: Dick Eisner)
- 38<sup>th</sup> Annual Natural Hazards Research and Applications Workshop, Workshop on Risk Communication, July 13-16, 2013, Broomfield, Colorado, USA. (lead: David Johnston, Ann Bostrom)
- World Social Science Forum, session on Decision-making under conditions of uncertainty 13-15 October, 2013, Montreal, Canada. (lead: David Johnston)

#### **Individual perceptions and risk behaviour**

- Annual Conference of Society for Risk Analysis, Symposium on RIA themes – June 2013, Trondheim, Norway. (lead: Dick Eisner)
- World Social Science Forum, session on Decision-making under conditions of uncertainty 13-15 October, 2013, Montreal, Canada. (lead: David Johnston)

**2014-2015**

	<i>Decision-making for uncertainty</i>	<i>Early warning systems</i>	<i>Adaptive management and resilience</i>	<i>Individual perceptions and risk behaviour</i>
Integrating new science with policy planning	x	x	x	x
Community building	x	x	x	x
Research leadership	x	x	x	x

**2015-2016**

	<i>Decision-making for uncertainty</i>	<i>Early warning systems</i>	<i>Adaptive management and resilience</i>	<i>Individual perceptions and risk behaviour</i>
Integrating new science with policy planning	x	x	x	x
Community building	x	x	x	x
Research leadership	x	x	x	x

**PROPOSED BUDGET**

Proposed budget: US\$70,000 per year

[Workshop expenses = US\$30,000]

[Part time admin support for community building = US\$30,000]

[publications = US\$10,000]

**Total budget over three years = US\$210,000**

**RIA Steering Committee Members, 2012**

- Co-Chairs: Mark Pelling (UK), Dick Eiser (UK)
- Members: Ann Bostrom (US), Ian Burton (Canada), David Johnston (New Zealand), John McClure (New Zealand), Douglas Paton (Australia), Joop van der Pligt (Netherlands), Britt-Marie Drottz-Sjoberg (Norway), Mathew White (UK), Emma Visman (UK)
- Corporate representatives: SERA, EUJRC





## **State of the art of disaster loss data recording in the EU: progress towards EU guidelines**

Venue: Brussels, European Response and Coordination Centre, rue Joseph-II, 79

Date: 23-24 October 2014

A key priority of EU disaster management policy is to support improvements in disaster loss recording and comparison for disaster risk reduction. Improvements in comparable data will require efforts at national level and also involve the international community and the private sector. A working group of EU Member States, coordinated by the Joint Research Centre, and in partnership with international initiatives on disaster loss data, has examined the state of the art in Europe. The meeting will review progress and define a roadmap towards EU guidelines and minimum standards for recording disaster loss data.

### **Draft Agenda**

#### **23 October 2014 (Meeting room: ERCC Crisis Room)**

12:00 Lunch and reception (offered by Commission)

13:00 Introduction (ECHO)

13:30 Presentation of State of the Art of Loss Data recording in EU Member States (JRC)

14:00 Technical interventions of working group partners per Member State, discussion of feedback

16:00 Presentations from newly joined MS (Latvia: Jevgenijs Golocuks; Lituania: Edgaras Geda; Finland: Taito Vainio; Anna Kaikkonen. *tbc*)

17:00 End of meeting

#### **24 October 2014 (Meeting room: ECHO SDR 1/A024 Salle Rouge)**

09:00 Introduction: summary of the results of DAY 1 and expectations on the roadmap (ECHO/JRC)

09:30 Presentation of State of the Art of Loss Data recording in EU Member States (JRC)

10:00 Member State comments

11:00 Presentations setting the scene for the roadmap (S. Menoni and/or A.Thieken on local loss recording, X. Romao on Uncertainty, Jaroslav Mysiak FEEM on economic loss indicators, *tbc*)

12:00 Wrap-up and definition of further mandate of Technical Working Group (JRC/ECHO)

12:30 End of meeting: networking at lunch buffet (offered by Commission)



## JRC SCIENTIFIC AND POLICY REPORTS

# Current status and Best Practices for Disaster Loss Data recording in EU Member States

*A comprehensive overview of  
current practice in the EU  
Member States*

*Executive Summary*

Tom De Groeve  
Karmen Poljansek  
Daniele Ehrlich  
Christina Corbane

2014



## EXECUTIVE SUMMARY

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**Disaster risk is increasing.** Population growth in exposed areas, an increase in extreme weather events and rapid disaster-prone economic development all contribute to an increase in casualties and economic losses due to natural hazards. One third of development aid, adding up to 3 trillion euro, was lost due to disasters in the past 30 years<sup>1</sup>. The capacity of developing and developed societies to carry the losses is limited and not well understood. Estimates of future losses are hampered by low quality historical loss data. **We must measure losses better.**

In the process towards the World Conference on Disaster Risk Reduction in 2015, disaster loss data have repeatedly been singled out as **essential evidence for sound policy making** and evaluating progress in reducing disaster risks. Already a key priority in the EU disaster prevention framework, the **2014 EU Council Conclusions on risk management capability** (13013/14) reiterate the importance and invite the European Commission to take actions to encourage the EU Member States to develop systems, models or methodologies for collecting and exchanging data on ways to assess the economic impact of disasters on an all-hazard basis.

Recording disaster loss data is important, but **no internationally agreed definitions or accounting practices exist** for disaster loss data, making national and global statistics incomplete and unreliable. The awareness about the utility of loss data is also often lacking, in particular in governments where public compensation schemes are small or non-existent. **Utility extends beyond accounting** (for compensation schemes and policy monitoring) and includes **prevention policy** (through forensic data) and **risk assessment** (through the development of accurate and localized damage functions for risk models).

To identify the gaps and challenges for recording loss data in Europe and identify and promote the opportunities for policy making, the Directorate General Joint Research Centre was tasked in 2013 to establish an **expert working group** with members from EU Member States **to report on the current state of the art in Europe and recommend best practices and guidelines**. Fifteen Member States participated to three meetings organized in 2014. The working group benefited also from an exchange of information with the United Nations Agency for Disaster Risk Reduction (UNISDR) and an international working group addressing Loss Data affiliated with the Integrated Research on Disaster Risk (IRDR), as well as various academic and scientific institutions. The EU and the IRDR DATA working group held a joint meeting in May 2014.

This report aims at presenting the state of the art and best practices for recording disaster loss data in EU member states. It is a follow-up of the 2013 study “Recording Disaster Losses: Recommendations for a European approach” which formulated a conceptual framework for the use and application of loss data and challenges for technical requirements in the EU context.

Based on contributions from 15 Member States and analysis in the EU Disaster Loss Data Working Group, the **main findings** of this study indicate that:

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<sup>1</sup> World Bank. <http://www.globalresiliencepartnership.org>.

- **12 out of 15 participating Member States** have established and maintained a loss database. **France, Germany** (partial access), **Greece, Italy** and **Sweden** have publicly accessible national disaster databases. **Austria**, Croatia, France, Greece, Italy, **Portugal, Romania, Slovenia** and **Spain** regularly update their disaster databases. France, Greece, Portugal and Slovenia have countrywide and multi-hazard loss databases, some of them supported by legislation and strong mandate (Slovenia). **Belgium**, Germany, Italy and **Spain** have databases with partial loss recording (e.g. disaster-specific, limited to floods).
- **Croatia, UK** and **Netherlands** do not have a national loss database, and **Bulgaria** is in the process of establishing one. Belgium is in the process of devolving the national database to separate regional databases.
- The processes of loss data collection (measuring loss) and recording (storing data in a structured database) significantly differ across the surveyed countries. There is a **lack of guidelines and standards** for loss data collection and recording, in particular for **human and economic losses**, which prevents data from being shared in a comparable way between the surveyed countries and from being aggregated at EU or global level.
- **IT systems supporting the loss data recording vary significantly** across Member States. Some are simple tables and others are federated database systems across various governmental levels or integrated systems linked to other governmental databases (e.g. cadastre, insurance records, hazard database)
- The terminologies used for **peril classification** and the types of loss indicators also vary between the countries but are compatible, which allows their translation into a common classification system and methodological framework.
- The **drivers for disaster loss data recording** are mainly linked to (semi) public national compensation schemes (Belgium, Croatia, France, Slovenia, Spain, Sweden), existing EU or national legislation (e.g. EU Flood Directive or Solidarity Fund) and improving prevention and response mechanisms (e.g. Austria for landslides, avalanches and flash floods; Italy for flood management in Umbria and Sicily).

The overview of the current practices in recording disaster loss data in EU Member States shows that the methodologies implemented in each country are appropriate for their purpose. However, to make the databases compatible with requirements for sharing data among Member States and with international organisations they all would require adjustments or completion. The loss recording practices also would need to be strengthened to make the data useful at national level beyond narrowly defined objectives, e.g. for prevention policy and risk assessment.

The recommendations drawn from the analysis can be summarized as follows:

- The **role and utility of loss data** should be discussed across government departments, including emergency management, urban planning, and government budget, and across government levels (local to national). High-level requirements should be informed by public and private needs across sectors.
- Implementation should be embedded in a Public-Public Partnership (PUP) or Public Private Partnership (PPP) to **ensure participation and ownership of all stakeholders**.

- Loss data should be recorded in **advanced (distributed) IT systems**, implementing an appropriate data model (linked to or integrated with other government databases) and supporting user-friendly data visualization and sharing options for a wide range of users.
- **Summary or aggregate statistics** (aggregation level to be defined by the Member State) should be shared using an open data policy in a common data standard to support trans-boundary and international risk reduction processes (including the post-2015 Framework). **Minimum requirements for a data-sharing standard** aligned with current practices are proposed in this report.

It is also recommended to continue the work of JRC and the EU Disaster Loss Data Working Group. A third phase would be needed to (1) build a conceptual framework for human and economic loss data, (2) establish guidelines and best practices for loss data recording at local and national level, (3) expand the expert network of the Working Group to include all EU countries and (4) assist Member States with technical advice on the implementation of minimum requirements for sharing loss data.



## Tentative Agenda

# First Meeting of the Expert Group on Disaster-related Statistics in Asia and the Pacific

27 – 29 October 2014, Sendai, Japan

### Background

Natural disasters are adversely affecting economic growth and social development gains in Asia and the Pacific region. With climate change, the risk from extreme weather events is expected to rise. To properly address this challenge, countries need to integrate disaster risk management into, and thus be monitored and reported as part of, their sustainable development framework.

A joint analysis of ESCAP and UNDP at the 2nd session of the ESCAP Committee on Disaster Risk Reduction held in 2011 underscored the fact that even basic statistics on disasters, such as the occurrence of disasters by type and the numbers of persons affected are not always adequately and consistently collected and reported. This absence of objective information on the realities of disaster occurrences and impacts constitutes a serious impediment to efforts by planners and policy-makers to develop effective disaster risk reduction and climate change adaptation policies and programmes. The absence of comparable concepts, definitions and methodologies across the region also hamper the ability to undertake regional level analysis which is required for regional policy making and strategy development. In response to the findings of the analysis, the Committee on Disaster Risk Reduction requested the secretariat to work on monitoring resilience.

Against this backdrop, ESCAP and UNDP undertook a five-country pilot study to investigate challenges pertaining to current disaster statistics production, including supporting institutional arrangements. The study provided the basis for a series of expert group meetings to put forward policy and technical recommendations for further work.<sup>1</sup>

Based on the findings of the expert discussions and the decisions by the Committee on Disaster Risk Reduction, member States through ESCAP Commission resolution 70/2 decided to establish an expert group comprising statisticians and disaster risk reduction experts to develop a regionally agreed basic range of disaster-related statistics.

The Expert Group on Disaster-related Statistics in Asia and the Pacific was established in September 2014. The first meeting of the Expert Group is being organized by ESCAP and the Tohoku University, in collaboration with and support of UNDP and Ministry of Foreign Affairs, Republic of Korea in Sendai, Japan from 27 to 29 October 2014.

<sup>1</sup> The meetings, organized by ESCAP, together with the International Research Institute of Disaster Science (IRIDeS) of Tohoku University and other partners, were held in Sendai, Japan in October 2013, in Bangkok, Thailand in November and December 2013, and in Jeju, the Republic of Korea in March 2014.

## Objectives

At its first meeting, the Expert Group will aim to:

- Achieve consensus on principles and criteria for defining and classifying disaster events, their occurrence and human and material impacts.
- Develop a plan for its further work towards determining a basic range of disaster-related statistics.

## Expected Participants

In addition to the members of the Expert Group, a number of regional and international experts are invited to the meeting.

## Tentative Programme<sup>2</sup>

Day 1	
09:00 – 10:00	<p><b>Opening session</b></p> <ul style="list-style-type: none"> <li>• Opening: Mr. Kilaparti Ramakrishna, Director SRO ENEA, ESCAP (10 minutes)</li> <li>• Message from the Chairs of ESCAP committees (10 minutes)               <ul style="list-style-type: none"> <li>◦ Dr. Lisa Grace Bersales, Chair, ESCAP Committee on Statistics</li> <li>◦ Ms. Fathmath Tashneem, Chair, ESCAP Committee on Disaster Risk Reduction</li> </ul> </li> <li>• Welcoming Remarks: Prof. Susumu Satomi, President, Tohoku University (10 minutes)</li> <li>• Election of Chair and Vice-chair(s) of the Expert Group (5 minutes)</li> <li>• Acceptance speech by the elected Chair (5 minutes)</li> <li>• Group photo session</li> <li>• Interaction with the Media</li> </ul>
10:00 – 10:15	Coffee Break
10:15 – 11:30	<p><b>Session 1 : Introduction and expectations</b></p> <p><i>Expected results: participants are aware of the background and functions of the Expert Group as stipulated in the Terms of Reference.</i></p> <p>Moderator: Chair of the Expert Group</p> <ul style="list-style-type: none"> <li>• Overview of TOR, Mr. Puji Pujiono, ESCAP (5 minutes)</li> </ul> <p>Participants' introduction, covering the following topics: (1h10)</p> <ul style="list-style-type: none"> <li>- Expectation to the work of the Expert Group (ambition level, key issues, main challenges)</li> <li>- Personal contribution (experience and areas of expertise)</li> </ul> <p><u>References:</u></p> <ol style="list-style-type: none"> <li>1) ESCAP Resolution 70/2</li> <li>2) TOR, Expert Group on Disaster-Related Statistics</li> </ol>
11:30 – 12:30	Lunch

<sup>2</sup> All indicated speakers are subject to confirmation.



12:30 – 13:30	<p><b>Session 2: Setting the stage</b></p> <p><u>Expected results: participants understand the broader imperatives for developing a basic range of disaster-related statistics, particularly in Asia and the Pacific, given the impending adoption of the HFA-2, and in the context of SDG monitoring.</u></p> <p>Moderator: Mr. Kilaparti Ramakrishna, ESCAP</p> <p>Presentations, 10 minutes each (40 minutes)</p> <ul style="list-style-type: none"> <li>• Strengthening the evidence-based policymaking and decision making in DRR in the context of SDGs – Mr. Puji Pujiono, ESCAP</li> <li>• The need for better disaster statistics – Prof. Yuichi Ono, IRIDeS, Tohoku University.</li> <li>• Lessons learnt from supporting national disaster losses databases: gaps, challenges and need for standards – Mr. Sanny Jegillos, UNDP Regional Centre, Bangkok</li> <li>• The use of disaster risk data to guide public investment – Mr. Sujit Mohanty, UNISDR ROAP Bangkok</li> </ul> <p>Q&amp;A (20 minutes)</p> <p>Key questions:</p> <ul style="list-style-type: none"> <li>- Why are disaster-related statistics needed in the Asian-Pacific region?</li> <li>- How will disaster-related statistics relate to post-2015 sustainable development goals including HFA2?</li> <li>- What similar processes are going on at the regional and global level?</li> </ul> <p><u>References:</u></p> <ol style="list-style-type: none"> <li>1) <i>Background Paper 1: Motivation for Establishing a Basic Range of Disaster-Related Statistics</i></li> <li>2) <i>Summary Outcomes of Previous Expert Group Meetings</i></li> </ol>
13:30 – 14:45	<p><b>Session 3: Framework for establishing a basic range of disaster-related statistics</b></p> <p><u>Expected results: participants agree on the conceptual framework for developing a basic range of disaster-related statistics.</u></p> <p>Moderator: Prof. Yuichi Ono, IRIDeS, Tohoku University</p> <p>Presentations 15 minutes each (45 minutes)</p> <ul style="list-style-type: none"> <li>• Defining the scope of a basic range of disaster-related statistics: Conceptual framework – Mr. Puji Pujiono, ESCAP</li> <li>• Development of statistical standards – Mr. Yanhong Zhang, ESCAP</li> </ul> <p>Q&amp;A (30 minutes)</p> <p>Key questions:</p> <ul style="list-style-type: none"> <li>- In which phase of disaster risk management are disaster-related statistics found to be most feasible?</li> <li>- Who makes what decisions during which phase and to do so require which data?</li> <li>- What are the crucial processes in establishing standards for disaster-related statistics?</li> </ul> <p><u>References:</u></p> <ol style="list-style-type: none"> <li>1) <i>Background paper 2: Conceptual Framework for a Basic Range of Disaster-Related Statistics</i></li> <li>2) <i>Best Practice Guidelines for Developing International Statistical Classifications, Mr. Andrew Hancock, Statistics New Zealand</i></li> <li>3) <i>The Role of International Standards for National Statistical Offices, Mr. Andrew Hancock, Statistics New Zealand</i></li> <li>4) <i>Principles and Framework for an International Classification of Crimes for Statistical Purposes, UNODC</i></li> <li>5) <i>2009 UNESCO Framework for Cultural Statistics, UNESCO</i></li> </ol>

14:45 – 15:00	Coffee Break
15:00 – 16:30	<p><b>Session 4: Country experiences</b></p> <p><u>Expected results: participants gain appreciation on the specific issues to be addressed in developing a basic range of disaster – related statistics, e.g. complexity in resilience monitoring and the necessity for cross country comparison, from the perspectives of both statisticians and disaster risk management experts.</u></p> <p>Moderator: Mr. Puji Pujiono, ESCAP</p> <p>Presentation: (20 minutes)</p> <ul style="list-style-type: none"> <li>• Ongoing efforts to improve disaster-related statistics, and case studies on current practices in Asia-Pacific countries – Ms. Monina G. Collado, ESCAP consultant</li> </ul> <p>Panel Discussion: 10 minutes each (50 minutes)</p> <p>Country sharing: <i>Responding to the five questions to highlight current practices</i></p> <ul style="list-style-type: none"> <li>○ Mr. Pema Thinley, ICT/GIS Officer, Department of Disaster Management, Ministry of Home and Cultural Affairs, Bhutan</li> <li>○ Mr. Poasa, Naimila, Acting Statistician-Demography, Fiji Bureau of Statistics, Fiji Bureau of Statistics, Fiji</li> <li>○ Mr. Artavazd Davtyan, Deputy Head, Department of Rescue Forces, Rescue Services, Ministry of Emergency Situations, Armenia</li> <li>○ Mr. Agus Wibowo, Head, Data Division, National Agency for Disaster Management, BNPB, Indonesia</li> <li>○ Ms. Hae Ryun Kim, Deputy Director, Research Planning Division, Statistical Research Institutes, Statistics Korea,</li> </ul> <p>Questions to panellists:</p> <ol style="list-style-type: none"> <li>1. How do you define “disaster event” in your country? And what criteria do you use to differentiate it from just hazard event?</li> <li>2. Who are the disaster data “users” and who are the “suppliers” in your country?</li> <li>3. How do you define the beginning and end of a disaster period?</li> <li>4. How do you define and classify the “disaster-affected” population? And how do you determine whether a death or injury occurring during a disaster is caused by the disaster?</li> <li>5. What types of material damage is covered in disaster impact assessments, and how do you estimate the monetised value of such impacts?</li> </ol> <p>Q&amp;A (20 minutes)</p> <p><u>References:</u></p> <p>1) <i>Background paper 3: Synthesis of Country Case Studies on Disaster-Related Statistics</i></p>
16:30 – 16:45	Summary of Day 1 (Mr. Puji Pujiono, ESCAP)

