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INTEGRATED RESEARCH ON DISASTER RISK

IRDR FORENSIC INVESTIGATIONS

Report from the ad-hoc Working Group

Toronto, 1-4 February 2010

CONTENTS

Executive summary

Despite considerable advances in the geophysical sciences and in geotechnical capacity over the past several decades, losses from disasters associated or related with natural phenomena continue to rise at a rapid rate. This report explores and elaborates upon various hypothetical explanations for this fact and endorses the idea of the ICSU Planning Group to develop and implement an innovative methodology identified as “forensic investigations” of disaster risk. Critical to this methodology is a broad multidisciplinary research strategy that will bring together researchers in the natural sciences, engineering, the social and health sciences, economics and other fields. It is proposed that the research will employ several approaches singly and in combination including; critical cause analysis; meta-analysis of existing studies and new research; longitudinal analysis, and disaster scenarios. The ad hoc Working Group recommends that a formally constituted Working Group be established as soon as practicable, charged with the responsibility to further develop and implement Forensic Investigations as outlined in this report.

Preface

In its planning for what was to become the new Integrated Research on Disaster Risk programme, the ICSU Planning Group proposed that there be an initial emphasis on case studies as a cross-cutting theme. *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 Science Plan proposed that these case studies be done in the form of forensic investigations, where the term 'forensic' was to suggest the qualities of serious, all-encompassing, arms-length, careful and detailed analysis of both 'failures' – or cases where mistakes were made – and success stories. The Science Committee for IRDR has endorsed these principles and approaches and concluded that there was need to move ahead, relatively quickly, to better define the scope and approaches of case studies and forensic investigations.

Due to some short-term opportunities for funding and people's availability, it was decided to convene a meeting in early February, hosted by the Institute for Catastrophic Loss Reduction in Toronto. Specific funding support was provided by UN ISDR and ICLR, while ICSU provided logistic support.

The participants in the meeting were a selection of IRDR SC members (S. Cutter, A. Lavell, G. McBean), B. Mills, who is chair of the World Weather Research Programme's (a research partner of IRDR) Working Group on Socio-Economic Research Activities (SERA) and I. Burton, a member of the ICSU Planning Group, who had taken a lead on case studies within the planning process. I. Burton was asked to chair the meeting. Special thanks are due to P. Kovacs, Executive Director of ICLR for his support of, and participation in, the meeting and to K. Hewitt, T. Islam, D. Sandink and C. Rodgers for their contributions to the meeting and the report. R. Basher of UN ISDR joined the meeting dinner and provided insight. This was an excellent group but it will be important to extend the participation in future meetings to other regions and areas of expertise to provide greater international diversity of authors, literature cited, and other inputs.

One output of the meeting is this report, which provides excellent guidance for the further pursuit of the concepts and activities of forensic investigation as a key component of the IRDR. The meeting has also recommended that the SC IRDR formally establishes a Working Group and charges it with the further development and implementation of forensic investigations. The report provides guidance on some initial steps that could be taken by such a Working Group on Forensic Investigations. The SC IRDR will consider these recommendations at its next meeting in April 2010.

On behalf of the SC IRDR, I thank again the participants in the meeting for an excellent report, based on some spirited and in-depth discussion, and for their specific recommendations.

G. McBean,

Chair, Scientific Committee,

Integrated Research on Disaster Risk

1. Context

The Science Plan for Integrated Research on Disaster Risk (International Council for Science, 2008) includes a proposal for the design and execution of "Forensic investigations of recent disaster events" (Section 12.2, p. 47). This proposal has also been endorsed and recommended by the Latin American ICSU disaster risk reduction research programme elaborated in 2008 (ICSU-LAC, 2009). It is suggested that such investigations be included in the first three years of the IRDR programme both to demonstrate some early results, and to help identify specific research questions to be addressed as the programme develops. The Science Plan also proposes the formation of a Working Group to further refine the concept of forensic investigations and subsequently design the template to guide the investigation teams.

With the support of ISDR an ad-hoc Working Group was convened in Toronto, 1-4 February 2010, for the purpose of elaborating upon the proposal and considering what next steps might be taken.

2. Problem statement

One of the underlying questions that began the momentum towards the IRDR proposal for forensic investigations was the conundrum: why when so much more is known about the science of natural events including extremes and when technological capacity is so much stronger, are large scale disasters (as well as the impacts of small and medium scale ones (see ISDR,2009)) apparently becoming more frequent and the losses continuing to increase at a rapid rate? (White, Kates and Burton, 2001). There has been over the last 50 years a substantial expansion of knowledge about the potential magnitude and frequency of many natural events and the places in which they are more likely to occur. Often the growth in losses is attributed to increases in human population and material wealth, and their expansion into more hazardous locations. This is certainly part of the explanation for increasing losses. It is also true that scientific knowledge and modern technology are not uniformly distributed and that many developing countries have a low capacity to utilize or introduce the science and technology that is theoretically available due to institutional or human resource barriers or, more importantly, cultural and resource scarcity reasons. But the fact that large disasters continue to occur in developed countries suggests that there must be more to the explanation than access to science and technology, and choice of location, important though these factors undoubtedly are.