Day 2	
09:00 – 10:15	<p><b>Keynote speech by the Government of Japan: Dr. Saturo Nishikawa, Vice-President, Japan Water Agency.</b></p> <p><b>Session 5: Definition and classification of disasters</b></p> <p><i>Expected results: participants agree on principles and criteria for establishing agreed definition of disaster occurrence and classification of disaster types</i></p> <p>Moderator: Dr. Lisa Grace Bersales, National Statistician, Philippines Statistics Authority, Chair of ESCAP Committee on Statistics</p> <p>Presentations: 15 minutes each (45 minutes)</p> <ul style="list-style-type: none"> <li>• Classifying disaster events in the EM-DAT – Dr. Debarati Guha Sapir, CRED</li> <li>• Disaster classification in GLIDE – Mr. Arakida, Senior Researcher, ADRC</li> <li>• Defining disaster occurrence for statistical purposes; analysis of existing disaster classifications – Mr. Teerapong Praphotjanaporn, ESCAP</li> </ul> <p>Q&amp;A (30 minutes)</p>
10:15 – 10:30	Coffee Break
10:30 – 11:30	<p><b>Session 5 (cont'd): Definition and classification of disasters</b></p> <p>Break-out group discussion (1hour)</p> <p>Key questions for the groups:</p> <ul style="list-style-type: none"> <li>- What are the criteria for a “disaster occurrence”?</li> <li>- What are the major groupings of disaster types?</li> <li>- What are the classifications within those groups of disaster types?</li> </ul>
11:30 – 12:30	Lunch
12:30 – 13:30	<p><b>Session 5 (cont'd): Definition and classification of disasters</b></p> <p>Presentations from the groups and plenary discussion (1 hour)</p> <p><i>References:</i></p> <ol style="list-style-type: none"> <li>1) <i>Background paper 4: Defining Disaster Occurrences for Statistical Purposes</i></li> <li>2) <i>Background paper 5: Disaster Type Classifications</i></li> </ol>
13:30 – 14:30	<p><b>Session 6: Disaster impact measurement</b></p> <p><i>Expected results: participants agree on principles for producing comparable measurements for assessing the impacts of disasters.</i></p> <p>Moderator: Mr. Yanhong Zhang, ESCAP</p> <p>Presentations: 15 minutes each (30 minutes)</p> <ul style="list-style-type: none"> <li>• Recording disaster losses: European Union experience, Mr. Daniele Ehrlich, JRC</li> <li>• Damage and losses methodology, Mr. Jack Campbell, Disaster risk specialist, World Bank, Tokyo</li> </ul> <p>Q&amp;A (30 minutes)</p>

14:30 – 14:45	Coffee Break
14:45 – 17:00	<p><b>Session 6 (cont'd): Disaster impact measurement</b></p> <p>Break-out group discussion (1h15)</p> <p>Key questions for the groups:</p> <ul style="list-style-type: none"> <li>- How to define disaster impacts on the population?</li> <li>- How to define material damage from disasters?</li> <li>- How to monetize the impacts?</li> </ul> <p>Presentations from the groups and plenary discussion (1 hour)</p> <p><i>References:</i></p> <p>1) <i>Background paper 6: Disaster Impact Statistics</i>  2) <i>Recording Disaster Losses, JRC</i></p>
17:00 – 17:15	Summary of Day 2 (Mr. Yanhong Zhang, ESCAP)
Day 3	
09:00 – 10:15	<p><b>Session 7: Way forward and work plan</b></p> <p><u><i>Expected results: the Expert Group agrees on its work plan.</i></u></p> <p>Moderator: Chair of the Expert Group</p> <p>Presentation: Suggested elements of a work plan for the Expert Group – ESCAP Secretariat</p> <p>Plenary discussion on</p> <ul style="list-style-type: none"> <li>• Work plan (future outputs, roles, schedule, etc.)</li> <li>• Communication strategies for the work of the group</li> </ul> <p>Key questions:</p> <ul style="list-style-type: none"> <li>- What are the expected activities and working arrangements of the Expert Group?</li> <li>- What are the immediate and longer-term deliverables?</li> <li>- What are the outlets for the work of the Expert Group?</li> </ul> <p><i>References:</i></p> <p>1) <i>Background paper 7: Outline Strategy for the Work of the Expert Group</i></p>
10:15 – 10:30	Coffee Break
10:30 – 11:30	<p><b>Session 8: Conclusions and recommendations</b></p> <p><u><i>Expected results: the Expert Group agrees on the conclusions and recommendations from its first meeting.</i></u></p> <p>Moderator: Chair of the Expert Group</p> <p>Presentation: Draft conclusions and recommendations – ESCAP Secretariat</p> <p>Wrap-up of the meeting by the Chair of the Expert Group</p>
11:30 – 13:00	Lunch
13:00 –	Field Trip to Tsunami affected area and its recovery process
	End of the Meeting

## CODATA Task Group

### “Linked Open Data for Global Disaster Risk Research”

*Approved by the CODATA 28<sup>th</sup> General Assembly, Taipei, 2012*

#### Objectives

In-depth analysis of the current state of disaster scientific data management and acquisition patterns indicates a great need for interconnection of dispersed scientific data related to disaster risk assessment and mitigation. Today, large amounts of disaster related scientific data exist, such as data from monitoring equipment, base maps, evaluation, progress, socio-economic statistics, and so on. They are typically dispersed geographically and owned by various government agencies, research centres, groups and, sometimes, individuals around the world. Task group of LODGD will study the mechanism for connecting such data to enable easier and faster discovery and access, and significantly reduce the barriers that researchers are facing today due to limited interconnection of various disaster-related data. The task group will research on a unified data query and retrieval method by attributes of disaster events in response to research need for data and information related to past disaster events. As live demonstration, the LODGD will push forward to setup a regional or global metadata discovery infrastructure of disaster related scientific data for a selected set of important past disaster events.

#### Membership

LODGD TG has a team with following 10 members. Three co-chairs are nominated to be considered by CODATA: Guoqing Li (CEODE), Michael Rast (ESA), and IRDR-DATA (Angelika Wirtz and Susan CUTTER).

Name	Institute	Experience and Background
Guoqing Li (Co-Chair)	Centre for Earth Observation and Digital Earth, China	Extensive knowledge and experience with remote sensing, spatial data infrastructure and disaster data management. Long time service in international organizations, such as CEOS, GEOSS, APN and ICSU.
Shuichi Iwata	University of Tokyo, Japan	Extensive knowledge and experience with scientific data policy and CODATA affair. Former president of CODATA and a member of the CODATA disaster data working group.
Chuang Liu	Institute of Geography and Natural Resources, China	Extensive knowledge and experience on geographic and data science. Long time service in international organizations, including UNGAID, CODATA and CEOS. The winner of the CODATA prize. Former member of the CODATA disaster data working group.
Dr. Jan Eichner (Co-Chair)	Geo Risks Research, Munich Re, Germany	Extensive knowledge and experience in global disaster risk research and dataset management. Serving as Co-Chair of the IRDR DATA Working Group.
Jiahua Pan	Institute for Urban & Environmental Studies, CASS,	Extensive knowledge and experience on world economy and environmental and natural resource economics research. Long time services on IPCC

	China	and UNDP, etc
Pakorn Apaphant	GISTDA Thailand	Extensive knowledge and experience with remote sensing and disaster information analysis. Former chair of CEOS/WGISS, and leader of ASEN disaster network project.
Michael Rast (Co-Chair)	European Space Agency (ESA/ESRIN)	Extensive knowledge and experience with data sharing and leader of a number of EU activities to support Supersite.
Jan-Ming Ho	Division of Planning and Evaluation, National Science Council of Taipei	Extensive knowledge and experience on digital library and archive technologies. Representative of IRDR IOC in Taipei of city disaster research.
Carol Song	Rosen Centre for Advance Computing, Purdue University, US	Extensive knowledge and experience with cyber infrastructure technology and information systems. Chair of XSEDE Service Provider Forum (NSF), and leading several data centric research projects (drought information network, climate change impact on agriculture, GEOSHARE, etc).
Susan L. Cutter (Co-Chair)	Hazard & Vulnerability Research Institute, University of South Carolina, SC 29208, USA	Serving as Co-Chair of the IRDR DATA Working Group.

## Expected Output

### 1. White Paper

A whitepaper will be released at the end of this stage. It will provide an assessment of the current state of integrative utilization of distributed disaster datasets, technical and policy requirements for such use, challenges and potential implementations. Workshops will be organized to gather community input, define the scope of work and encourage community involvement.

### 2. Demonstration of Metadata level Disaster Data Infrastructure

The demonstration application and web resource will be developed and delivered during the second stage. Study cases in some regions or countries with high disaster influence or potential will be selected and used in the demonstration.

### 3. International Cooperation on Disaster Metadata Clearinghouse

Advertise the disaster metadata clearinghouse concept and encourage the involved agencies and organizations around the world to embrace this concept to strengthen the international cooperation on disaster data management and data sharing.

(Source: <http://www.codata.org/task-groups/linked-open-data-for-global-disaster-risk-research>)

Editorial.

The forensic investigation of root causes and the post – 2015 framework for disaster risk reduction.

The 3<sup>rd</sup> United Nations World Conference on Disasters is scheduled for 14 – 18 March, 2015 in Sendai, Japan. This provides an opportunity if not a professional obligation to reflect on both the advances and the gaps in relevant research, and on the extent to which research results have been realized. For some time now a revolutionary shift has been emerging in the research community that should concentrate many minds. It is the understanding that the conventional explanations for disasters built around the concepts of exposure and vulnerability are not by themselves sufficient. There are deeper, root causes that need to be better identified, verified, analyzed and made transparent. When the overwhelming majority agree and support this new thinking, then the revolution itself is over. What remains is the challenge expressed in a single question. “How do we move from a political ecology of disasters that locates causality in the systemic features of society to meaningful action in those entrenched systems?” (Oliver-Smith 2013). The new thinking has not been translated into realized results.

A partial answer lies in research that can provide evidence for the innovative policies and management required. This is the context for forensic investigations that can focus on the underlying or root causes of disasters. It is necessary despite earlier innovations that placed more emphasis on public exposure and people’s vulnerability. Such research has largely fallen short of providing sufficient evidence-based results to overcome the obstacles to innovation or to provoke fundamentally changed policies or management capabilities in the pursuit or risk sensitive development. On the contrary it has often served to excuse the creation of future risks.

After having identified the shift to a greater recognition of vulnerability since about the 1970’s Anthony Oliver-Smith and others continue to question why with “the resulting huge accumulation of knowledge and data, there has been so little progress in reducing the impacts of socio-natural disasters?” (Oliver-Smith 2013, White, Kates, and Burton 2001). The now widely accepted response in the research community is that citing exposure and vulnerability as valid causes simply does not go far enough. (Alexander and Davis 2012). More penetrating research is needed into the root causes of growing exposure and vulnerability.

Three organizations have joined their considerable efforts to support such a more penetrating line of disaster research. The International Council for Science (ICSU), the International Social Sciences Council (ISSC) and the United Nations International Strategy for Disaster Reduction (ISDR) have collaborated to create a new international research programme known as Integrated Research on Disaster Risk (International Council for Science 2008). This programme has provided the leadership to visualize and provide the substance for the Forensic Investigations of Disaster project or FORIN (Burton 2010, Integrated Research on Disaster Risk 2011). The FORIN project is presently creating a research design that makes its own rationale especially relevant to the Sendai Conference. The initial formulation of the forensic approach was presented in the paper FORIN Project No. 1. (IRDR 2011). It proposed a set of integrated, longitudinal case studies which address a common set of issues through comparable methods. They are designed to probe as deeply as possible into the underlying causes of disaster so that

cross-study meta-analysis can be made. This allows the FORIN studies to search for systemic causes which are not determined solely by the unique circumstances of particular events or the locations or countries in which they occur. The objective is to establish evidence-based results that can be used at all levels of disaster management and policy and practice. It is anticipated that such enquiry can foster and enhance the implementation of the new international framework for disaster reduction which is expected to be adopted at the Sendai World Conference.

In the four years since FORIN began a number of pilot studies have been initiated using the FORIN template. Six of these studies are being independently evaluated together with 45 similar studies in a draft report currently being circulated for professional comment. (Fraser, Patterson, and Pelling 2014). The draft report makes five suggestions for the further development of the disaster forensic methods which can be summarised as follows: i) develop improved understanding of governance contexts for disaster management; ii) identify the relative roles of parts of the disaster cycle in perpetuating specific types of risk; iii) integrate backward looking (historical) and forward focussed (project future) analysis; iv) develop methods to analyze causal pathways and relationships; and v) develop FORIN indicators to compare analyses over time in order to assess the cumulative impacts of FORIN. IRDR is currently considering a revised FORIN method and developing a research and implementation plan to engage a second generation of forensic investigations that will be more numerous, more coherent and more consistent analyses. It is expected that this work in progress will both inform the World Conference in Sendai and facilitate the application of the new framework.

These efforts respond to the stated purposes and objectives of Sendai “to review the implementation of the Hyogo Framework for Action (HFA 2005-2015) and to adopt a post-2015 framework for disaster risk reduction”. At the First Session of the Preparation Committee for Sendai (Geneva 14 – 15 July 2014) the UNISDR Secretariat reported that while progress had been made on most of the priorities for action in the HFA “countries report less progress in Priority for Action 4. on reducing the underlying risk factors and tackling the causes of risk creation”. ([www.ISDR.org](http://www.ISDR.org)). Forensic investigations offer a means to meet this need. More importantly from the perspective of the post-2015 framework, FORIN provides a mechanism for carrying out research that can help to improve policy and practice at the international level. A Note by the Secretariat for the First Session of the Preparation Committee for Sendai states that “the primary responsibility to holistically manage risks rests with countries”. The note goes on to state: “While the causes and consequences of risk may be national, transboundary or global in scope, disaster risks have local and specific characteristics and their management requires the full engagement of local communities, leaders, and administrators and the respect of local and indigenous knowledge”. The Note by the Secretariat does not comment to a similar extent on the recognition that disaster causes may be transboundary or global in scope. By drawing upon the integrated character of forensic investigations the post – 2015 Framework could include a stronger initiative to meet the global dimensions of disaster risk through orchestrated and comparable case studies. Let us not fail in our obligations. Whatever the frequency, magnitude, and distribution of future disasters, they will reflect the choices we are now making on how to manage our environment, how to allocate our resources, and how to live with each other as peoples and countries. Such choices partly depend on the design and application of research.



Ian Burton.

University of Toronto.

The author wishes to thank Terry Cannon, Terry Jeggle, and Anthony Oliver-Smith for their constructive comments and critiques of a draft of this editorial.

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## PROGRESS REPORT AND PROPOSALS ON FORIN TO SENDAI PREPCON II ICSU - ISSC - UNISDR.

Integrated Research on Disaster Risk Reduction. (IRDR)

FORIN. Project on Forensic Investigations of Disaster.

This report is submitted by the IRDR working group on FORIN. September 2014.

### **Policy Maker's Summary and Proposals.**

This report describes the establishment of the Project on Forensic Investigations of Disaster in 2010 and the progress that has been made in its first four years. Activities are summarized together with the results of an independent evaluation. In the light of experience and the independent evaluation the next phase of FORIN is being prepared and a new and revised template will be developed at an expert meeting in Paris 10-12 November 2014, designed to be of help in furthering the post-Sendai mechanism for disaster risk reduction. Some preliminary indication is given of the possible outcomes that are expected to emerge. In order to strengthen the work under Priority for Action 4 in the Hyogo Framework for Action and its successor mechanism, three proposals are made to formally and specifically include FORIN in the Sendai mechanism; to establish a Working Group; and to link with the proposed International Science Advisory Mechanism.

### **1. Background Context.**

The FORIN Project was established by IRDR in 2010 and is part of the overall IRDR Programme with its International Programme Office in Beijing, China. Its main objective is to increase and strengthen the knowledge that underlies evidence-based policy making for disasters and disaster risk management at all levels of governance and all geographical scales. That there is insufficient understanding of the underlying or root causes of disasters, including their increased frequency and magnitude is generally acknowledged in the world-wide disaster research, management, and policy communities. FORIN is an international response (including both non-governmental and intergovernmental organizations) to address this knowledge deficiency. The FORIN template (2011) formalizes the analytical space and agenda for root cause research, empowering a form of analysis that conceptualizes disasters as intrinsic to development and societal processes.

The FORIN vision includes the idea of moving incrementally towards a mechanism for the investigation of disasters triggered by extreme geophysical events that will be analogous to the investigations made by Transport Safety Boards in a framework of international cooperation, which have contributed in a major way to the increase in air passenger safety over the past several decades. Towards this end, the FORIN Project proposes a series of case studies that use a common methodology thus allowing for broader and more penetrating conclusions to be reached. These results it is hypothesized will go beyond the location and time-specific findings that commonly emerge from single one-off investigations and will help to identify underlying and system-wide causes in a manner that permits more effective disaster risk management. A template for forensic studies including methodologies and core questions was published in 2011 (Forensic Investigations of Disasters. FORIN Publication No. 1. IRDR Beijing) and has been widely circulated and used in a number of case studies.

## **2. Activities 2010 - 2014.**

In the 3 year period since the publication of the FORIN template, the perspective and methodology have achieved significant recognition internationally. It has proved to be a key component in the design and organization of five major research projects (Castillo 2013; Faustino-Eslava 2013; Huang et al 2013; Naruchaikusol 2013; Vojinovic 2013). In addition, four FORIN workshops for advanced students have been held; in Taiwan at the Academia Sinica (3/11-20/12); in the United States at the meeting of the International Union of Geodesy and Geophysics and the Geophysical Risk and Sustainability conference on Extreme Natural Hazards and their Impacts at Chapman University (12/8-11/12); and in Mexico at the Universidad de Ciencias y Artes de Chiapas (6/30-7/5/13) and the Universidad Nacional Autónoma de México (2/24-5/14) (Alcántara Ayala and Oliver-Smith 2014). In addition, FORIN has figured importantly as a methodological perspective and guide in 45 published articles in a broad array of professional journals and in presentations in scientific meetings of a wide variety of disciplines and topical area studies.

## **3. Independent Evaluation.**

An independent evaluation of the first 3 years of FORIN has now been made (Fraser et al 2014). This includes a review of the methodology and the existing case studies including five studies that closely follow at least some elements of the template and another 45 similar studies that follow the forensic approach without explicit use of the template.

The following statements taken from the evaluation give an indication of its generally favourable review:

"...the distinguishing feature and main utility of the broad FORIN framework is that it gives power to analysis that conceptualises disasters as intrinsic to development and societal processes more broadly, based on its interdisciplinary and comprehensiveness. As seen through the case study analysis, the approach aims to integrate different scales of analysis and is revealing of the interactions between socio-economic and political and risk dynamics. Its objectives, methods and questions are broad enough to allow for its adaptation to different contexts and forms of risk. FORIN's methodological approach also fosters the inclusion of multiple stakeholders in the research process and the innovation of the FORIN narrative allows for rapid studies that can be expanded over time."

The evaluation recognises the need for a revised version of the FORIN template in the light of experience and the case studies and proposes 5 "core elements" for the further development of FORIN. These are:

- a. Developing our understanding of the governance context for disaster management.
- b. The role of the disasters cycle in perpetuating risk.
- c. Integrating backward looking and forward looking analysis.
- d. Developing methods for analyzing causal pathways.
- e. Developing FORIN indicators for comparative analysis over time and through which to assess the impact of FORIN.

## **4. Work in Progress.**

In addition to some ongoing case studies, steps are now in place to revise the FORIN template. The first meeting of a Working Group established for this purpose is planned for November 10 – 12, 2014 in Paris, immediately prior to Prep Com II. It is not possible to anticipate in any detail the outcome of the Paris meeting, but a verbal report could certainly be made at Prep Com II.

### **5. The programme and potential of FORIN post-2015. (post-Sendai).**

While specific elements of the discussion at the Paris workshop will be subject to change, a general outline of the agenda is possible. As the principle component of its core methodology, causal pathways and the kinds of data required to establish causal links will be central concerns for the advanced version of FORIN. Methods for causal analysis, including possible causal loops and feedbacks, will be developed, drawing on both longitudinal analysis and projective scenario building to trace the development of past and present risk and potential future risk in cultural, social, political and economic practice. Methodological strategies to establish causal chains of explanation will be explored in depth as well. In addition, data needs to substantiate linkages of causal factors will also be detailed.

The advanced version of FORIN will also focus on elements of governance that drive disasters or disaster reduction, such as the role of performance and interpretation in the organizational responses to disaster, institutional culture and beliefs, barriers to communication and understanding between institutions, their dynamics across scales, information sharing and bureaucratic compartmentalization within institutions. The advanced version of FORIN will interrogate the notion of the risk continuum and the movement from impact to recovery in the reduction or expansion of risk. An additional focus will be the institutional capabilities to assess and manage risk (and the developmental drivers of risk) including the prevalence of command and control models, by different kinds of political regimes that vary according to value orientation, and social and cultural foundations (Fraser et al 2014).

The new version of FORIN will critically engage standard development concepts, projects and practices for their role in the construction of risk. Disaster risk and social vulnerability are in large measure the products of historical and existing processes of social and economic development. However, despite publicized attention of international development agencies to risk reduction to natural hazards, contemporary forms of development as enacted generally give it little priority in planning or programs, with political focus and funding still largely centered on emergency management. The advanced version of FORIN will address the inconsistencies and contradictions in current development policies and models of development as well as the huge imbalances in power at international and national levels.

A recent call for the increased use of scientific information in disaster risk reduction and resilience underscores the need for guidance on methodologies, taxonomies and terminology in scientific research on disasters (Welcome Trust 2014). The concern for terminological clarity and consistency on the concepts of root cause, critical cause, vulnerability, resilience, adaptation, risk, disaster risk reduction, and others that have played central if somewhat debated roles in framing and developing responses to disasters particularly when risk assessments are applied and how these affect action to mitigate root causes of disasters. However, definitions vary significantly, on issues of temporal and spatial scales, cross scale interactions and the fundamental units of analysis and application. Each of them thus involves perspectives that have the potential to either reveal or obscure important questions, presenting complex problems for both analysis and application.

FORIN research seeks to dispel the widespread but incorrect perception that disasters are independent events that happen in specific places to specific communities. Each one is perceived as unique and separate. FORIN postulates that disasters are linked both by systemic causes and by their widespread and expanding consequences in what can be termed an epidemiology of disasters. Meta-analytical methods will be employed to establish the bases for comparison for the identification of the characteristics of an epidemiology of disasters.

The complexity of disasters and the need for integrated, interdisciplinary and holistic research will also be addressed. Research projects that are capable of capturing the multiple drivers, and the inter-dependencies that combine to generate disasters require an organizational methodology that draws on joint, reciprocal framing of research questions, involving multiple stakeholders and multiple methodologies in the design, execution and application of research (Hackmann 2012). A framework will be sought for the design of integrated, multi-disciplinary research projects on the root causes of disasters.

The advanced version of FORIN will also seek to develop tools derived from research on root causes for policy formation and analysis. Research on root causes will enable policy makers to trace causal trajectories in the construction of social vulnerability and the occupation of zones of high exposure to hazards as well as environmental and social processes that are increasing risk. Identifying the pathways created by root causes will enable policy makers to make changes that do more than address the symptoms that are manifested in high vulnerability, exposure and risk, thus increasing the resilience of communities. In addition, indicators will be sought for evaluating the use of science in decision making on DRR, particularly as regards assessing true costs and benefits of specific development strategies as well as policy initiatives for disaster risk reduction. Such assessments will prove central in the assessment of accountability and responsibility for root causes and outcomes.

## **6. Proposals.**

The further development and application of the forensic approach to investigating the root causes of disasters can make a significant contribution to the achievement of Priority for Action 4. in the Hyogo framework for action. (HFA). It has been reported by the UNISDR Secretariat that while considerable progress has been made on most of the priorities for action in the HFA "countries report less progress in Priority for Action 4 on reducing the underlying risk factors and tracking the causes of risk creation". ([www.UNISDR.org](http://www.UNISDR.org))

In order to take advantage of the preparatory work undertaken by ISDR - FORIN the following initiatives are proposed:

1. Formally and specifically incorporate FORIN into the text of any Declaration or Framework for Action or similar instrument that is agreed at Sendai, with the intention to support and facilitate the development of a 5 year plan of further research and application.
2. Establish a Working Group under and within the Sendai mechanism or programme, to cooperate with the ICSU - ISSC - and UNISDR in the further implementation of FORIN.
3. Link the work of FORIN to the proposed International Science Advisory Mechanism for Disaster Risk Reduction to Strengthen Resilience.

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## **A Review of the FORIN Methodology and Existing FORIN Case Studies**

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### **Abstract**

The paper reviews the FORIN (FORnsic INvestigations of disasters) methodology for understanding the root causes of disaster events with the aim of developing its use across scales and types of disaster event. It is based on an assessment of existing case studies that have formally adopted the FORIN framework. The paper highlights how FORIN provides a broad and adaptable framework for the holistic assessment of root causes. It also outlines five key challenges to FORIN: 1. Developing our understanding of the governance context for disaster management, 2. The role of the disasters cycle in perpetuating risk, 3. Integrating backward-looking and forward-looking analysis, 4. Developing methods for analysing causal pathways and 5. Developing FORIN indicators for comparative analysis over time and through which to improve the policy update of FORIN and potentially assess its impact.

### **1 Introduction**

This review of FORIN aims to assess FORIN's utility as a conceptual and methodological framework for analysing disaster root causes. Specifically, the review was undertaken as part of the PEARL (Preparing for extreme and rare events in coastal regions) project, which sets out to include a root cause analysis in its assessment of the formation of risk and vulnerability in particular coastal zones<sup>1</sup>. This review is the first step in this analysis, and will be followed by a draft proposal for a revised FORIN framework, based on testing the proposed framework against 40 peer-reviewed studies of European coastal disasters. The final step will be to propose a methodology to be used in PEARL for this revised framework.

The paper proceeds as follows: The second section sets out the main elements of FORIN. The third section examines in more depth the case studies officially undertaken under the rubric of FORIN so far, analysing the utility and limitations of FORIN in each case. The fourth section reviews the FORIN approach in light of the case study analysis and a review of other root cause analysis frameworks. The fifth section concludes with recommendations for the development of the FORIN methodology.

### **2 What is FORIN?**

#### **2.1 Aim, justification and hypotheses**

FORIN (FORnsic INvestigations of disasters) is an investigative multi-disciplinary framework that aims to uncover, and then promote learning from, the root causes of disaster losses and risk by examining policy, management, social and cultural, and emergency response decisions made before, during and after disaster events. FORIN aims to deepen the spatial and temporal scales of disaster analysis and integrate a systematic understanding of the links between disasters and development. It does so by promoting independent, scientific investigations of disaster causes which aim to shift

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<sup>1</sup> For more details, see <http://www.pearl-fp7.eu/>

the paradigm of disaster management policies towards more holistic approaches which also address the underlying factors that precipitate disaster losses and damage.

Although the noticeable growth in losses from disaster events is often attributed to increases in human population and material wealth, and their expansion into more hazardous locations, this is not a complete explanation of a now recognisable phenomenon. Since major disasters continue to occur through the developing and developed world, in turn suggests that there must be more to the explanation than access to science and technology, and choice of location, and resource scarcity (Birkmann 2012; Adger et al. 2005). In addition, the vast majority of these studies into the causes and consequence of a disaster event are conducted in isolation from those most intimately involved and ultimately responsible for disaster risk planning and management. The FORIN methodology has been specially developed to fill the deficit and deficiency in existing research on disasters by reducing these barriers and incorporating a more inclusive approach.

Through the development of a multidisciplinary framework with a common set of fundamental questions explicitly designed and enacted to provide an in-depth investigation of a range of disaster events, FORIN is utilisable at various scales. FORIN studies seek to address four key hypotheses that have been identified as inherent to a reduction in vulnerability to disasters:

1. The risk reduction hypothesis
  - greater accountability, visibility and transparency of risk reduction processes being employed would enable and stimulate improved disaster risk reduction
2. The integration hypothesis
  - integrated and participatory research is required to yield more useful and effective results
3. The responsibility hypothesis
  - precise identification and structuring of responsibilities and accountability both for creation and/or the prevention of the growth disaster risk is key in reduction of that risk
4. The communication hypothesis
  - intended recipients of disaster risk reduction knowledge are unaware of the insights or alternatively are resistant to the knowledge and information and may feel threatened by it

## 2.2 The FORIN Methodological Framework

The FORIN methodology is based around the development of case studies that answer a set of core questions about responsibility and risk for use with a range of different disaster types. Using the Hyogo Framework for Action (International Strategy for Disaster Reduction 2005) as a foundational reference, FORIN identifies governance as the primary factor in driving disaster risk reduction at multiple scales, and therefore a critical element to address directly (Integrated Research on Disaster Risk 2011). Besides governance, other critical elements (See Figure 1, Source: Integrated Research on Disaster Risk 2011) highlighted by the FORIN framework further reinforce the need to employ a fully integrated research agenda across disciplines in order to maximise the utility of FORIN



generated results across temporal and spatial scales. These addition elements include i) risk assessment, made up of causal agents, social systems and infrastructure, and ii) understanding and awareness of underlying causal processes and outcomes and impacts in terms of sectors, spatial distribution and susceptible populations. Specific research questions that can be investigated across scientific disciplines have been developed for each element of the framework. These include 20 core questions to be directly addressed in each of the case studies according to the specific circumstances and 10 generic questions which can be used to help design a project synthesis report.

Figure 1. A conceptual framework for key questions.



Due to the diverse range of disasters that can be analysed using the FORIN approach, a series of organisational pathways have been identified in order to categorise studies employing part or all of the suggested framework. Initially, four disaster types have been identified which include:

- Specific events (e.g., the Hanshin earthquake, Japan)
- Recurrent events (e.g., floods in Mozambique)
- Thematically important dimensions (e.g., school and hospital safety, trans-boundary risks)
- Risk drivers (e.g., management, poverty, governance, etc.)

In addition to the types of disasters that each study is concerned with, four methodological pathways have been identified. The use of these pathways are dependent on different contexts or motivating interests involved, but they are all guided by the same overall objectives outlined by the FORIN approach. The selection of the appropriate research methodology for a specific event or set of risk conditions is a function of the expertise of the research groups conducting the studies as well as the nature of the case study itself. These pathways have been identified as:

#### 1. Critical cause analysis

- Analyses that seek to identify the root causes of the disaster events. This approach is based on the belief that problems are best solved by attempting to correct or eliminate root causes, as opposed to merely addressing the immediately obvious symptoms.
- Multidisciplinary in nature integrating social, environmental and technical assessments.

## 2. *Meta-analysis*

- Systematic reviews of the available literature carried out to identify and assess consistent findings across diverse studies for causal linkages as well as the effectiveness of interventions

## 3. *Longitudinal analysis*

- Repeated observations of comparable events, either geographically (e.g., two different but essentially comparable places with similar event characteristics where the sequence of actions, decisions, policies, etc. are cross-examined in comparative fashion) or comparative in-situ (same place, two temporally different events, repeat events; or the same place with two different perils).

## 4. *Scenarios of disaster*

- Science-based retrospective re-constructions of specific conditions, causes and responses involved in particular destructive events selected on the basis of a known hazard that represents a realistic and possibly inevitable future event.

As one of its aims, FORIN expects to be able to establish a range of case studies across disaster types as well as methodological approaches in order to more fully understand both the risks posed by disasters as well as how to reduce the increases in catastrophic losses which continue to be realised.

### **3: Review of FORIN Case Studies**

This section shifts from a review of FORIN itself to an assessment of the utility of the methodology as deployed. An analysis of each case study was undertaken and the matrix in Table 1 was used to visualise which components of the FORIN conceptual framework and core questions were covered. Each question was colour coded. The results can be assessed in terms of the comprehensiveness of the methodology deployment, but not of the quality of the methodology or data produced, nor of the impact of any study on practice. As can be seen from the tables (displayed in the Annex), no single study has covered the full range of FORIN questions, although the study of the GEJET by Fujiwara, Sagara and the ICHARM studies use all FORIN methods and cover all the framework elements specified by FORIN.



The FORIN case studies were also analysed for what they tell us about the strengths and limits of, and gaps in FORIN as applied to date. As can be seen from the table below, the strengths of the FORIN approach lie in its conception of disasters as inseparable from both development processes and everyday societal processes; comprehensive analysis that learns from the past to ground sustainable disaster management; inter-disciplinarity; the inclusion of multiple stakeholders; the adaptability of FORIN components and the range of methodological pathways, which allows for scenario analysis alongside historical methods. Limits included defining the scope of FORIN and allowing for the analysis of changes in imperceptible ‘climate normals’ alongside disaster events. Common gaps included methods and concepts for analysing causal relationships.

**Table 2: Summary of the strengths, limits and gaps in FORIN in case study applications of the approach**

Study	Strengths of FORIN	Limits of FORIN	Gaps in FORIN
Naruchaikusol, Beckman & Mocjizuki 2013	<p>Allows for investigation inter-play disaster risk and development processes at different scales and effects of cumulative decision-making at these scales</p> <p>Scenario method allows integration of predictive methods</p>		
Huang et al. 2013	<p>Conceptual view of disaster as inseparable from everyday and wider development and societal processes; disasters as result of the outcome of interaction between different systems and different phenomena</p> <p>Inter-disciplinary framework, importance of historical approach for policy learning, allows for synthesis of societal dynamics, pre, during and post disaster, assists comprehensive scenario planning</p>	<p>If disaster is perceived of as societal disturbance, where limits of ‘disaster’ end, how to define relevant stakeholders, what are the criteria for setting a generic framework across different disaster types, what are the implications for policy from this comprehensive view</p>	<p>Authors turn to systems theory for conceptual and methodological basis for the analysis of causal pathways; use to establish most critical phenomena and main ‘storylines’ that explain their relationship</p>

Castillo et al. 2013	<p>Use of comprehensive, inter-disciplinary approach that integrates perspectives of different stakeholders</p> <p>Adaptability of hypotheses, objectives and methods of FORIN to context of climate change</p> <p>(Also innovation of the FORIN narrative allowed for preliminary studies to be produced)</p>	<p>Influence of long-run changes in climate 'normals'</p> <p>Practical challenges of inter-sectoral work</p>	<p>Models used to enhance the predictive capacities of the FORIN approach, allowing analysis of common variables affecting risk and resilience to disasters and climate change</p> <p>Objectives modified to include element related to transformational change</p> <p>The original FORIN framework was also modified to include a more explicit characterisation of risk (as the holistic analysis of hazard, exposure and vulnerability in the past, the present and projected into the future), the research cycle itself and capacity building as a core element by which the research results are implemented.</p> <p>The report also included modifications made to the core questions to adapt them for the context of climate change.</p>
Faustino-Eslava et al. 2013	<p>Use of FORIN as a predictive tool even where there is no history of disaster</p> <p>Inclusion of multiple stakeholders in discussions of risk mitigation measures</p>		
Fujiwara, Sagara & ICHARM studies of			Questions around damage to

GEJET			infrastructure networks, and damage propagation between networks
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### 3. Critical Analysis of the FORIN approach

FORIN's overall approach can be described as one aiming at a 'root cause analysis'. Root cause analysis has no generally agreed definition. FORIN makes a key contribution in formalising this analytical space and agenda. Root cause analysis has been described as "a structured investigation that aims to identify the true cause of a problem and the actions necessary to eliminate it" (DKKV 2012). These two components – cause and remedy – are shared by FORIN, as is a claim to analytical acuity. The following section assesses FORIN's success drawing on existing FORIN studies and a wider group of non-FORIN studies that have deployed similar approaches.

#### 3.1 The strengths of FORIN as a disaster root cause analysis approach

Arguably the distinguishing feature and main utility of the broad FORIN framework is that it gives power to analysis that conceptualises disasters as intrinsic to development and societal processes more broadly, based on its inter-disciplinary and comprehensiveness. As seen through the case study analysis, this approach aims to integrate different scales of analysis and is revealing of the interactions between socio-economic and political and risk dynamics (Huang et al. 2013; Naruchaikusol, Beckman, and Mochizuki 2013; Castillo 2013). Its objectives, methods and questions are broad enough to allow for its adaptation to different contexts and forms of risk. FORIN's methodological approach also fosters the inclusion of multiple stakeholders in the research process (Faustino-Eslava 2013), and the innovation of the FORIN narrative allows for rapid studies that can be expanded over time (Castillo 2013).

#### 3.2 An analysis of FORIN's analytical elements

The review of FORIN identified 5 core elements for the development of FORIN as an approach to root cause analysis:

1. Developing our understanding of the governance context for disaster management
2. The role of the disasters cycle in perpetuating risk
3. Integrating backward-looking and forward-looking analysis
4. Developing methods for analysing causal pathways
5. Developing FORIN indicators for comparative analysis over time and through which to assess the impact of FORIN

1. Understanding the governance context for disaster management

The governance component of FORIN is arguably the linchpin of the project. However, could different approaches to understanding governance be utilised to unpack more clearly questions of decision-making and capability? Of the 40 studies of disaster causation reviewed for this paper (see Annex 3), particular studies emphasised elements not yet included in FORIN: the role of performance and interpretation in organisational responses to disaster (Adrot 2013), the role of

institutional culture and beliefs (Constantinides 2013) and the lack of communication and understanding between institutions (Emdad Haque 2000). The existing FORIN approach would seem to emphasise an actor-oriented, top down orientation. Other FORIN-inspired studies, such as the STREVA project to examine the root causes of volcanic risk, for example, explore what defines institutional capacity at different scales and how it is influenced by the relationship between formal and informal institutions, networks between different actors and coherence across those scales (Wilkinson 2013). As well as this vertical, multi-scalar conception of tiers of governance, an institutional political economy approach can help unpack the horizontal relationships between different organisations within a particular institutional configuration.

The questions that arise, then, are how institutional capabilities to assess and manage risk (and the developmental drivers of risk) are shaped across these dimensions in the context of different political regimes (Pelling 2003), with different value orientations and social and cultural foundations, at different points in time (in particular when disasters open up 'windows' of opportunity for change)(Birkmann et al. 2010). Further questions might also address the role of disaster narratives in the process of disaster causation and the influence, for example, of the discursive production of disasters as amenable to technical solutions alone, or the labelling of affected communities as 'responsible' in ways that might be contested (Aragon-Durand 2007; Rebotier 2012). This final sense of how notions of responsibility come to be used within the disaster-related discourses of different actors connects most strongly with a view of governance as a set of everyday practices which also influence how risk and vulnerability are experienced (Zeiderman 2012).

The emphasis on knowledge as a core component of institutional capability also raises the issue of the relationship between risk assessment and governance. Risk assessment exercises do not only occur outside governance structures (as a separate element) but are also embedded in them, raising questions about how different knowledge sources are used as well as communicated. This acknowledgement potentially re-frames the hypothesis that the knowledge that exists about disaster risk reduction has not been communicated effectively. Although this is certainly also the case, it suggests the need to pay attention to how scientific understandings of risk are constructed and deployed in particular contexts in ways that may restrict a holistic understanding of vulnerability and risk (rather than take risk knowledge as a given)(Jasanoff 2004; Lane, Landström, and Whatmore 2011).

## 2. The role of the disasters cycle in perpetuating risk

The disasters cycle itself – preparedness, mitigation, response, recovery and reconstruction – is a process embedded in the institutions of governance that influences the occurrence of risk. The post-disaster phase is not simply the end point of the disaster event, but a process in its own right that has its own antecedents in the social, economic and institutional context and forms part of how we understand disasters as complex and unfolding phenomena, rather than single points in time(DKKV 2012). These antecedents merit their own forensic analysis: how and why were particular response options chosen, by what actors and with what results? This is often a neglected area of analysis with similarly few studies tracking decision points in the generation of impact, though recent studies (Whittle et al 2012) indicate the reconstruction process can have a considerable impact on human wellbeing and vulnerability (Birkmann 2011). Problems with accessing insurance payments and

secondary economic costs, as well as gains in reconstruction may be more important in some instances than the initial disaster. In addition, disasters might also be intensified and risks continue due to inappropriate disaster response strategies (DKKV 2012). The nature of response and recovery determines how existing vulnerabilities are ameliorated or exacerbated and may preclude as well as enable policy and planning changes for enhanced resilience (IPCC 2012). In addition, FORIN does not identify what sort of recovery or to what scale that recovery should be seen. Here the concepts of resilience and transformation may help measure processes of risk reduction, against the ideal of 'building back better', used but not developed in FORIN documents, and deep structural change that transforms the nature of social relations (Pelling 2011).

### 3. Integrating backward-looking and forward-looking analysis

The FORIN case studies have already demonstrated how scenario-based analysis can be integrated with historical root cause analysis, with both the Thai and Filipino cases using down-scaled climate change models alongside other FORIN methods. In addition, one FORIN case study (and one ongoing FORIN investigation into volcano risk) focuses on providing a baseline analysis of risk in an area under threat, but with no history of disaster (Faustino-Eslava 2013). The predictive capacity and conceptual focus of FORIN in this regard merits further investigation. A FORIN-like approach could be used in conjunction with other predictive analyses, like the social vulnerability index (Cutter et al. 2003) or the disaster risk index (Peduzzi et al. 2009), to identify vulnerability hotspots and enhance pre-disaster actions. Conceptually, the FORIN emphasis on historical root cause analysis could be developed with an approach that moves to understand how historic drivers connect with contemporary manifestations, and might drive risk into the future.

### 4. Developing methods for analysing causal pathways

While FORIN talks in general terms about root causes, in analysing the causal processes that lead to disasters, it may be helpful to make further distinctions about causal types and causal processes. For example, the Root Cause Framework suggested in DKKV 2012 keeps a strong distinction between *drivers* and *root causes* (where drivers are the activities and processes that translate root causes into unsafe conditions, while root causes are the structures and processes that go beyond an individual crisis or event (DKKV 2012). Further to both frameworks, however, is a consideration of how actions and decision-making are set within the interaction of social and ecological processes in ways that are dynamic, and potentially non-linear (Miller et al. 2010). The FORIN case studies used systems analysis as a methodological and conceptual guide for analysing causal processes, through the construction of causal loops and analysis of the strength of different causal phenomena.

### 5. Developing FORIN indicators for comparative analysis over time and through which to assess the impact of FORIN

While the FORIN framework incorporates a number of thematic areas which map onto specific research questions, developing indicators on the basis of these would facilitate analysis of risk over time and across different cases. The development of consistent and useful sets of indicators of both social and natural dimensions of disaster risk poses two distinctly inherent problems with respect to a complexity of the research parameters: (1) keeping the number of indicators manageable and (2) resolving differences in perspectives and terminology between social and natural system scientists



(Loomis et al. 2014). These issues would have to be overcome before a comprehensive methodology could be developed. However, such a methodology could also facilitate both the measurement of the impact of FORIN (assuming that FORIN's impact can be attributed from changes in risk processes). It might also assist in translating the findings of FORIN studies into tractable frameworks that can be utilised by decision-makers to improve disaster management processes (akin to the 'check list' used in the DKKV methodology).

## 5 Conclusions

This paper suggests that FORIN has provided a broad and adaptable approach for the study of disaster root causes, with FORIN's hypotheses, objectives and framework resonating well across a wide range of studies of disaster causation. Studies that have used the FORIN framework have been guided by its principles of holism and multi-disciplinarity and the inclusion of a wide range of stakeholders in the analysis process. Undertaking a 'full' FORIN, however, requires time and resources that have been beyond the scope of most existing studies, although the FORIN narrative approach has been used successfully as a starting point for inter-sectoral analysis.

The paper has also suggested avenues for the development of FORIN in a number of key areas. The implications for FORIN's main components are summarised in the table below:

Framework	<p>Inclusion of the different governance elements that drive disaster reduction, including institutional dynamics across scales</p> <p>Incorporation of the disaster management cycle, including response and recovery, as a driver of disaster and disaster recurrence</p> <p>Incorporation of the idea of transformation, not just 'bouncing back'</p>
Approaches	<p>Discussion of ways in which 'predictive' FORINs could employ predictive tools from the social sciences, such as social vulnerability indices</p> <p>Development of a set of comparison indicators for studies</p> <p>Methods for causal analysis (and possible causal loops and feedbacks) underpinning the framework</p>
Examples of possible additional questions (dependent on context)	<p>How have institutional capabilities across different scales and levels of government influenced disaster risk management?</p> <p>What narratives of disaster have been used by different governance actors and how has the use of these narratives affected actions to mitigate disaster risk?</p> <p>How are risk, hazard and vulnerability defined and used when risk assessments are applied and how does this affect actions to mitigate root causes of disaster?</p>

**Annex 1: Summaries of FORIN Case Studies**

Authors	Naruchaikusol, Beckman & Mocjizuki 2013
Reference	Disaster response and adaptive capacity of upland communities in the face of increasing climate risk. A discussion of changing livelihoods, land use, and natural-resources management in Northern Thailand.
FORIN Study Type	Critical cause analysis and Scenarios of disasters
Disaster Typology	Recurrent events

This study investigated the inter-relationships between land-use changes and adaptive capacity to climate risk in Northern Thailand focusing on how these relationships were influenced by policy-related and economic activities at national, provincial and local levels. The study highlighted numerous climate risks facing marginalized, primarily agricultural communities, including flash floods, heavy rainfall, temperature extremes, and prolonged drought. Extensive details of climatic and environmental conditions, as well as management regimes were discussed. Adaptive management of land-use also formed a key component of this study, and was investigated through extensive stake-holder engagement. A legal and political framework discussion was provided for each study site to provide context for decisions and potential adaptation changes. Policy recommendations for increased disaster risk reduction were made, including the need to establish a comprehensive disaster warning system to improve local emergency-management capacity, especially in the face of the continued risk of landslides post heavy rainfall. Other recommendations into how to improve localised social resilience, including economic and agricultural diversification, and incentives for that practice, were also made.

#### Methodology Used

This study employed expert interviews and community focus groups. Interviews were conducted with farmers and village leaders, both individually and in small groups, using semi-structured interviewing, timelines, and participatory maps of village land use. Group interviews with key informants were also held. Climate change scenarios were discussed as part of the participatory exercises.

#### Utility to FORIN

This is a good example of how to use FORIN as a predictive tool for improvement in long-term disaster management to a recurring threat. The economic structure of these communities was extensively discussed but there was less emphasis on the social structure. Further elucidation of the social values of the communities may have provided more information on potential barriers to disaster risk reduction from a more local scale perspective. Since no one disaster event was being described some of the FORIN questions were not relevant, especially in terms of the outcomes/impacts component of the FORIN framework.

Authors	Huang et al. 2013
Reference	Towards a Generis Framework for Synthesizing the Societal Disturbance from Typhoon Marokot
FORIN Study Type	Meta-analysis
Disaster Typology	Specific event

This study focused on causes of social disturbance after Typhoon Morakot hit southern Taiwan in 2009 leaving 461 people dead, 192 missing and an estimated \$3 billion (USD) in damages. Research initially focused on establishing a disaster event database based on a range of news and information sources, and then classified reported social disturbances in order to categorize cause and effect. Investigation topics emphasized societal issues, social structure, especially government management and administration, and human behaviour. Specific causal loops were generated to demonstrate feedback circulation. The results suggest that disasters are not independent events but an outcome of interactions between different systems (e.g., people, organization, and infrastructure) and between different phenomena (e.g., hazardous waste and household damages).

#### Methodology Used

This study used a meta-analysis approach, specifically the archival literature approach, assisted by textual analysis and methods of induction and deduction, to find phenomena associated with Typhoon Morakot as well as relationships among these phenomena. Documents used included newspaper articles, online new media, academic papers and government publications. Vensim software was then used to develop cause and effect diagrams and describe complex relationships.

#### Utility to FORIN

This study reinforces the flexibility of a FORIN and demonstrates the wide range of investigative studies that can be designed around the framework as it stands. Although many of the core questions are answered during this report, the authors take a more indirect approach in general, so it was difficult to link the material with a specific core question or framework element in the visualisation table. The FORIN approach was used along with a systems theory perspective, which informed the causal analysis.

Authors	Castillo et al. 2013
Reference	Harmonizing FORIN for Climate Change Adaptation and Disaster Risk Management to Develop Multi-sectoral Narratives for Metro Manila.
FORIN Study Type	Longitudinal analysis
Disaster Typology	Recurrent events

This project aimed

1. to adapt the FORIN framework for disaster analyses into a comprehensive climate change action planning and disaster risk management framework,
2. to operationalize the framework by developing FORIN narratives focused on Metro Manila,
3. to attempt to connect key variables, processes and trends into a systems model structure.

This investigation produced discrete FORIN narratives encompassing the physical, social, economic and health sectors in addition to developing sectoral casual loop diagrams and preliminary system model structures. This approach generated extremely comprehensive documentation of existing threats to each sector as well as detailed recommendations for climate change action planning.

### Methodology Used

An initial literature review was performed to determine how FORIN and climate change action planning could be integrated. The expert consultation process utilising the combined framework involved 2-3 experts each from 4 sectors (physical, social, economic and health) to develop a FORIN narrative for each of their sectors for Metro Manila. The social sector report used primarily secondary sources of information including the Disaster and Climate Change Study (2008-2009) conducted in three flood basins of Metro Manila. This study utilized household and community profiling surveys, key informant interviews, and focus group discussion. Orientation meetings and monthly inter-sectoral workshops were held throughout the project lifespan. Dissemination of results to the university community of the Manila Observatory and other interested groups was conducted. Vensim software was used to develop the casual loop diagrams and preliminary system model structures.

### Utility to FORIN

This investigation uses FORIN as a part of a larger, integrated disaster risk management and climate change action planning model to maximise the predictive capabilities of the FORIN approach. This combined integrated model allows analysis of common variables that affect risk and resilience to both climate change and disaster impacts. The new framework preserves the original FORIN principles, such as the need for a comprehensive approach that engages researchers from different fields and stakeholders from different sectors. The case study authors also found the hypotheses, objectives and methods of FORIN to be adaptable to a DRM / CCA framework. The objectives were modified, however, to include an element referring to transformative change. The original FORIN framework was also modified to include a more explicit characterisation of risk (as the holistic analysis of hazard, exposure and vulnerability in the past, the present and projected into the future), the research cycle itself and capacity building as a core element by which the research results are implemented. The report also included modifications made to the core questions to adapt them for the context of climate change. However, due to these modifications, it becomes difficult to assess the report using the visualisation assessment matrix.

As in the case study of Typhoon Marokot, this study used systems analysis to deepen the assessment of the underlying feedbacks and processes between different variables that underpin risk. Several additional challenges were reported by the authors, especially when creating the system models after the FORIN framework had been applied. These included issues with 1) unavailable data on sectoral overlaps after the FORIN narratives were constructed creating the potential for duplication in the models, and 2) data availability for several variables have not been documented or have not been disaggregated at the level

required for the model to truly track changes in impacts and in the associated risks due to climate change and extreme weather events. The authors also discuss the challenges to FORIN in analysing changes in 'climate normals' rather than discrete disaster, events and the challenges to inter-sectoral work.

Authors	Faustino-Eslava et al. 2013
Reference	Predictive Forensics for Averting Possible Disasters: A FORIN Template for Tackling Issues Related to the Valley Fault System and the Angat Dam in Luzon, Philippines.
FORIN Study Type	Scenarios of disasters
Disaster Typology	Specific event and Recurrent event

This report provides extensive background on geohazard risk associated with the Valley Fault System on the Island of Luzon and potential risk associated with any damage to the Angat Dam in the face of repeated geohazard episodes. This study uses the FORIN framework as a predictive set of indicators to enhance disaster risk reduction by investigating the geophysical, social and economic drivers of risk in this region. The biggest challenge identified by the research team is that scientific information currently available at the national agency level is not filtering down to the local communities where that information could be critical to local planning efforts.

#### Methodology Used

A range of geophysical research was conducted using several key methods including: geologic mapping, magnetic surveys, and ground penetrating radar. Focus groups were conducted with local communities to determine risk awareness. Participants included the Municipal Mayors from three communities as well as their Municipal Planning and Development Office as well as 71 residents from the municipalities. Integrated economic analyses were conducted to determine potential economic impacts of flooding scenarios if the Angat Dam was damaged.

#### Utility to FORIN

This study describes how to use FORIN as a predictive tool for improvement in long-term disaster management to a recurring threat. It supplies a highly detailed physical baseline with extensive information regarding the tectonic setting and regional geology of the area that could be vital to a FORIN study in the event of a disaster. The study refers to FORIN's use in relation to the design of the focus groups, and the inclusion of multiple stakeholders in the discussion of possible risk mitigation measures.

Authors	Fujiwara	Sagara 2011	ICHARM
Reference	Scenario Analysis of Mega Earthquake and Tsunami in Central Japan	Critical Cause Analysis of Delayed Evacuation in the Great East Japan Earthquake and Tsunami	Meta and Longitudinal Analyses of High Death Rates of Some Particular Municipalities in GEJET
FORIN Study Type	Scenarios of Disasters	Critical Cause Analysis	Meta-Analysis / Longitudinal
Disaster Typology	Specific event	Specific event	Specific event

\*Review produced from 3 separate power point presentations from the IRDR 2011 conference

These three studies combine to form a FORIN analysis of the Great East Japan Earthquake and Tsunami (GEJET). Each study covered a slightly different aspect of the disaster with components looking at the emergency response and evacuation whilst other components focused on more of a critical cause analysis. A large amount of information describing the events of the GEJET has been generated by these studies including modelling of the impacts on infrastructure and attempting to understand why those impacts were so great in terms of death rate. There is also information generated about why some areas were more impacted than other ones in the form of specific case studies. Large emphasis was placed on understanding failures in evacuation procedure that lead to high numbers of deceased. Although risk-reduction avenues were not specifically presented, much of the information generated can be used to create a lessons learned profile.

#### Methodology Used

Each study used a range of methods including archival analysis of multiple sources, interviews, and GIS modelling. These methods all contribute to the fact that these studies cover all four methodological pathways associated with FORIN. Many of the detailed methods used are hard to assess due to the fact that they are not included in the presentations. This section can be greatly improved once access to reports and papers is established.

#### Utility to FORIN

The combination of these three studies provides the best example of a 'complete' FORIN to date with a range of core questions being covered using multiple methods. The visual matrix highlights overlaps between methods employed. This redundancy provides key comparative possibilities that allow a more comprehensive picture to be formed. It also highlights the difficulty of covering the full range of questions posed by a FORIN study, with legal frameworks and social and power structures seemly the most difficult to cover using the FORIN framework. The identification of specific critical action points (linked specifically to evacuation but relevant on a broader scale) highlight a major avenue of investigation that may be relevant to FORIN. Sagara also suggests the addition of questions around damage to infrastructure networks, and damage propagation between networks.

**Annex 2: Visualisation tables for FORIN Case Studies**

Table 2.1 Visual assessment of FORIN framework areas covered by Naruchaikusol et al.

DISASTER: Continual Flooding Thailand, Sopon Naruchaikusol		FORIN Framework element																																								
		Governance/P priority					Risk Assessment					Understanding/awareness					Outcomes/impacts					Risk reduction					Enhancing resilience															
Methodological pathway		8	11	11a	18	19	G10	1	2	2a	6	7	3	4	5	6	7	20	12	13	14	15	16	17	G2	G6	G9	9	10	G1	G4	G5	G8	15	15a	15b	15c	15d	G3	G7		
<b>Critical cause analysis</b>	Disaster typology																																									
	Specific events																																									
	Recurrent events	x	x					x	x			x	x												x																	
	Thematically important dimensions																																									
<b>Meta-analysis</b>	Specific events																																									
	Recurrent events																																									
	Thematically important dimensions																																									
	Risk drivers																																									
<b>Longitudinal analysis</b>	Specific events																																									
	Recurrent events																																									
	Thematically important dimensions																																									
	Risk drivers																																									
<b>Scenarios of disaster</b>	Specific events																																									
	Recurrent events												x														x	x	x						x						x	
	Thematically important dimensions																																									
	Risk drivers																																									

G11

x



Table 2.2 Visual assessment of FORIN framework areas covered by Huang et al.

DISASTER: (Typhoon Morakot, 2009) Taiwan, Tailin Huang		FORIN Framework element																																						
		Governance/P priority					Risk Assessment					Understanding/awareness					Outcomes/impacts					Risk reduction					Enhancing resilience													
<i>Methodological pathway</i>		8	11	11a	18	19	G10	1	2	2a	6	7	3	4	5	6	7	20	2	13	14	15	16	17	G2	G6	G9	9	10	G1	G4	G5	G8	15	15a	15b	15c	15d	G3	G7
<b>Critical cause analysis</b>	Disaster typology																																							
	Specific events																																							
	Recurrent events																																							
	Thematically important dimensions																																							
<b>Meta-analysis</b>	Risk drivers																																							
	Specific events							x	x	x		x	x	x			x					x															x			
	Recurrent events																																							
	Thematically important dimensions																																							
<b>Longitudinal analysis</b>	Risk drivers																																							
	Specific events																																							
	Recurrent events																																							
	Thematically important dimensions																																							
<b>Scenarios of disaster</b>	Risk drivers																																							
	Specific events																																							
	Recurrent events																																							
	Thematically important dimensions																																							



Table 2.4 Visual assessment of FORIN framework areas covered by Faustino-Eslava et al.

DISASTER: Geohazards Luzon, Philippines, Faustine-Eslava		FORIN Framework element																																						
		Governance/P priority					Risk Assessment					Understanding/awareness					Outcomes/impacts					Risk reduction				Enhancing resilience														
<i>Methodological pathway</i>		8	11	11a	18	19	G10	1	2	2a	6	7	3	4	5	6	7	20	2	13	14	15	16	17	G2	G6	G9	9	10	G1	G4	G5	G8	15	15a	15b	15c	15d	G3	G7
Disaster typology																																								
<b>Critical cause analysis</b>	Specific events																																							
	Recurrent events																																							
	Thematically important dimensions																																							
	Risk drivers																																							
<b>Meta-analysis</b>	Specific events																																							
	Recurrent events																																							
	Thematically important dimensions																																							
	Risk drivers																																							
<b>Longitudinal analysis</b>	Specific events																																							
	Recurrent events																																							
	Thematically important dimensions																																							
	Risk drivers																																							
<b>Scenarios of disaster</b>	Specific events	x						x	x				x	x	x		x	x		x						x	x	x										x	x	
	Recurrent events	x						x	x				x	x	x		x	x		x					x	x	x										x	x		
	Thematically important dimensions																																							
	Risk drivers																																							

Table 2.5 Visual assessment of FORIN framework areas covered by Fujiwara, Sagara and ICHARM studies (GEJET)

DISASTER: Great East Japan Earthquake and Tsunami 2011		FORIN Framework element																													
Japan	Governance/Priority	Risk Assessment					Understanding/awareness					Outcomes/impacts					Risk reduction					Enhancing resilience									
		8	11	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	1k	1l	1m	1n	1o	1p	1q	1r	1s	1t	1u	1v	1w	1x	1y	1z		
Methodological pathway		1					2					3					4					5					6				
Disaster typology		8	11	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	1k	1l	1m	1n	1o	1p	1q	1r	1s	1t	1u	1v	1w	1x	1y	1z		
<b>Critical cause analysis</b>	Specific events	x	x																												
	Recurrent events																														
	Thematically important dimensions																														
	Risk drivers																														
<b>Meta-analysis</b>	Specific events																														
	Recurrent events																														
	Thematically important dimensions																														
	Risk drivers																														
<b>Longitudinal analysis</b>	Specific events																														
	Recurrent events																														
	Thematically important dimensions																														
	Risk drivers																														
<b>Scenarios of disaster</b>	Specific events																														
	Recurrent events																														
	Thematically important dimensions																														
	Risk drivers																														

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## **Concept Note: A FORIN Disaster Research Workshop Program**

**Anthony Oliver-Smith, Irasema Alcántara Ayala (FORIN project Co-chairs)**

### **Introduction:**

Over the last half century, despite a major paradigm shift and the resulting huge accumulation of knowledge and data, we have still seen relatively little progress in reducing the impacts of socio-natural disasters, particularly, but not exclusively in the developing world. Such an outcome suggests a deficiency in much existing research on disasters that generally seems to concern itself with the more immediate physical/material aspects of hazards or disasters at the expense of exploring more deeply the longer-term, underlying causes of disasters. To address this lack, the Integrated Research on Disaster Risk (IRDR) Scientific Committee of the International Council for Science (ICSU) has developed a research template called Forensic Investigations of Disasters (FORIN), with detailed procedures and methods, based on the premise that solutions to serious problems must be based on in depth knowledge of critical causes. The FORIN methodology has received widespread acceptance and has proven to be a key element in the design and organization of successful research projects (Pelling and Birkmann 2013; Johnston 2013). As part of the activities undertaken in the IRDR-FORIN program, two workshops, (Taiwan 2012; Mexico 2013) have been held to share the FORIN methodology with young scientists and advanced students from all disciplines related to the field of disaster risk reduction in order to understand the complex and underlying causes of disasters. Based on the organizational framework of the Munich Re Foundation (MRF) /United Nations University Institute for Environment and Human Security (UNU-EHS) summer academies (2005-2012), these workshops have been very successful trial runs. To further the dissemination of the FORIN methodology, we therefore propose that IRDR-FORIN and UNU-EHS establish a two year collaborative workshop program to expand the dissemination of the FORIN methodology and to create a global community of practice among young researchers around the world.

### **Background:**

Since the 1970s the concepts of socially constructed vulnerability and risk have become orienting principles for the field of disaster research, but in situating causality of disasters in society both research and management of risk and disasters become particularly challenging. The concept of vulnerability challenges us to address those identifiable social features that lead to damages and deaths from specific hazards. Unfortunately, research has not fully lived up to the task, focusing typically on either the geophysical or atmospheric processes or the technological and structural aspects of the damage. In the process, vulnerability has changed from a critical concept to a merely descriptive one. Emergency preparedness and the disaster relief and reconstruction response are also examined. Sometimes an enquiry may extend to the effectiveness of existing policy and make recommendations for future policy improvements, but these efforts rarely seem to probe very deeply into the more underlying and sometimes longer-term causes of the disaster. Despite widespread recognition and acceptance of these conclusions, sufficient advances in disaster risk reduction have not resulted in either developed or developing countries.

### **Forensic Investigations of Disasters (FORIN)**



With a view to addressing this situation a working group of the IRDR developed a multidisciplinary research methodology (FORIN) aimed at exploring the key causal processes driving disaster risk, events, and processes as well as those factors that either enhance or inhibit the reduction of both risk and disaster. Based on a forensic approach that emphasizes more penetrating investigations developed in a more explicitly designed and enacted multi-disciplinary framework or protocol and set of fundamental questions for probing the on-going rise in disaster losses, four complementary modes of analysis for a research methodology designed to explore the critical causes driving both disaster risk and disaster events and processes. The approach is multi-disciplinary and aims at integrating social, environmental, and technical assessments both qualitatively and quantitatively.

The first methodology, Critical Cause Analysis, focuses on the identification of the critical factors in the immediate pre-disaster, impact and post-disaster recovery phases as well as threshold points and critical limits in both organization and technology for success or failure in risk reduction or damage prevention. The second methodology, Meta-Analysis, aims at a systematic review of available literature to identify and assess consistent findings across diverse studies with a view toward assessing causal linkages, the strength of relationships among factors and the efficacy of interventions. The focus of meta-analysis may vary from a specific event or hazard to thematic attributes of disaster risk such as the role of insurance in loss prevention among the poor or risk patterns across hurricane prone urban areas. The third methodology, Longitudinal Analysis, involves the detailed, place based historical re-analyses of particular disaster events to more fully understand the long and short term processes and contexts that expose people and their assets to risk. Longitudinal analyses provide in-depth understanding of the evolution of vulnerability and risk construction and the systemic causes and consequences of disasters. Disaster Scenarios, the fourth methodology, retrospectively reconstructs and specifies the conditions, causes and responses involved in particular destructive events. This methodology proves particularly useful as a diagnostic or predictive strategy as it projects loss and its causes into the future as opposed to examining and explaining real loss in the past.

### **FORIN workshops**

Given the evident difficulties in disseminating generally accepted findings to broader research and management communities on disaster risk reduction, workshops on the FORIN methodology, especially for younger researchers and practitioners, figure importantly among the activities proposed in the FORIN project work program. To date, two workshops have been held as trial runs with very successful outcomes. Deriving from the prior experience of Anthony Oliver-Smith with the UNU-EHS, both workshops were modeled in part on the Summer Academies of the Munich Re Foundation-UNU-EHS program on social vulnerability. From March 12-19, 2012, with funding from the Academia Sinica in Taipei, Taiwan, a FORIN methodology workshop was held for students and young scholars from Asia. Students from China, Taiwan, India, Pakistan, Thailand, Cambodia, the Philippines, and Bhutan attended the 9 day event. Faculty for the workshop included Anthony Oliver-Smith, Allan Lavell, Bob Alexander, David Smith, Haruo Hayashi, and others. From June 25 to July 4, 2013 a workshop by Irasema Alcántara Ayala on the use of the FORIN methodology in specific relation to landslides was held in Tuxtla Gutierrez, the capital of the state of Chiapas in Mexico. Students from Argentina, Brazil, Colombia, Guatemala, Mexico, Panama, and Venezuela attended. Faculty included Anthony Oliver-Smith (Emeritus-University of Florida and IRDR), Irasema

Alcántara-Ayala (UNAM and IRDR) and Roberto Barrios (Southern Illinois University). Both workshops attracted roughly three times the number of applicants for the number of available places for participation. Both workshops included lectures, discussions, field trips, and student collaborative research proposal writing.

The two trial run workshops have been sponsored by the [International Council for Science \(ICSU\)](#) and the [International Geographical Union \(IGU\)](#), the Academia Sinica of Taiwan, the Taipei International Center of Excellence, ICSU's IRDR programme, the [ICSU Regional Office for Latin America and the Caribbean \(ICSU-ROLAC\)](#), the [Mexican Academy of Sciences \(AMC\)](#), the [International Consortium on Landslides](#), the [National Autonomous University of Mexico \(UNAM\)](#), the University of Sciences and Arts of Chiapas (UNICACH), and the National Centre for Disaster Prevention in Mexico (CENAPRED).

Given the interest generated by both workshops, it is evident that there is considerable demand among students and young professionals for such advanced training. It is also clear on the basis of the two successful trial run workshops, funded independently on a one time basis, that programmatic funding for a workshop series would contribute significantly to the use of a methodology that directly addresses core issues in the research that is needed so acutely in the reduction of disaster risk. Accordingly, we are proposing a collaboration between the ICSU-IRDR FORIN project and the UNU-EHS for the establishment of a two year program of six workshops, one each year to be held in Africa, Asia, and Latin America. The workshop program would be managed and run by a coordinating committee composed of participating personnel from each institution. The initial stage of the collaboration would consist primarily of mutual efforts in proposal writing to obtain funding for the workshop program. Once funded both institutions would collaborate in the dissemination of information on the program as well as the siting, organization, participant selection and training activities of the workshops over the projected two year span of the program.

# Pathways for Transformation:

## Disaster risk management to enhance development goals



*This photograph depicts key representatives from national government, local authorities, Māori organisations and the Māori community who collaborated in a rapidly nationalised response to address the needs and facilitate recovery of the Christchurch community after the Canterbury earthquakes. The collective are depicted at Rēhua Marae, the Ngāi Tahu tribal urban community centre, which was the initiating centre for the response and operated after the February 22nd earthquake as a emergency welfare and outreach support centre for the entire Christchurch community. Subsequent to the welfare centre being decommissioned, Rēhua has continued to act as a hub for Māori resilience initiatives that address social risk factors associated with poverty. One such is He Toki ki te Rika, a Māori trades training programme that is facilitating youth education and employment in the Canterbury rebuild.*

*Rehua marae was also registered as a Ministry of Civil Defence and Emergency Management recovery assistance centre prior to the earthquakes, by the recently deceased 'Upoko' or regional tribal leader Mr Henare Rakihia Tau ONZM (pictured centre with his walking stick and flanked on his right by the Cabinet Minister for Māori Development the Hon Pita Sharples). Mr Tau was a fierce supporter of 'transformative' Disaster Risk Reduction planning. He had registered all the marae in his region as welfare centres and more recently led a Māori seminar for the 2013 World Social Science Fellows' Forum in New Zealand, which addressed Maori risk interpretation and related decision- making within the context of disasters. Mr Tau passed away on the June 30 201, it is respectfully suggested that should you decide to use the photo as your cover picture, that you consider including in the report a small memorial acknowledgement of his contribution.*

## Pathways for Transformation: Disaster risk management to enhance development goals

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## Pathways for Transformation: Disaster risk management to enhance development goals

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### Executive Summary

#### CONTEXT

**Disaster risk and development are intimately linked.** Disaster risk is a product of hazard, the exposure of assets and people and their susceptibility to harm mediated by capacity for risk reduction, response and recovery. Who and what is exposed and the degree of susceptibility and capacity is determined by ongoing processes of development. Under climate change and local environmental change, such as deforestation, development also induces and shapes hazard.

**Disaster risk management impacts on and is shaped by local development trajectories.** Planned disaster risk management weighs up the benefits and costs of investing in safety through choices in economic planning, land-use policy, social sector investment and critical infrastructure. The success of disaster risk management shapes the geography of risk and loss, if is a driver of inequality across societies, communities and individuals with unequal capacity, susceptibility and hazard exposure.

**Transformation in disaster risk management opens new policy space for fundamental shifts in development trajectory.** Both the speed and trajectory of development can be influenced by transformative disaster risk management. Transformation itself is a policy neutral concept which describes only the depth of change resulting from a disaster risk management intervention. However when combined with a normative framework, such as the Sustainable Development Goals it can open up a policy agenda that identifies the leverage points – and so the responsibility – that disaster risk management has to proactively contribute to moving development pathways in a desired direction, for example – towards resilience or towards sustainability.

**As a new policy field, there is yet limited empirical evidence upon which to base transformative disaster risk management policy.** Work in sister policy domains, especially in climate change mitigation and more recently in adaptation and to a lesser extent in natural resource management recognise the necessity of transformation if we are to move towards sustainable development. Existing evidence from transformation in climate change adaptation includes that presented in the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (IPCC 2012). This work focussed on leadership, learning, innovation and adaptive management. The adaptation literature also distinguishes between transformation that is planned, accidental or spontaneous and presents transformation alongside incremental adjustment as two policy sets that can move social and social-ecological systems towards resilient and sustainable futures.

#### STUDY AIMS, FRAMEWORK AND METHODOLOGY

**This study asks if transformation pathways for disaster risk management can be observed, and if so then how and why they unfold as observed.** This is an initial, qualitative analysis to establish an empirical basis for policy development that can more actively open strategic transformative action within the disaster risk management field.

**The study was built from five case studies: Christchurch (New Zealand), Sundarbans (India), Lower Sindh (Pakistan), Niger and New York Metropolitan Area (USA).** Each case study was completed by a local research team already expert in local risk management policy. Case studies followed a common rubric and reporting structure that provided information on context, actors, drivers, outcomes. Case studies were chosen to provide analytical breadth and include richer and poorer country contexts, rural, small and large urban areas, and disaster risk management options led by individuals, civil society, government and international humanitarian actors.

**A conceptual framework proposed indicators of transformation to guide analysis.** The high level indicators were:

- Intense interaction between actors,
- The intervention of external actors
- Change going beyond efficiency and targets to goals and governance regimes.
- Behaviour exceeding established coping strategies
- Behaviour exceeding that promoted by established institutions (laws and cultural norms)

## **FINDINGS**

**New Zealand: individual and structural transformation.** On 4 September 2010 Christchurch was struck by a magnitude 7.1 earthquake. The earthquake has catalysed national debate that has brought strong voices from Māori, women's, student and regional groups as well as new business and political interests and into the mainstream. Structural transformation was observed, for example through the creation of He Toki ki te Rika, a Māori trades training programme that facilitates youth education and employment in the Canterbury rebuild and beyond. Transformation was also observed at the level of individuals brought into positions of influence, enriching city and national policy debates on disaster risk management and more broadly – especially from gendered and Maori perspectives.

**India Sundarbans: the local burden of spontaneous transformation.** In a context of frequent, extensive risk and episodic catastrophic events pathways of transformation were observed to unfold in parallel at the household level and with regional consequences. Households were seen to transform through crisis migration when in-situ adaptive capacity met its limits. In aggregate household level transformations contribute to a depopulation of the region providing tacit support for an emerging conservation narrative based on reducing population and its pressure on a globally significant ecological resource.

**Sindh Floods, Pakistan: Extending citizenship rights through disaster response.** The understanding and exercise of citizenship was transformed in the Lower Sindh in the aftermath of large scale flooding in 2010 and 2011. This period reshaped political space for citizen-state interaction in the post-disaster period. These interactions and changes in relationships were moulded by formal processes such as the implementation of disaster response policy, but also by the unplanned actions of individuals that in aggregate have pushed a more progressive form of 'disaster citizenship'. In particular this study reveals a transformation in discourse and in the institutions of citizenship, and its impact on development pathway.

**Niger: A moment of critical reflection transforming development and humanitarian practice.** Ongoing failure of the international humanitarian sector to reduce risk and for timely response to food insecurity across sub-Saharan Africa led to an agenda for transformative change for the international humanitarian nongovernmental Save the Children. The case study focussed on activity in the NGO and its work in Niger. The intersection of incremental changes in Niger and wider discursive debate in the international aid system led to a moment of critical reflexivity within Save the Children, focussed on the future of responses to slow-onset shocks. The organisation was able to use this moment to consolidate and realign internal, incremental change towards a transformational agenda. Incremental change within the organisation made Save the Children better able to support transformational change in the delivery of food security with its partners in sub-Saharan Africa.

**New York: Public transit systems and pathways to transformative flood control strategies.** Transportation systems are in many ways the infrastructural backbone of a region's economy. The Metropolitan Transportation Authority (MTA) operates the transit system for New York City (NYC) and the surrounding region. The MTA operates on more than two thousand miles of track and carries more than 2.6 billion passengers per year. This case identified transformation in the process and membership of decision-making circuits post-Sandy, and in the agenda for urban development which

has opened space for transportation's role in decisions for strategic investment. These processes in turn are connected to plans for gentrification or retreat in areas of current risk.

## DISCUSSION

Core observed characteristics of transformative pathways for disaster risk reduction are:

**Pathway competition:** Post disaster is a period of potential policy instability where alternative behavioural, organizational and policy forms emerge. Emergent development approaches can be contradictory. Only some new forms will become institutionalized sufficiently to survive and contribute to a revised development trajectory.

**Pathway experimentation.** Planned, technological and administrative reforms can allow for controlled opening of potentially transformative social and political space. The New York and Sindh cases both led with technological innovation. Both provide scope for a controlled experimentation with social change processes without commitment.

**Pathway scale effects.** Perhaps the clearest experience across the case studies is the tendency for the local level to carry the weight and costs of transformation. Transformation at the local level can enable resilience at higher systems levels, for example in regional development policy.

**Pathway lock-in.** Institutional structures are designed to be resistant to organisational transformation. Transformation is most likely when multiple local and external actors are aligned, in critique of established systems elements,

## CONCLUSIONS

The core question put to this study – can we observe decision-making processes that lead disaster risk management strategies to impact upon underlying development trajectories can be answered firmly in the positive.

The study has shown that transformative disaster risk management can be both incidental and purposeful. The majority of observed transformations were local – found at the level of households or in organisational decision-making. Even when policy led transformation was also observed to be targeted at affecting strategic change this was worked through in local policy for land-use management, local governance and economic development.

The study has drawn out the importance of policy as a driver of transformative change but more significantly the case studies presented show the potential for individuals and population level behaviour and of organised civil society as agents of transformation. This is a fundamental observation and opens questions on the scaled distribution of the burden of undertaking transformation.

In providing a first systematic analysis of transformative potential in disaster risk management, the report arguably opens more questions than it can resolve. Next steps at shaping a policy agenda for transformative risk management include:

- What kind of disruption is required to open transformative action?
- How do existing structures and dominant actors behave when faced with potential transformation?
- What are the early warning signs of transformation, especially for the poor and vulnerable?

## 1. Introduction

In its ‘‘Proposed elements for consideration in the Post-2015 Framework for Disaster Risk Reduction’’ UNISDR states:

*‘‘Sustainable development goals cannot be achieved without managing disaster risk. The overall focus of disaster risk management, therefore, has to shift from shielding social and economic development against what are seen as external events and shocks, to one of transforming development to manage risks, sustainably seize opportunities, strengthen resilience, thereby ensuring a sustainable development.’’* (UNISDR: 2014)

The shift in focus for risk management from externalising risk to questioning the sustainability of underlying development places disaster risk management squarely at the heart of development processes. While this view has long been championed it has proven difficult to articulate. Current debates on transformation offer a new lens on this challenge. The present report offers an analytical framework and empirical assessment of the range of pathways through which disaster, disaster risk reduction and response have had a transformative impact on underlying development trajectories, processes and values across an international selection of case studies.

Within this lens disaster is conceptualised not as an aberration of, or archipelago to development, but as a moment or period in the unfolding of development history. Disaster is an event that reveals accumulated development failures and vulnerability expressed in damage and loss. Individual development pathways are an expression of specific value sets, reproduced and legitimised by institutions, habituated behaviours and dominant discourses. Individual pathways entwine, sometimes smoothly, at other times producing friction, to produce collective pathways for development. Transformation draws analytical and policy attention to the potential for disaster events, risk reduction and response to provoke a change in pathway trajectory. Transformation describes the depth and reach of development impact, and when combined with a normative framework that provides a specific value position it can indicate who might benefit or lose, or whether such changes in the direction of development pathway are more or less socially desirable. Normative frameworks include sustainable development, economic growth and equitable development with multiple interpretations possible of the same transformative pathway. The Sustainable Development Goals represent a detailed agenda against which transformative pathways can also be judged to assess the potential or actual contribution of disaster risk management.

By highlighting potential transformation makes clear the responsibility for disaster risk management to realise its role as a component of unfolding development. To deny the potential of risk reduction to contribute to unfolding development, to relegate disaster risk reduction to a position of protecting existing development structures, practices, goals and values, is to miss the bigger picture that disaster risk and loss are a product of development decisions and their legacy. Risk management strategy may legitimately choose to support existing development pathways – but transformation demands a justification of this policy choice.

This report offers a basic analytical framework to move from abstract discussion of development pathways to specific actions and responsibilities on the ground. To do this we have elaborated an actor based framework. This view builds on the work of earlier, alternative frameworks that have emphasised component parts of our framework, including work that has focussed on innovation and leadership (IPCC 2012), reflective decision-making (Matyas and Pelling 2014) and the interaction between development sectors as transformation emerges (Pelling et al 2014). Our core concern is to identify the interaction of actors (individuals and organisations) with dominant development pathways and here an actor oriented frame that can open the relationship between policy actors, constraining institutions and the structures that drive development trajectories provides most analytical leverage. Examples are built around five case studies (see Box 1). These are presented in the results section in some detail, this detail necessary to situate these events in respective development pathways and to then draw out the ways in which responding to or preparing for future disaster has touched pathway



trajectory - by accident or design. We then discuss common features observed from these cases to allow some general comments on transformation in disaster risk management.

### **Box 1: Case Studies**

#### **New Zealand**

The Canterbury, New Zealand earthquake sequence of 2010-2011 which devastated Christchurch and surrounding districts led to substantial response at local and national government level and significant changes in both risk management and wider public policy, which may transform development in the region, though it is unclear to whose benefit.

#### **India**

The Sundarbans, a unique mangrove forest ecosystem, extends along the Indian and Bangladeshi coastline. The impact of the Aila super cyclone of 2009 compounds other development failures in the region. In the wake of the storm transformation is evident but experienced and interpreted in different ways by both resident and external actors.

#### **Pakistan**

In the Lower Sindh region of Pakistan the aftermath of large scale flooding in 2010 and 2011 led to an unusual government response in distribution of financial aid which has in turn triggered an apparent transformation in citizen engagement in disaster and development policy fostering increased senses of citizenship through more directed rights claims and public engagement.

#### **Niger**

Failures in the strategic response of INGOs and other actors to slow onset food security shocks in Africa over the last decade have raised a desire to transform the delivery of development and humanitarian aid. This case study focusses on the incremental steps being undertaken by some actors towards wider transformative change at a higher systems level.

#### **USA**

The impacts of tropical storms Irene and Sandy in 2011 and 2012 are the latest in a sequence of extreme weather events which have triggered debate about the resilience of New York City's development trajectory. This case study focuses on the urban public transport system. Both pressures for transformation and resistance to the deployment and underlying access rights for public transport are revealed post-Sandy.

## **2. Conceptual Framework**

Transforming development through disaster risk management and climate change adaptation is emerging as an alternative to treating risk as external to development – to be addressed by incremental changes that use risk management to protect existing development goals, practices and relations (Pelling 2011). This shift in thinking reflects the increasing recognition that the inexorably growing rate of disaster losses (EM-DAT 2014) has its root causes in failed development. Also that movement towards sustainable development, and meeting agreed Sustainable Development Goals, is unlikely without fundamental changes to development pathways. In short moving towards sustainable and just development requires a recalibration of the disaster risk management-development relationship.

The insufficiency of a 'business as usual' approach to disaster risk management is not a new observation. Hewitt (1984) and Wisner et al (2004) amongst others have long argued that development itself is a driver for and generative of disaster risk. Transformation for disaster risk management positions this observation alongside a number of parallel debates on transformation. Most notable are those from the climate mitigation community where a considerable expertise and literature exists of transforming society towards low consumption development (as described by working group III of the IPCC's Fourth and Fifth Assessment Reports) drawing on a systems theory framework expressed

through socio-technological transitions literature. A second and closely aligned systems view come from the take up of social-ecological systems (SES) thinking in natural resource management and climate change adaptation literature. The SES approach includes transformation (fundamental change) in its account of systems level shifts from one state to another. Importantly though SES frameworks have been predominantly deployed to understand resilience (stability seeking) and contain, rather than focus on, transformation. Recognising that stability in unsustainable sectors is not desirable, recent work from climate change adaptation and disaster risk management has attempted to address this bias and has attracted attention through extensive peer review in the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) (2012). SREX offers transformation as one of seven solutions for adapting to climate change, defined there as:

“The altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems).” (IPCC 2012: 564)

The idea of transformation moves work beyond a focus on coping within and adapting to dominant development contexts to mobilising the potential for risk management to seek change in the structures of development that constrain vision, entitlements and capacity. Where development has systemically failed and produces unsustainable, insecure and unjust outcomes as well as disaster risk it opens policy and public space to think of alternatives and use risk management as a point of leverage in moving towards sustainable, equitable and secure development. This option comes, however, at a cost. Transformation – disrupting the status quo – may be appealing to those concerned with re-directing development toward sustainable pathways; but stability, rather than disruption, is what development organisations are most comfortable with. This can be seen in all spheres, from science to politics and is often strongly held by the poor who have least resources to cope with change and instability as surroundings systems shift (Pelling and Dill, 2010). Political and policy organisations and institutions are built intentionally to be durable and resistant to pressures for transformational change (Clemens and Cook: 1999) including those responsible for disaster risk management and climate change adaptation (Pelling and Matyas, 2011). Alongside this inertia development discourses define ‘how things are done round here’ normalising dominant values and creating individual as well as organisational and systemic resistance to disruption (Pelling, 2011).

### **Learning from past Transformations**

Transformation remains a young area of work but already empirical cases are emerging to provide some theoretical and policy texture. A case from the Mulwene area in Maputo, Mozambique, shows a transformation in housing provision resulting from an unforeseen event chain (Neilson: 2010). Following severe floods in 2000 the city prepared to establish new housing areas in Mulwene to cater for displaced residents. Plans were drawn up but a lack of capacity meant they were not implemented. However over the following years the local population appropriated the vision and regulatory framework for construction of a model residency area in the wake of the flooding. Through appropriating and developing the targeted land – to which they had no legal rights – the local community have used elements of the government plans and legislative frameworks to create a de facto legitimacy for their actions, and in doing so have transformed local governance and development. The ability for local populations to create systems of governance, decision-making and rule enforcement to transform local development pathways is one which Ostrom (1990) demonstrates in a number of case studies; in her view offering an escape from the tragedy of the commons which suggests a local level race to the bottom in management and exploitation of common pool resources.

Where the initiative for change was taken by the community presented with the inability of authorities to enact their own plans in Maputo, a case from India shows the ability of an individual leader to effect transformation. The city of Bhuj in Gujerat made headlines both because of its dramatic devastation in the earthquake of 2001, and because of its wholesale espousal of the ‘build back better’ principle. The BBC reported ‘Gujerat’s astonishing rise from the rubble’ (2011) The disruption was a powerful entry point for a dramatic transformation, with the whole city redesigned and reconstructed – reportedly due to the drive of government official Pradeep Sharma. More reflective assessments sound

a note of caution: Tafti and Tomlinson (2013) found that whilst homeowners were well catered for; those in rented accommodation were poorly supported and the expectation that the market would provide suitable and affordable accommodation proved fallacious, this despite over 1800 consultative meetings. A wider study of post-earthquake housing in Gujerat (Sanderson et al: 2012) similarly concluded that the evident transformation did not necessarily take account of the residents' needs: "Very often, reconstruction is seen as a building project delivering products, rather than an opportunity to engage in development".

Experience from the Indian Ocean tsunami shows how gradual and yet persistent pathways for transformation can be identified. Research from the Andaman and Nicobar Islands, India explored the role played by NGOs in opening (or widening) political space – specifically, space for the renegotiation of development priorities in favour of local communities – within local government. One of the most significant changes post-tsunami has been the establishment of an NGO sector where none existed previously. In Little Andaman, only three NGOs now remain out of the huge initial influx. One of these, an Indian NGO that works to promote and enable child rights, has undertaken a variety of initiatives including: establishing child development centres (CDCs), offering trainings and support meetings for parents, managing a child-run newspaper, and delivering health awareness programmes. The NGO is now accepted as a regular stakeholder in the local governance framework. Whilst this NGO's narrow focus on child rights may make this *appear* to be a small step for transformation more widely, it has nevertheless succeeded in widening the space for state-society negotiation around development priorities (Blackburn: pers comm).

These and other case material indicate that while transformation is an intuitively attractive goal when development is manifestly unsustainable and unjust, success at scale requires the support, and leadership of actors across scales from the local up. Perhaps the best documented case of failed transformation – with failure a result of top down leadership without buy in from national or local levels – is the reconstruction and development in Honduras after Hurricane Mitch in 1998. The impact of the storm on Central American countries and the need for massive reconstruction aid opened an opportunity for affected countries and donors to reflect on the root causes of risk production in dominant development pathways – concentrated urbanisation, deforestation, inequality. Transformation was called for in the resulting Stockholm Declaration, 1999, and included an agenda for using reconstruction to:

- Reduce social and ecological vulnerability
- Enhance transparency and good governance in recovery efforts;
- Consolidate democracy and the active participation of civil society
- Respect human rights and equality between women and men
- Reduce the external debt burden of the countries of the region

(Christoplos et al: 2010)

An overarching aim was to avoid the risk of the large international response undermining the capacities and legitimacy of the states of the region. However an assessment produced by the World Bank in 2004 (Telford et al: 2004) found that these transformative goals had not been met. They conclude that short timescales, a lack of social cohesion, high levels of corruption and unfocused efforts by the many agencies involved all contribute to this. They report one G-15 donor stating:

"Reconstruction more-or-less happened, but transformation has not. Security has deteriorated dramatically, poverty is increasing. The coffee crisis is more devastating than the drought. If we (donors) don't see fundamental transformation we shall leave."

The assessment of progress post-Mitch in Honduras runs counter to the above cases. Whilst transformation may be invoked, its effectiveness depends on persistent drivers over substantial timeframes to achieve transformative tipping points. Disasters as an entry point are a potential but not a sufficient driver for transformative change. The art of transformation is to embed disaster risk

management within development so that responsibility for transformation is a co-responsibility of both communities from the onset.

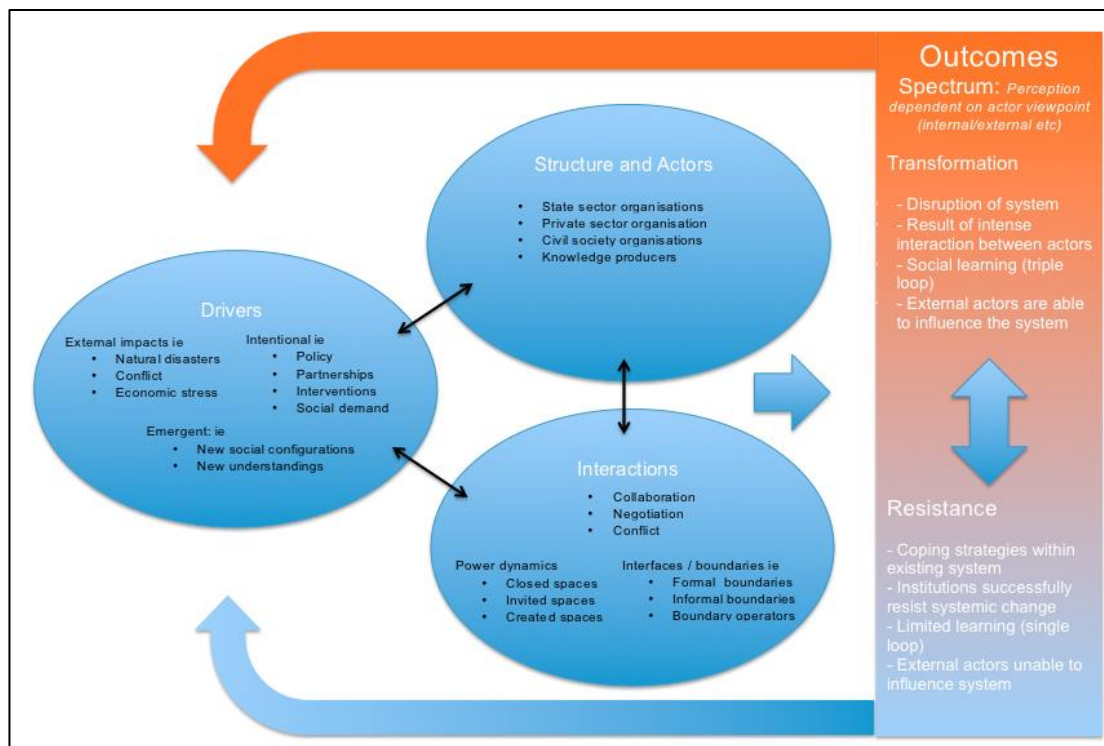
### An Actor Framework

To understand the scope for disasters and risk management to open transformative moments in dominant development pathways it is helpful to reflect on those in-built institutional characteristics that resist change. Specific mechanisms for resistance to political change include closing political spaces or more subtly managing ‘invited political spaces’ (Gaventa: 2005) thereby excluding particular views and actors from meaningful participation even when major disruptions occur. Gaventa (1980) described communities becoming resigned and passive in the face of recognised development deficits as a result of this persistent exclusion.

Social actors may force open the closed political spaces through actions such as campaigns. The trajectory of transformation resulting from disruption depends on the relative power of associated actors. Long (2001) demonstrated that it is not just obviously influential actors who can shape development trajectories, but that other, seemingly less powerful actors could exercise influence. Development interventions, for example, often have outcomes different to those anticipated, due to the unexpected agency of such actors (Mosse, 2004). Outcomes then are determined by which actors, and whose agency, take control of the spaces which are opened for and by risk management and it is here that transformative potential is likely to be found.

If disaster risk management can open new policy space for government, civil society and other public actors, how and where might transformation then come about? Where fundamental, systemic change is approached, it would be useful to know something of the precursors, early warning signals and determinants of change.

**Figure 1: Transformation and resistance pathways from an actor oriented viewpoint**



This study adopts Long’s (2001) actor oriented perspective, focusing on values, intentions, choices, negotiations, conflicts and collaborations between actors (whether groups or individuals) rather than on the mechanic functioning of a ‘system’. Taking an actor perspective and holding in mind a range of scales – from local urban and rural through subnational to national and international – several basic

analytical building blocks to help better understand processes of social change can be identified. These include: social **structures** constraining a broad array of individual and corporate **actors** who may have shared or conflicting interests. The **interactions** between these actors are shaped by **institutions** (rules, law, culture) and occur at meeting points which have been described as interfaces (Long: 2001, 2002). Such institutions may be more or less formal in nature, and resultant interfaces inclusive or exclusive, collaborative or conflictual. These encounters are stimulated by a range of **drivers**, both external and internal, including disruptions such as environmental, economic and social shocks, deliberate initiatives of groups and individuals and emerging trends, social shifts and innovations. The interactions between the various actors in response to these drivers will lead to a range of **outcomes**: from resistance (coping with the status quo) through incremental change to transformation (Pelling: 2011). These elements are represented in Figure 1 below, emphasizing our interest in dynamic, unfolding, processes of development, rather than a single historical moment.

Figure 1 indicates that transformative outcomes are indicated by changes associated with a disrupted system, intense interaction between actors, potentially the successful intervention of external actors and of evidence of change going beyond efficiency and targets to goals and governance regimes. Resistance is indicated by a continuation of existing coping strategies, successful continuity within dominant institutions (laws and cultural norms), learning limited to efficiency gains and limited influence of actors external to the system of interest.

The organising framework has at its heart *drivers* – disruptive processes which may be initiated deliberately or may be unanticipated. The dynamic interactions of *actors* impacted by these drivers determine the depth of change (from transformation to resistance) and the direction of that change (regressive or progressive) from a specific actor perspective. Thus, whilst Figure 1 represents a process, we also want to understand normative aspects of outcomes. Who does transformation benefit? Does it contribute to sustainable development?

### 3. Methodology

The study is built on five original case studies commissioned to examine episodes of potential transformation associated with disaster events. Cases were chosen purposively through a search of recent high visibility projects and drawing on the expert knowledge of the writing team. The study aimed to illustrate the universality of disaster risk management as a contributing factor in development trajectory and its scope for transformation. Consequently we selected as diverse a set of cases as possible (see Table 1). These include examples of everyday, chronic and catastrophic events; of geophysical and hydrometeorological hazards and of vulnerable human systems ranging from low-income resource dependent villages to a global megacity. It was particularly challenging to find experts able to comment on the transformative potential or outcomes arising from risk reduction activities, but these are included alongside response and reconstruction. Finally we sought to recognise the influence of viewpoint and provide accounts from the perspective of citizens at risk, development planners, a humanitarian NGO and disaster risk managers. The case studies are highly context dependant but the analysis is able to draw out some common threads that can help in structuring the emerging policy debate around transformation.

To facilitate comparison, case study authors applied the common framework of drivers, actors, interactions and outcomes described above. In each case data came from a mixture of secondary data and expert interviews, often augmented by the expert local knowledge of the author. Case studies underwent two rounds of review by the lead author and editor. Case study documents run to around 20 pages each. The summary versions presented here were validated by the case study authors in a final review round.

**Table 1: The study sample**

Study Site	Focussing event	Development context	Disaster-Cycle phase	Actor viewpoints
Christchurch, New Zealand	Canterbury Earthquake Sequence of 2010/11	High-income, urban	Reconstruction	Disaster risk managers
Sundarbans, India	Recurrent, everyday and catastrophic riverine and storm surge floods including super-cyclone Aila, 2009	Low-income, natural resource dependent villages	Whole cycle	Exposed households and regional development planners.
Sindh, Pakistan	Widespread flooding in 2010/11	Low-income, natural resource dependent villages	Relief	Development planners
Niger and the Sahel region	Recurrent drought and slow onset food insecurity shocks (2005/08/10/12)	Very-low-income, natural resource dependent region	Early warning and response	International Non-Governmental Organisation
New York Metropolitan Area	Storm surge floods including Irene, 2011 and Sandy, 2012	High-income, megacity region	Reconstruction and recovery	Transport planners

#### 4. Findings

The following case studies are presented in a common structure: context, actors, drivers, outcomes. The aim is to draw out connections between these elements of the framework and in particular to flag where moments of potential or actual transformation arise, and how. Our conceptual framework (Figure 1) indicates transformative outcomes through:

- Changes associated with a disrupted system,
- Intense interaction between actors,
- The successful intervention of external actors
- Change going beyond efficiency and targets to goals and governance regimes.

Transformation has not been observed when evidence finds:

- Continuity in established coping strategies,
- Continuity in dominant institutions (laws and cultural norms),
- Learning limited to efficiency gains
- Limited influence of actors external to the system of interest.

The viewpoint of actors and system scale are also important themes, the case study teams were asked to identify potential or observed feedbacks between systems across scales from local (eg household or organisational) to local, national or international economic, governance or policy-making systems. This recognises that only rarely do complete meta-systems transform, more likely is the observation of local transformation with incremental impact on the overarching social-ecological system. This has strategic implications for policy when overarching systems constrain local efforts at social and ecological sustainability and security.

### **1. New Zealand: individual and structural transformation**

On 4 September 2010 Christchurch was struck by a magnitude 7.1 earthquake. The earthquake struck in an area considered at relatively low risk and has stimulated a wide discussion in New Zealand about risk management and development governance. This debate that has brought strong voices from Māori, women's, student and regional groups as well as new business and political interests and into the mainstream. Transformation is observed at the level of individuals who have been brought into positions of influence, enriching New Zealand – especially from gendered and Maori perspectives. Structural transformation was also observed through the creation of He Toki ki te Rika, a Māori trades training programme that facilitates youth education and employment in the Canterbury rebuild.

#### **Context**

The 4 September 2010 earthquake and the subsequent aftershock series have caused 160,000 residential dwellings to file insurance claims for damage (King et al. 2014). Most buildings in Christchurch's CBD have been damaged beyond economic repair and the CBD was cordoned off and accessed restricted for several months with major effects on businesses (EERI 2011). The total cost for reconstruction is now estimated at \$40 billion NZD (\$32 billion USD) with the central government estimating its net contribution at \$15 billion NZD (\$12 billion USD) (The New Zealand Treasury (2013).

The suite of national legislation and key decisions made in response to the Canterbury earthquakes may be viewed as a rapid governance adaptation strategy embedded within an overall trend in governance reforms underway in New Zealand prior to the earthquakes. All the key pieces of legislation in the natural hazard risk management framework are under review or have had reforms introduced to strengthen the national government's role, standardize and streamline policies, curb perceived bureaucracy and shorten decision making processes. There are strong concerns about the retreat from decentralized and collaborative governance approaches and the potential lasting implications for local government and representative democracy.

Disaster recovery is always set within a social context and New Zealand has a sophisticated natural hazard risk management policy framework, with an array of well-established regulatory instruments largely formed by a suite of legislation first adopted during the 1990s and early 2000s, in a period of government reform emphasizing sustainable management and more decentralized and open, collaborative and transparent processes of government including land use, development, and emergency management.

#### **Actors**

Like many countries, the framework is designed with a shared system of governance and common and overlapping responsibilities apportioned among layers of government and citizens, both pre- and post-disaster, and structured to engage from the 'bottom-up', with citizens responsible for protecting their assets; local governments having primary responsibility for land use policy to avoid and mitigate hazards and supplying resources when disasters do occur; and regional, subnational and national agencies providing the authorities, guidance, resources, and support as needed. By design, the effectiveness of the framework depends upon the extensive coordination and cooperation among all levels of government and its citizenry, as well as non-governmental organizations, insurers, and other stakeholders who also provide support to the process.

An additional consideration is that Aotearoa, New Zealand is legally and socially a bi-cultural country without a formal constitution, although Te Tiriti O Waitangi (The Treaty of Waitangi), the founding document of nationhood was gazetted in London in 1840 (Royal Commission on Social Policy, 1987, 1988). Further to the Royal Commission on Social Policy's (1987, 1988) translation and legal definition of the articles of Te Tiriti O Waitangi as core principles of jurisprudence, the principles' partnership, protection and participation have been integrated into most legislation. Government agencies, organisations and individuals who receive funding from the Crown have a statutory requirement to act in accordance with the principles. However, Māori engagement with government

disaster risk reduction planning and policy development as well as the national emergency management infrastructure has been minimal (Paton et al. 2014). In contrast, to ‘command and control’ approaches to disaster management, Māori crisis management practices are characterised by collective authority, agency and action. Māori responses to natural hazards are also shaped by cultural values and incorporate cultural technologies for mitigating the social impacts of adverse events (Kenney et al. 2012). Institutional resistance has prevented the inclusion of Māori and/or communitarian approaches within hierarchical emergency management practices which have encouraged both expert as well as individualised responses to natural hazard risks. The Canterbury earthquakes sequence has facilitated institutional transformation with lessons learnt shaping regional governance (CERA, 2012) and the revised New Zealand Civil Defence and Emergency Management Plan, which was released for national consultation on May 23<sup>rd</sup> 2014.

When the Canterbury earthquakes sequence commenced in 2010, Māori constituted (25,725) 4.1% of the Christchurch urban population, and the resident tribe Ngāi Tahu comprised a minority of 32% of the Māori community (Statistics New Zealand, 2012a). Māori resided throughout Christchurch but the majority lived in low socioeconomic areas, particularly the Eastern city suburbs (Statistics New Zealand, 2012a, 2012b), which were also the places most severely impacted by the earthquakes. Despite perceived economic marginalisation, a nationalised Māori earthquake recovery network led by the local tribe Te Rūnanga o Ngāi Tahu, was rapidly established following the February 22<sup>nd</sup> 2011 earthquake. Effective operationalisation of inter-tribal resources, Māori organisations and extended familial networks constituted an exemplar of the values whanaungatanga (relational support) and manaakitanga (hospitality). The immediate activation of marae (Māori community centres) as recovery assistance centres was representative of cultural technologies commonly employed to address risk and facilitate community resilience during adversity (Hudson and Hughes, 2007). Research (Paton et al, 2014) suggests that the Māori earthquake recovery network provided financial grants of NZ\$ 953,000.00 (Te Rūnanga o Ngāi Tahu, 2012), social and housing (assessments, repairs and accommodation) support, liquefaction removal, emergency services, acute health care and/or basic necessities to 20,000 Christchurch households

### **The Drivers**

By their very nature, large-scale disasters exceed the capacity and capabilities of policy and management frameworks from the bottom up. They simultaneously deplete capital stock and social services and thus demand an elevated and sustained commitment of funding, information and other critical resources, all within a compressed time period. In New Zealand, they also can serve as focusing events for policy and politics and the primary earthquakes, seemingly relentless aftershocks and resulting damage stimulated a suite of nationally-adopted legislation and Cabinet-level decisions aimed to improve the timeliness and effectiveness of decision making and to reduce uncertainty for residents, businesses, insurers, and other stakeholders in the recovery.

The key interactions resulted from the progressive decisions of the national government to centralize authority for recovery governance, culminating with the creation of a new national department charged with managing recovery—Canterbury Earthquake Recovery Authority (CERA)—and a re-zoning of residential land across the Canterbury region based upon a new understanding of earthquake hazards and future risks. In a span of three years, New Zealand’s national government extended voluntary purchase offers to 7,349 properties located in neighborhoods heavily impacted by earthquake-induced ground failures and subsidence and nearly all homeowners have completed their relocation out of the buyout areas.

### **The Outcomes**

Since the Canterbury region is only in its third year of recovery and even the most optimistic estimations project that rebuilding will take several more years to complete, it is not yet possible to fully assess the strengths, weaknesses and outcomes of the legislation and decisions guiding the process. An early analysis shows signs that the centralization may have helped to strengthen coordination among national agencies, expedite policy and decision making, and ensure accountability for the considerable public expenditure; but, the effectiveness of coordination among multiple levels



of government, capacity building at the local and regional levels, and collaborative engagement and empowerment of citizens and key stakeholders in the decision making and implementation are some areas where the changes may not have been as effective.

In contrast, the prompt and effective Māori response to the Christchurch earthquakes has challenged conceptualisations of indigenous peoples as vulnerable populations and acted as the genesis for increased engagement and collaboration between Māori, local authorities and central government. As stipulated in the Canterbury Earthquake Recovery Act (2011), Te Rūnanga o Ngāi Tahu has a statutory role in authorising the urban rebuild and recovery planning (CERA 2012). This public private partnership is the first instance of a Māori entity being engaged as an equitable partner by local and national governance structures in strategizing to ensure regional sustainability and resilience. The earthquake may therefore be viewed as a key driver of institutional change which opened up space for the formal inclusion of Ngāi Tahu in legislation governing the Christchurch recovery. The Canterbury Māori Recovery Plan is ensuring the creation of accessible cultural services and facilities, restoration of significant natural features and rivers, development of housing on Māori land reserves as well as documentation and preservation of sacred tribal sites (wahi tapu). Te Rūnanga Ngāi Tahu tribal initiatives are also shaping the longer term resilience of tribal members, Māori and the wider community in Christchurch. Risk factors that are associated with earthquake vulnerability including financial hardship, unemployment, inadequate insurance, poor housing and natural resources management are being addressed (Te Rūnanga o Ngāi Tahu, 2012).

Unless amended, the Canterbury Earthquake Recovery Act 2011 and the authorities of CERA and the Minister for Earthquake Recovery will expire in April 2016. Ensuring that recovery efforts remain effective after it is disestablished is one of the major challenges facing CERA. Having not been as directly involved in the recovery policy design and implementation, it is also unclear whether local authorities in the Canterbury region have the necessary expertise and capacity to assume the leadership and operational reins for recovery in less than three years' time. Also, the national government' intervention in land use policy and hazard liabilities in the aftermath of disasters, conflicts in many ways with the previous social contract maintained through the responsibilities conferred upon local governments and the nationally-backed insurance program to distribute the risks among property owners, insurers, and government.

The suite of national legislation and key decisions made in response to the Canterbury earthquakes are arguably going to have long-lasting effects on the natural hazard risk management framework for the entire country, but may also be viewed as a rapid governance adaptation embedded within an overall trend in governance reforms underway in New Zealand prior to the earthquakes. All the key pieces of legislation in the natural hazard risk management framework are under review or have had reforms introduced to strengthen the national government's role, standardize and streamline policies, curb perceived bureaucracy and shorten decision making processes. There are strong concerns about the retreat from decentralized and collaborative governance approaches and the potential lasting implications for local government and representative democracy and the rule of law.

## **2. The India Sundarbans: the local burden of spontaneous transformation**

This case study considers pathways of transformation that unfold in parallel at the household level with regional consequences. Households are seen to transform when adaptive capacity meets its limits in the wake of underdevelopment, slow onset, gradual environmental shifts and sudden extreme disaster events in an environmentally vulnerable and fragile ecosystem. In aggregate, these household level transformations contribute to a depopulation of the region providing tacit support for an emerging conservation narrative based on reducing population and its pressure on globally significant ecological resources.

### **Context**

The Sundarbans is a unique mangrove ecosystem – not only because it is the largest of its kind; nursing a critically endangered species diversity valuable both to the global commons and to local ecosystem products and services, but also because of its role as a buffer to over 60 million people

whose lives, properties and infrastructure worth billions are protected from extreme weather events by this barrier across the coastline of India and Bangladesh. Kolkata and Dhaka, and many smaller towns and villages are protected by the Sundarbans.

The Indian part of the Sundarbans, approximately 40% of the entire ecosystem stretches 16,000 sq.km, between two countries. It is inhabited by 4.5 million people and threatened consistently and increasingly by climate change and local environmental shifts. Already a hotspot for climate change impacts, this ecosystem has recorded sea level rise, changes in sea surface temperature, cyclone intensity and incidence, temperature and rainfall patterns at a rate far higher than global averages (Mitra et al 2009, Mousavi et al 2011, Pethick and Orford 2013). Set in this context super cyclone Aila hit the Indian Sundarbans in May 2009. The cyclone had a disastrous impact on agriculture, and destroyed the small asset bases the poor possessed. High levels of salinization in soil prevented households from recovering in situ. In India, at least 149 people were killed, at least 100 river embankments were breached by storm surge produced by the cyclone. At least 50,000 hectares of agricultural land was lost during the storm, costing an estimated Rs.125 crore (US\$26.3 million). Throughout the state, an estimated 40,000 homes were destroyed and 132,000 others were damaged. At least 350,000 people were affected by Aila, other reports indicated that upwards of 2.3 million were displaced by the storm as 175,000 homes were destroyed and 270,000 were damaged (Dhar 2009).

### **Actors**

For those households with low-income, limited assets and natural resource dependent livelihoods Aila was a tipping point. Households who had reached the limits of adaptive capacity were forced to consider new and fundamentally different livelihood options, migration has been a common response. Out-migration is transformative of life-experience, identity, community and in aggregate of the local economic system and population pressure exerted on local ecosystem services. Migration revealed a gap between the ability of those at risk to switch development pathway, compared to the institutional architecture of the region which has not yet been able to provide support, either to migrants, those potentially likely to migrate in the future, those left behind or in receiving communities.

Such institutional resistance supported an increasingly imaginary status quo. Disaster risk reduction has not been able to keep pace with the needs of those migrating and instead continues to focus on technical measures; investing heavily in embankments, which can cause substantial social displacement, and the development of saline tolerant crops, which may be incompatible with environmental concerns and also not a locally preferred choice. Environmental interests such as International Union for Nature Conservation (IUCN) and the World Wide Fund for Nature (WWF) have a development vision for the region that prioritises depopulation with a shift towards conservation. Central and federal government has been influenced to support this vision by the projected value of Sundarbans as a global commons and by external environmental interests. Jalais (2007: 4) expresses this poignantly, “Fascination, on the one hand, for the natural aspects of the Sundarbans, but on the other, an unsettling silence on the social and human facet of the region.”

### **Drivers**

The Sundarban is already experiencing the impacts of climate change (Mousavi et al. 2011, Jadhav and Munot 2009, Preethi et al. 2011) which put pressure on environmental and livelihood stability. In addition to this underlying pressure, variability and change in regional water regimes exceeds the coping capacity of local water management infrastructure and related land-use (Nandy and Banyopadhyay 2011, Rahman et al. 2011) The resulting frequent, small, discrete hazard events include regular embankment breaches and the erosion of river banks and coasts. Against this background of slow onset and everyday hazard, Cyclone *Aila* was an extreme hazard and loss event that pushed many households to collapse (Pelling, 2011)

The slow onset nature of climate change impacts and extensive risk character of the region potentially allow time and space for families to adjust and adapt autonomously – with or without State support. *Aila* has been critical in destroying this possibility. The rapid and widespread loss of household assets, the overwhelming of government and civil society capacity to support social development has forced

many individuals and households to turn to migration without planning. This has exposed migrants, especially the lowest skilled, to exploitation, as described below. This observation underscores the significance of such extreme weather events in the transformation of social systems with low adaptive capacities and high vulnerabilities.

Migration is not only forced, it also reflects a change in social values and aspirations. The penetration of cable television and mobile phones has extended aspirations. Aspirations are given cultural specificity by social networks that connect individuals in villages with urban migrants. In Kolkata for example, new settlements bear the names of villages in Sundarbans as their inhabitants hail from the same village and look to the settlement for community support.

The governance and policy making regime in Sundarbans is top-down. While popular political awareness in the region is high, there is very little direct engagement in the political process or open expression of dissent. Space for participation is very constrained. Apart from *Panchayats*, the self-governance body at the village level, there is little formal negotiating space for local actors. Through the *Panchayat*, it is nearly impossible to influence decision making processes outside of village level issues. Reasons for this include direct involvement of stronger global and national actors who control and shape the dominant discourse about management of the region and top-down policy processes with little concern for local social justice or needs (Jalais 2010, Mukhopadhyay 2009).

While the region's development pathway is driven from above, it is not the product of a clear vision but rather of relationships between international, national and regional agencies. This matrix of institutions and influences has been described as being locked at cross-purposes, missing opportunities that could be leveraged from involvement of the global community in the Sundarban. Resulting development deficits that lead to maladaptation, poverty, hunger and insecurity are interpreted by local communities as the State's hostility towards them (Jalais 2010, Mukhopadhyay 2011, Ghosh 2012a, 2012b).

### **Outcomes**

Two transformative pathways are revealed through this case study. First, migration emerged as an increasingly dominant choice for the poor and vulnerable who have reached the limits of their adaptive capacity. Migrations of skilled workers, unskilled women in the care industry (nannies, maids and medical attendants), and educated youth are described by households as enhancing wellbeing and life chances. The wellbeing of unskilled labour migrants and of women and children who have stayed behind are associated with declines in wellbeing at the individual and household levels (Ghosh 2012a, Bera 2012). The operating of people traffickers is an extreme form of exploitation to which especially the low and unskilled – men and women - are vulnerable. For these individuals the burden of transformation is very high.

Migration outcomes vary by gender, age, skill (education), economic and social status. The wealthier, more articulate and better informed have long used migration as a means to access education opportunity, and employment leading to alternative livelihoods less dependent on fragile agriculture, which they feel will gradually enable them to shift out from the Sundarbans.

A second transformative pressure is less deliberate but a result of the aggregate impacts of migration at the regional level. Whilst there is little in existing social development policy to actively encourage or support migration it fits well with the dominant development narrative of conservation and depopulation. In this way outmigration not only places the pressure of transformation on the poor but also supports the dominant development narrative of the region and of its most influential external actors. The inability of institutions, including regional development policy and social investments to identify migration as a development driver and pathway, and to invest resources in enhancing the prospects of migrants is an important finding. This flags clearly the challenge of those local actors entering into transformative spaces that are already marginalised from dominant development investment. In this case limited investment in education first constrains the livelihood options of the local population, making migration more attractive. At the same time, without investment in skills

migrants are only able to work in poorly paid and exploitative sectors. In the Sundarbans this is exacerbated by the behaviour of private labour scouts, who, mostly migrant workers themselves, supply labour to their place of work. While this helps them with some extra cash, it also offers certain security and a point person for those trying to migrate or need to migrate, as well for the families of migrant workers who stay back. An informal arrangement, they constitute an extended social network. There is no policy instrument except rapid improvements in mobile communication and telephony networks that has facilitated and fostered migration.

### **3. Sindh Floods, Pakistan: Extending citizenship rights through disaster response**

Contestations and negotiations in citizenship and the understanding of citizenship were transformed in the Lower Sindh in the aftermath of large scale flooding in 2010 and 2011. This period has reshaped political space for citizen-state interaction in the post-disaster period. These interactions and changes in relationships were shaped by formal processes such as the implementation of disaster response policy, but also by the unplanned, experiences of individuals that came together to result in an outcome that was able to push a more progressive form of ‘disaster citizenship’. In particular this study reveals a transformation in discourse and in the institutions of citizenship, and its impact on development pathway.

#### **Context**

The state in Pakistan passed the National Disaster Management Act (NDMA) just a few months after the first floods in December of 2010. The Act refers to disaster relief as *ex-gratia* assistance; in other words not an obligation but an act of generosity. It complicates this further by also establishing a basic minimum right to disaster relief, while leaving unclear in the text whether this “minimum” is a responsibility or a goodwill gesture. At the same time however, in the aftermath of the floods in 2010 and then again in 2011 the state implemented a universal cash transfer policy for each household affected by the disaster.

The Pakistani state used the National Database and Registration Authority (NADRA) to identify households domiciled in the disaster affected area and then dispensed money to them using cash cards called Watan and Pakistan cards. Hence it was not just a universal cash transfer but also a government-to-citizen (G2C) money transfer taking place through the NADRA registration system, using the Computerised National Identity Card (CNIC) number of the head of each affected household. The ‘universal’ nature of such disaster relief meant that people did not have to show that they were deserving of such state support, rather all households who had been affected by the disaster were provided this cash transfer. Additionally the mechanism of connecting this disaster relief with citizenship numbers meant that people understood this form of state disaster response as an ‘entitlement’ of citizenship. It therefore became discursively and in reality extremely difficult to divorce this form of disaster response from what people understood as legal citizenship, even though disaster response has not been institutionalised in the legislation as such.

#### **Actors**

Evidence from the field demonstrates that even political representatives (a Member of Provincial Assembly [MPA] from Badin) and state functionaries (the District Coordination Officer [DCO] of Thatta) articulated cash transfers through the ATM cards as a *de facto* right of citizenship. This suggests that the transformation in citizenship that emerged as a result of the disaster response policy interacting with various socio-political processes was not entirely intended by the state. Rather it fell between the intentional and unintended spectrum of transformation. While the state did not intend to make disaster relief a legal right of citizenship, the design and implementation of the cash transfer programme resulted in citizens understanding it in these terms.

Despite considerable development literature discussing the absence of the state and the gap between state and citizens in Pakistan, evidence from three districts in Lower Sindh clearly demonstrated that in times of disaster, when individual and even community capacity to overcome the challenge brought on by the floods was overwhelmed, people immediately expected help from the state. This research indicates that while the words for rights and entitlements were not used, citizens saw the cash transfers

through ATM cards – the Watan and Pakistan Cards – as a fundamental right. A certain minimal disaster response is already conceptualised as an important part of citizenship in Lower Sindh.

### **Drivers**

The internal context within Pakistan, especially Sindh was enabling and allowed a range of socio-political factors to be catalysed by the flooding disaster of 2010 and 2011. The principle factor among these was that the centre-left government of Pakistan People's Party (PPP) had been elected into office in 2008, in the first democratic elections to be held in the country, after nine years of military rule. The PPP leadership, the Bhutto family, is Sindhi and also seen to be particularly sympathetic to the interests of its working class and rural vote bank. The political environment in the country when the banks of the Indus River were first breached by flood waters was one where large scale state interventions were being implemented to address poverty and vulnerability amongst the most marginalised and excluded populations. In addition to the state directly reached out to address people as citizens through various social and technological changes creating civic and social spaces for change.

An enabling international environment also helped to drive this momentum. Over the last decade governments in the Global South have been reaching out to marginalised and vulnerable citizens through state interventions, such as *Bolsa Familia* (Brazil), *Oportunidades* (Mexico) or even the *National Rural Employment Guarantee Scheme* (India). In such a global political climate the World Bank, an institution that holds considerable sway in Pakistan's economic policies also supported rather than blocked this transformative trajectory in state-citizen relations.

### **Outcome**

The outcome of this intervention was that the state was able to engage citizens, demonstrating their stake in a modern state. The disaster citizenship that emerged in the aftermath of the 2010 and 2011 floods also resulted in a more long-term and extensive transformation. Despite the National Disaster Management Act of Pakistan shying away from declaring disaster response an entitlement or a right of citizenship, the discursive framing of the state's interventions in the post-disaster context were commonly being constructed by people in Lower Sindh as a right. Once disaster response or state led adaptation interventions are understood as a right, they cannot be taken back, making this post-disaster moment a truly transformative one in post-independence Pakistan, extending perceptions and understandings of citizenship rights as well.

## **4. Niger: A moment of critical reflection transforming development and humanitarian practice**

This case study illustrates how the intersection of two processes – incremental changes in Niger and wider discursive debate in the international aid system—led to a moment of critical reflexivity within the Save the Children organisation, focussed on the future of responses to slow-onset shocks. It demonstrates how the organisation was able to use this moment to consolidate and realign incremental change processes towards a transformational agenda. Delving into the case study of Niger, it highlights the complexities and challenges faced as such an undertaking unfolds.

### **Context**

Niger is a landlocked country situated in the Sahel eco-climatic zone of West Africa. It is impacted by a number of natural hazards including recurrent droughts, floods and locust invasions. It can experience extreme fluctuations in the price of staples and in terms of trade and has seen a general degradation of traditional coping mechanisms. In times of stress, vulnerable households may resort to strategies such as removing children from school, unplanned migration and forced changes in livelihood that can have immediate and long-term consequences for individual, household and community wellbeing. These challenges are intensified by longer-term processes of change including climate change, population growth (currently at 3.8% per annum) and urbanisation (currently at 4.9% per annum) (World Bank 2012; UN DESA 2011). Facing socio-economic and cultural vulnerabilities, women and girls are disproportionately affected.

Since the 1990s, and notably following the food crisis of 2005, there has been a gradual effort by a variety of actors to confront the underlying vulnerabilities associated with slow-onset shocks in Niger. While this change has taken place across a variety of sectors from social protection to nutrition to livelihoods, the case of early-warning provides a central and representative example of the pathway through which broader change has taken place.

### **Actors**

Save the Children has been operating a country programme in Niger since its response to the food crisis of 2005. During this time it has engaged in multiple development programmes and humanitarian responses, including the subsequent food shocks of 2008, 2010 and 2012. Throughout this time the organisation has worked with a number of actors such as the Nigerien Government, the national early-warning system (SAP), regional bodies (e.g. CILSS), UN structures, research bodies (e.g. Aghrymet) and other NGOs on improved approaches to slow-onset shocks. Parallel to the work being undertaken in Niger, at the international level, Save the Children also has teams engaging in technical programmes, policy, advocacy and humanitarian research and debates related to slow-onset shocks.

### **Drivers**

Slow-onset shocks such those related to food insecurity in the Sahel are not a new phenomenon. In Niger, in recent years, major events have impacted the country in 2005, 2008, 2010 and 2012. Developments in the international humanitarian system and governments' ways of working have demonstrated incremental changes in the institutional and organisational management of these shocks, but nonetheless, studies have pointed to a marked increase in numbers affected in recent years (Bailey, 2013). Amidst these currents of incremental adjustment, large-scale events such as the drought in the Horn of Africa in 2010-2011, Haiti earthquake in 2010, Pakistan floods of 2010, and Sahel drought of 2013 led to increasing discursive attention within the international aid system focussed on the continuous failure to adequately respond to these crises.

### **Outcomes**

Drawing on the incremental programmatic experience in country programmes and provoked by the large-scale events described above, a cross-divisional international task team within Save the Children was formed known as the Slow Onset Task Team (SOTT). This group has drawn together personnel from multiple divisions (development, humanitarian, advocacy, etc.) in order to reflect on the root challenges of slow-onset shocks and to develop an agenda to better address them. Four Activity Strands outlined by this process, are currently being advanced within the Niger country programme:

**A) Improving internal (Save the Children) Early Warning and Response Systems:** Save the Children in Niger has been working to develop the processes and procedures for a flexible delivery platform that is capable of adapting programming in the event of deteriorating situations.

**B) Strengthening external (national, regional and global) Early Warning and Response Systems:** Working in partnership with the Government of Niger, UN structures and other NGO actors, Save the Children has been supporting to develop a harmonised local level early-warning information system that can provide high resolution information on degrading food and nutrition security across the country.

**C) Bridging the relief-development gap through flexible programme design:** Linking together early-warning information (B) with processes and procedures for a more effective decision making in slow-onset shocks (A) plans are underway to operationalise a flexible delivery platform in programmes and activities.

**D) Promoting reform of the international humanitarian system:** Experiences from this process of change are being shared with national and regional bodies and forums to foment further reaching change.

These efforts to transform development visions and trajectories related to slow-onset shocks in Niger permits several reflections on the challenges, constraints and opportunities that can arise as an actor works to undertake an intentional agenda of transformational change.

External events can create opportunities for critical reflexivity within an organisation. Whilst significant of their own accord, the existence of ongoing processes of incremental change can help an organisation to use these moments to consolidate and redirect change towards a transformational agenda. Within Save the Children, shocks in the Horn of Africa and Sahel opened a discursive space for critical reflection on slow-onset emergencies. Establishing a cross-divisional task-team at the international level (The SOTT), the organisation was able to build on incremental changes already occurring related to early-warning information systems in Niger and redirect these to a transformational agenda.

In undertaking a transformational change agenda, the speed of change in some spaces may need to be brokered with other change agendas to accommodate wider system outcomes. To achieve an institutional transformation with regards to having a slow-onset capable delivery platform, Save the Children could have developed its own independent early-warning information system relatively quickly. However, to ensure that sustainability of the local early-warning information system and to guarantee ownership by the national government and local actors, it was important to delay this process. Had this process not been followed, the transformation of institution could have occurred but at the expense of a transformation in the broader system. Accordingly, change champions may need to broker agendas and prioritise activity spaces.

There can be challenges in adopting change within an organisation due to institutional legacies and processes. In Niger for instance, the development of a flexible delivery platform within Save the Children required reflection on the possibility of retrofitting programmes with new processes or if flexibility could only be applied to new grants. Furthermore, other organisation wide essential standards such as the requirement to develop emergency contingency plans (known as Emergency Preparedness Plans (EPPs)), were found to overlap with planned work, creating possible redundancies in contingency planning activities.

Investing financial and human resources can be essential for bringing about transformational change. As seen in the case of Save the Children's investment to kick-start the local early-warning systems, this initial seed funding need not be substantial, but without it change may be slow to start. Given priorities and time constraints of existing staff, it can also be very helpful to invest in human resources that can be dedicated to advancing the change agenda. Additionally, it is important to acknowledge that financing a transformational agenda may require a bricolage of complementary funds. Internal 'breakthrough funds' contributed to the work on 'sentinel sites' while an ECHO funded project supported the work on response analysis and slow-onset processes and procedures. In order to capitalise on different funding opportunities and to stitch these together coherently, it is important that there is an overarching vision of change.

Finally, to effect transformational change in development trajectories, visions and outcomes the role of donors is of central importance. The disconnection between humanitarian and development funding mechanisms means that there are often gaps in programme finance. In cases of chronic insecurity, long-term development programmes often do not exist, and where they do, they do not normally have the capacity to respond to changing circumstances. Long-term finance is necessary to realise the types of change outlined in this case study as is flexible finance that allows for crisis modifiers in the case of degrading situations. Without major reforms in donor approaches towards funding for early, preventative action, scope for deep-rooted change will be impaired. Case studies demonstrating effective interventions and studies into the cost-effectiveness of early and preventative approaches may be tools for successful advocacy with donors in these areas.

### **5: New York: Public transit systems and pathways to transformative flood control strategies**

Transportation systems are in many ways the infrastructural backbone of a region's economy. The Metropolitan Transportation Authority (MTA) operates the transit system for New York City (NYC) and the surrounding region. The MTA operates on more two thousand miles of track and carries more than 2.6 billion passengers per year. The focus of the case study is on empirical or inferential examples of where flood control strategies as disaster risk reduction (DRR) trigger two types of social-political transformations—defined here as process and product transformation.

#### **Context**

A large fraction of NYC and the surrounding infrastructure lies less than ten feet above mean sea level. The transit infrastructure in these areas is vulnerable to inundation during major storm events due to coastal surges and inland flooding caused by concurrent rainfall that is prevented from draining to the sea by the accompanying surge. Prior to the industrial revolution, sea level had been rising along the East Coast of the United States at rates of 0.35 to 0.43 inches per decade. Currently, rates of sea level rise in the NYC metropolitan region range between 0.98 and 1.57 inches per decade, with a long-term rate for NYC from 1901 to 2006 averaging nearly 1.2 inches per decade (NOAA, 2012). Prior to Irene and Sandy, on August 8, 2007 a severe and largely unpredicted thunderstorm swept through the city resulting in major and in some areas prolonged service disruptions of the MTA's transit system. Three and a half inches of rain fell in 2 hours. The heavy rain overwhelmed the regional drainage system along with the MTA pumps that were designed to handle no more than 1.75 inches per hour.

The flash flooding rendered almost the entire subway system inoperable, affected over 2 million transit users, and caused significant economic losses that day because employees and customers could not get into the city's central business districts. Suddenly the prospect of climate change impacts seemed more immediate and relevant to the everyday. The trajectory of economic development within the City was unaffected but policy leaders became alerted to the potential connection between climate change and economic loss. The event became a policy window for the initiation of climate change adaptation policy in NYC and marks a transition in the city's climate action (Solecki: 2014).

#### **Actors**

"I strongly believe we have to prepare for what the scientists say is a likely scenario. Whether you believe climate change is real or not is beside the point - we can't run the risk. And as New Yorkers, we cannot and will not abandon our waterfront. It's one of our greatest assets. We must protect it, not retreat from it." Mayor Bloomberg, Announcing the Special Initiative on Rebuilding and Resiliency report, 11 June 2013

Flooding and climate change discourses have evolved over the last two decades. Government agencies began to include more climate change-driven considerations into decision-making. Particularly important were several flooding and storm events such as the August 8, 2007 intense rainstorm, which caused flooding and damage to many components of the MTA transit system. At the same time, then Mayor Michael Bloomberg convened the New York City Panel on Climate Change and the Climate Change Adaptation Task Force to develop adaptation strategies for critical infrastructure—including the transit system. In August 2008 Mayor Bloomberg announced the creation of the New York City Climate Change Adaptation Task Force, a group made up of representatives from the city's Departments of Environmental Protection, Planning, Public Health, and Transportation, among others, as well as state and regional transportation agencies including the MTA and private railroad and telecommunication companies. The primary focus was on what steps could or should be taken to ensure the continued function of the city's critical infrastructure. The effort was defined as "...one of the most comprehensive and inclusive strategies ever launched to secure a City's critical infrastructure against the effects of climate change" (NYC Office of the Mayor, 2008). At the same time, the Mayor brought together the New York City Panel on Climate Change (NPCC). The panel was composed of experts from the academic, legal, insurance, and engineering sectors and was convened to advise the Climate Change Adaptation Task Force (CCATF) on the development of adaptation strategies to



secure the city's infrastructure from the effects of climate change. The CCATF included representatives from the MTA and other regional transit agencies and private railroad companies.

The 2010 report of the NPCC established the foundation for climate change adaptation in NYC and guided the Adaptation Task Force members in their climate change adaptation planning process. The recommended climate action focused on the concept of Flexible Adaptation Pathways allowing decision-makers and stakeholders to adjust their plans and activities as new and assumedly more sophisticated science information emerges in the future. Other important elements of the NPCC efforts included developing potential adaptation decision tools and processes to evaluate existing codes and standards and discern whether they need to be adjusted in the face of climate change.

A significant barrier for promoting resiliency and adaptation rests with the complex nature of cities and their extended metropolitan regions, and the administration of urban transit systems and other critical infrastructure. Coordination across these different organizations and associated constituencies is inherently difficult. In such a highly differentiated system landscape, the capacity to develop and implement integrative adaptation plans can be limited. For NYC, a city quite advanced in climate adaptation, the post-Hurricane Sandy resiliency and adaptation planning did not include comprehensive and detailed strategies because the transit system (the MTA) in the city is operated by the state of New York - a distinct governmental entity which was to receive separate post-disaster federal aid. Another barrier, potentially the most profound, is that elements of MTA operations do not formally recognize this as part of a long-term trend and broader-scale climate change (Solecki 2014). It was stated that within many offices especially those associated with facilities operations, the bulk of employees remain sceptical regarding the reality of long-term climate change and in general the term 'climate change' currently is not widely discussed in the context of planning, management and operation. Climate resiliency to extreme weather and climate events has given climate change discussion some purchase within the agency, and it has helped foster the development of newly constituted climate change advisory taskforce with the MTA.

The linkage between short term and long term planning was hampered by the MTA administrators, who were mostly focused on the effects of extreme events and climate variability that could disrupt or influence their systems now, rather than on risks more distant in the future. While the administrators recognized that future climate change would involve greater temperature and precipitation shifts, a variety of factors including the traditional focus of transit agencies operations and management on near-term timeframes (next 10 to 20 years) and the general lack of confidence in long-term climate projections and the uncertainties associated with them forced attention to be on the short-term.

### **Drivers**

Hurricane Irene (August 2011) resulted in extensive flooding into distant suburban and exurban areas north and west of NYC and slight storm surge flooding in the City itself. It caused approximately \$65 million USD of damage for the MTA and most important the loss of a section of commuter train line north of NYC from a rain-induced railway bed washout (MTA, 2012). Fourteen months after Irene, Hurricane Sandy hit the metropolitan region causing catastrophic damage, the most significant of which came from a record storm surge and coastal flooding. In the aftermath of Hurricane Sandy, Mayor Bloomberg created the Special Initiative of Rebuilding and Resilience (SIRR) and reconvened the NPCC. The SIRR focused on assessing the damage from Sandy, understanding how future climate change might influence the level of coastal risk, and promoting resiliency efforts in the City's neighbourhoods most at risk to current and future flooding. The SIRR released its report in June 2013 and the NPCC released its climate projection updates at the same time.

Hurricane Sandy dealt New York's transit system a massive blow resulting in approximately \$4.75 billion USD of damage (MTA, 2013). Almost all of the major underground transit (subway) tunnels flooded with the record storm surge. The majority of systems were shut down for the remainder of the workweek after the landfall of Sandy on a Monday evening. Significant loss and damage reduction resulted from the fact that the entire transit system was closed well in advance of the storm's full

impact and that mobile assets such as subway rail cars and buses were relocated to higher elevation sites away from storm surge zones.

### **Outcomes**

Extreme events constitute learning opportunities to review all aspects of the transit system's operation and management including an assessment of every individual's responsibility during a system crisis. While it is clear that many of the extreme events which impacted the MTA system in the past decades have led to advances in disaster risk reduction operations and management, the post-disaster learning process has been ad hoc and incomplete and has not taken advantage of all the possible lessons for future action. The story of the South Ferry station is an interesting case in point. From 2005-2009, an extensive construction took place and a nearby new South Ferry station was opened at a cost of \$527 million USD. Renovated without extensive thought to storm surge and flood risk, the new station was severely damaged from Sandy flooding. Roughly six months after the storm the MTA reopened the mothballed old station to provide service at the site and began the process of restoring the new station at an estimated cost of an additional \$600 million USD. A crucial question, yet to be fully answered, is to what extent is the new information on dynamic climate risk including accelerated rates of sea level rise and increased flooding periodicity are being integrated into the current efforts. A strong commitment to rebuild and restore is evident through the MTA, the City and the state Governor's office. Yet, the connection between rebuilding, restoration and resiliency to future climate change is not well defined (MTA 2012, MTA 2014).

The mantra of the post-Sandy era in the New York Metropolitan Region has been one of defiance – “no retreat” and “stronger than the storm.” The disaster risk reduction and climate change adaptation strategies that have emerged reflect these sentiments. It is during the year and half since Sandy that discussion and action with respect to redevelopment of the storm surge affected areas has begun to emerge. Parallel to this process has been an examination of the role and importance of public transit in advancing disaster risk reduction but also implicitly with respect to potential development shifts.

The reclaiming of the waterfront for recreation and residential development will be one of the great legacies of the Bloomberg era. The water's edge was heralded as a great amenity just at a time that the vulnerability of the waterfront to storm surge and sea level rise became more widely understood. Hurricane Sandy dramatically accelerated this understanding. After the hurricane it was recognized that during an extreme flooding event the NYC's vital transit lifelines and infrastructure were highly susceptible to disruption and that the shoreline areas particularly of the outer boroughs (those excluding Manhattan) were especially at risk. When Sandy struck, the Jamaica Bay and the Rockaway Peninsula area maintained a disproportionate share of the public housing and government-run senior citizen housing, and mental health/special medical service facilities, as well as some of the most disadvantaged populations in the city. These regions were significantly affected by Sandy and not only by the immediate storm surge and damage but also by the relatively slow pace of recovery. Several months after the storm while almost all public services and businesses were back in operation in other parts of the city, these areas continued to suffer with stores shuttered and residences uninhabitable. While the focus has been on helping residents rebuild and promote resiliency, in many cases, the financial assistance was slow in coming or not sufficient.

The impact of Sandy in these most vulnerable neighbourhoods has fostered a public discussion of the long-term future for these locations. While arguing that options other than retreat should be available and that new construction must be more resilient, the process of redevelopment has raised issues of public policy, equity, and public participatory governance, and a possible re-imagining of these coastal areas. For example, discussion has emerged on whether the public housing and government senior and health service facilities should be relocated away from the shore and on how to provide a revised flood insurance mechanisms which will provide benefits to home owners who put into place flood resilience measures. Simultaneously, an ongoing push within the city for public participatory budgeting was greatly accelerated by recovery debates that followed Sandy within some of the most affected neighbourhoods. Community meetings and opportunities for communities to make decisions regarding redevelopment funds and in some cases to seek a government buy-out for their

neighbourhoods were part of the post-Sandy experience. These processes can be connected to a broader set of shifts in New York that are promoting increased use of citizen science data collection and analysis and principles of enhanced localism (e.g., a focus on locally sourced food, distributed alternative power generation, and reduced commuting distances).

The full outcome of these pressures has yet to be realized, but influencing all are market forces. Hurricane Sandy revealed that many communities at the water's edge, distant from the urban core and lacking good transit access were also highly at risk to flooding. The need for heightened resiliency and redevelopment was clear. Providing better transit access and more new flood protection structures were seen as mechanisms to provide added value to otherwise relatively high amenity value waterfront adjacent locations. In this situation, transit is used a mechanism to promote disaster risk reduction and economic growth. The questions that remain are: will the redeveloped neighbourhoods still have places for their less economically advantaged residents or will the resiliency-driven construction spur a process of gentrification and set in motion larger social-political transformations that create new risk profiles in advance of the next storm?

## 5. Discussion: In what circumstances can disaster risk management open space to address accumulated development failures or gaps?

This section discusses the key findings from the report case studies. Results are summarized in Table 3 which draws out six key characteristics of transformation introduced by our conceptual framework. Each case study presents a distinct historical context and development trajectory but common lines of influence can be seen that can help derive some core principles for the interaction of disasters and risk management with development.

**Table 3: Pathways for Transformation**

Indicators of Transformation	Christchurch	New York	Sundarbans	Sindh	Niger
Disruption	Yes to physical infrastructure, local economy, population and development narrative	Yes to infrastructure performance and physical assets and business continuity	Yes to life and livelihoods	Yes to life, livelihoods and infrastructure	Yes to lives, livelihoods and organisational efficacy
Intense actor interaction	Yes, at local and national levels.	Yes, between administrative interests	No, strategy is isolated by sector and scale	Yes, at the technical level	Yes, within the INGO, donor communities and government
External intervention	Yes, increased central state and corporate private sector in reconstruction and Maori led initiatives	Yes, from science in planning for future risk	No, firmly set within state and national risk management and development planning	Yes, with expert interventions	Yes, shaped by external thinking.
Triple loop learning	Yes, insertion and enactment of Maori values in response and reconstruction	No, focus on efficiency not major redesign or revised social role for transport.	Yes, amongst household livelihood and identity	No, mode of delivery and extension of citizenship.	Yes, new organisation goals and processes to reduce risk.
New forms of coping	Yes, emergent social forms	Yes, new technology and user management investigated to	Yes amongst households and for individuals	Yes, based on new entitlements claims	Yes, new organisational forms and processes

		enhance future risk management	who meet adaptation limits		under development.
Failure of institutions	<b>Yes</b> , new legislation in place	<b>No</b> , institutions robust and flexible	<b>Yes</b> , at the household level but reinforcing state level	<b>No</b> , institutions robust and flexible	<b>Yes</b> , at the organisational, government and policy community level.

**Pathway competition:** The Christchurch event provides a clear of example of two development models coevolving. Liberal and Maori response and reconstruction efforts have involved individual and structural transformations. Both approaches have their roots in pre-earthquake society and both have gained ground in the response and reconstruction period. However, the discourses around each trajectory and their methods of operation are distinctive (centralization and the introduction of public-private partnerships compared to collective and communitarian action), potentially conflictual. Both also challenge some of the institutional foundations of New Zealand's Anglophone and welfare state oriented social democracy. These two pathways seem to be pulling in contrasting directions, towards more market oriented and collectivist development strands. Legislation, organizational structures and social development interventions institutionalise these pathways producing an increasingly multifaceted development trajectory post-earthquake.

**Pathway experimentation.** Planned, technological and administrative reforms can allow for controlled opening of potentially transformative social and political space. The New York and Sindh cases both led with technological innovation. Both provide scope for a controlled experimentation with social change processes without commitment. In New York, planned revision of public transit may include significant redesign and revision of transport management structure. In Sindh, cash transfers extended citizenship rights, claims and stakes. Both the Christchurch and the Niger case consider the management of the pace of change. Time compression in response to the Canterbury earthquake sequence constrained involvement of the community and local government actors in response. In contrast, and perhaps because changes have unfolded in a pre-disaster space, the Niger case has explicitly identified the need for critical reflection and consideration of a range of alternatives, allowing time for diverse actors to engage with the change process.

**Pathway scale effects.** Perhaps the clearest experience across the case studies is the tendency for the local level to carry the weight and costs of transformation. In the Sundarbans scale effects were not planned. Households self-transformed using migration as a survival and development strategy faced with region wide flood risk. The resulting population movements supported regional strategies for depopulation. Scale effects can also be reversed. In Niger, purposeful local but incremental action by Save the Children changed operating procedures and goals with a view to transforming the delivery of drought and food crisis management. In New York discussion of risk management combined with gentrification of water front neighbourhoods shows just how tightly coupled development trajectories for risk management can be to urban planning.

**Pathway lock-in.** Institutional structures are designed to be resistant to organisational transformation. Transformation is most likely when multiple local and external actors are aligned, in critique of established systems elements,

Distinctive, disruptive drivers resulting from disasters of differing scales characterise all cases: In the Sundarbans the failure to open a transformational policy space to support transforming households has constrained space for institutional transformation. This increases the likelihood that self-transformation at household level may have negative outcomes for those electing to pursue it. Environmental actors such as WWF and IUCN may see out-migration in the Sunderbans as an attractive demographic transformation in line with their preference for depopulation and conservation in the region.

By contrast the Canterbury earthquakes have proved a driver for transformation at organisational level, potentially shifting development trajectories, but for whom, and in what ways? The shift towards centralised and de-bureaucratised decision-making represents an institutional transformation. A further institutional transformation has resulted from awareness of the response strategies of the Māori, leading to the involvement of local tribe Te Rūnanga o Ngāi Tahu as a partner, a new departure in disaster risk management. It is not clear at this stage whether these institutional transformations have led to significant adjustment of core developmental pathways.

Hurricanes Sandy and Irene in New York created dramatic disruption, but the institutional structures under consideration appear more resistant to organisational transformation than was the case in Canterbury. The complex array of interlocking institutions displayed ‘institutional interlock’ limiting the effect of the disruptive events, on their behaviour. The study questions, for example, whether climate change information has been taken account of in the expensive reconstruction of South Ferry station after serious damage due to Sandy. The then Mayor’s strident statement that “... as New Yorkers, we cannot and will not abandon our waterfront. It's one of our greatest assets. We must protect it, not retreat from it.” represents an institutional schema defining the direction of development. As in the Canterbury case the impact of these incipient transformations may be negative to the local populations, who in both cases may have reduced voice or agency. The underlying question, as David Harvey (2012) poses, is about who gets to shape and define the city.

Agency amongst local actors is displayed in Pakistan, where external institutional pressures from the World Bank have played a part in triggering innovative cash payments via Watan cards, which have in turn influenced discourse at the local level, increasing individuals’ awareness of rights. This signals a potential shift in the social contract which may redirect the development pathway.

Moving away from external disruptions, can institutional structures transform themselves intentionally? In the Nigerien case the prevalence of slow onset disasters has triggered an intentionally transformative response. The key question is whether the transformative outcome matches intention, and who the transformation benefits. The study anticipates the possibility of a transformative change breaking down the humanitarian/development barrier impairing effective developmental response but it is yet to be seen whether this historically intractable barrier can be removed.

The Sunderban case study documents not only the impact of Aila, but the increasingly unsustainable lifestyle resulting from the impacts of climate change. Similarly in Niger livelihoods are fragile, though the precise impact of climate change is less clear (UNEP: 2006, Black et al 2013). In both cases a key determinant of transformative outcomes in response to vulnerability and disaster is the responsiveness of institutions. The phenomena of institutional lock-in was identified in the New York case, and the authors of the Nigerien case study note that the need to manage the pace of anticipated organisational change must be adapted to take account of the variable responsiveness of institutions. Deeper anticipated transformation in that case –merging humanitarian and development workstreams and funding – is yet to emerge.

Returning to the Sunderbans, interlocking institutional goals appear to leave the most vulnerable groups with their only option as out-migration from the area. A more transformative outcome is seen in the Sindh, which benefits from the conjunction of a responsive government with specific local ties, the existence of models of direct financial support from other countries, support of the World Bank and the active engagement of communities.

From across the case studies two overarching themes emerge, and reinforce observation made elsewhere in the wider literature: (1) transformation is resisted by established institutional frameworks, (2) transformation is dependent on the relative influence of multiple actors.

## 6. Conclusions

The core question put to this study – can we observe decision-making processes that lead disaster risk management strategies to impact upon underlying development trajectories can be answered firmly in the positive.

The study has shown that the interaction between disasters, disaster risk management and underlying development trajectory can be both incidental and purposeful. The majority of observed transformations were local – found at the level of households or in organisational decision-making. Even when policy led transformation was also observed to be targeted at affecting strategic change this was worked through in local policy for land-use management, local governance and economic development.

The study has drawn out the importance of policy as a driver of transformative change but more significantly the case studies presented show the potential for individuals and population level behaviour and of organised civil society as agents of transformation. This is a fundamental observation and opens questions on the scaled distribution of the burden of undertaking transformation.

A better awareness of cross-scale interactions as well as cross-sector communication as key determinants of transformative potential and in the distribution of possibilities and trajectories speaks directly to the two likely future scenarios for disaster risk. First where risk becomes more extensive: here as we see from the Sundarbans, Niger and Sindh while extensive risk impacts on widely distributed population's adaptation will be at the household level and it is here that adaptation limits will be reached and forced transformations undertake. It is important that policy actors and institutions are able to anticipate this and prepare to support forced transformation. Such preparations, as Save the Children and the Pakistan Government have found are not easy and not always predictable in their outcomes. The ways in which risk managers have been able to develop anticipatory policy and hedge to contain the unexpected impacts of policy in the transformation solution space are new priorities. Second, as urbanisation and population growth continue and assets become more concentrated so the risk of major catastrophe increases in scale and geography. The likely policy response here is for investment in large scale engineering or social protection schemes. Macro-management also offers scope for transformation – from land-use and market behaviour to the decision-making process itself. Managing risk at scale has been left out of discussions on the procedural justice which have concentrated on local and NGO led activities. This is a missed opportunity and one that will become increasingly evident and risk management scales up to meet likely future challenges.

In providing a first systematic analysis of transformative potential in disaster risk management, the report arguably opens more questions than it can resolve. Next steps at shaping a policy agenda for transformative risk management include:

- What kind of disruption is required to open transformative action?
- How do existing structures and dominant actors behave when faced with potential transformation?
- How best to anticipate and steer transformative pathways to avoid collateral costs, especially to the poor and vulnerable?

This new policy agenda can build on the substantive findings of this study which finds that transformative disaster risk management is:

- instrumental and spontaneous,
- delivered by individuals and in aggregation at the level of population
- led by national and international actors, across the public sector and civil society, and
- felt most strongly at the local level.

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