It might be expected 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 some developed countries where it seems (subject to some serious limitations in 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. In many developing countries the "success" rate has been less satisfactory and there are clear indications that in the highly vulnerable and exposed countries at least, losses are increasing faster than wealth, and are an impediment to social and economic development. Single larger scale or a series of sequenced smaller scale events can sometimes set back years of economic and social development, foster

political insecurity, and cause long lasting environmental impacts. Where the environment has been severely degraded, as in Haiti for example, such events will probably lead to greater human impacts as new socio-natural hazards are added to already existing natural ones. In developed countries disaster risks could be managed better. In developing countries it is not enough to say that improvement is possible, it is an imperative.

After a major disaster event it often happens that an enquiry is made or new research undertaken into the causes and consequences. When such investigations are conducted (and there have been many), they typically focus heavily on either the geophysical or atmospheric processes or the technological and structural aspects of the damage. Emergency preparedness and the disaster relief and rehabilitation response are also often examined. Sometimes an enquiry may extend to the effectiveness of existing policy and make recommendations for future policy improvements. These efforts rarely seem to probe very deeply into the more underlying and sometimes longer-term causes of the disaster, although excellent examples of this are to be found. (Oliver-Smith 1999; Maskrey (ed), 1996). Nor are the enquiries necessarily carried out at arms-length from those most intimately involved and responsible. This is understandable to the extent that those consumed in disaster response and on the spot have the most knowledge of just what occurred, but not necessarily why or how. One consequence appears to be that enquiries tend to leave many questions unanswered or even not asked. Is it also the case, as some would argue, that in the aftermath of a disaster when many are suffering materially and physically and from post-traumatic stress disorder that there may be reluctance to risk creating more distress by probing too deeply into the causes?

3. The forensic approach

The ad-hoc Working Group endorses the idea that more penetrating investigations, developed in a more explicitly designed and enacted multidisciplinary framework with a common methodology and a common set of fundamental questions could and should be made as part of the early phase of the IRDR programme. Such studies will search for additional, wider and more fundamental explanations for the current rise in disaster losses. These might extend from gaps in scientific knowledge in some instances to the ineffective application of available knowledge. Commonly identified in previous investigations are poor building standards, planning and design of infrastructure and human settlements. Less frequently addressed are questions concerning how and why decisions were made and management options chosen. This applies not only to major policy choices but to the many everyday incremental decisions and social and cultural practices that shape the resilience and vulnerability of communities. Investigations should explore these questions as well as new forcing that may be emerging through the evolution and proliferation of communication and other technologies or the globalization of the world economy. The IRDR research initiative is therefore aimed to conduct investigations of these and other hypotheses and ideas at a greater depth and with more rigour than has previously been

achieved. The use of the term forensic investigations should not be taken to imply that lessons and insights and new understandings can only be derived from "failures" or cases where mistakes can be identified. It is also important to conduct forensic investigations in places where extreme events have occurred with much less serious or highly variable consequences to help accumulate evidence of good practices and other success factors. An examination of good practice and low impact, as opposed to bad practice and high impact, can be achieved with different results by looking at the impacts of the same event on different areas and sectors and different events on the same types of problem and sector. Clearly the forensic approach as briefly described requires more elaboration and the development of guidance for its implementation. The wider utility of such an exercise will depend on its interdisciplinary design and the non-partisan and professional integrity with which it is executed. The status and reputation of ICSU and its partners in ISSC and ISDR gives reason to believe that there are good prospects that such ambitions can be met.

The essential elements of the disaster forensics approach as envisaged by the ad-hoc Working Group can be summarised as follows:

i) Investigation of the circumstances, causes and consequences of losses in disasters and to identify conditions that have limited or prevented loss.

ii) To operationalize and test a series of hypotheses of damage causality (including primary and secondary hazards, settlement, land use, the built environment, development paths and others).

iii) To identify especially key factors in the expanding numbers or losses in disasters during the past few decades and to show just how they enter into risk and disaster.

iv) Investigation of the use of existing scientific knowledge in disaster risk assessment and management

4. Research methodology

Four approaches are identified as offering different and complementary modes of analysis for application in a series of core investigations of events of particular concern in given places, regions, or contexts where existing explanations seem insufficient or are contested and/or where there are some prospect of bringing exceptional or recurring losses under greater control. These might centre upon Critical Cause Analysis (CCA), and this can in turn draw upon other approaches including meta analysis, longitudinal analysis and scenarios.

It is the sense of the Working Group that despite great advances in many aspects of science applied to disasters, there are rarely investigations sufficient to base a full and comprehensive assessment of the causal factors. Geophysical and geotechnical understanding is rarely brought together with social profiles of risk and response. There are deaths and damages in a range of recent disasters about which there is no mystery. The immediate and proximate causes of the collapse of schools and hospitals in Gujarat, Sechuan and northern

Pakistan are well understood. So are the reasons for the collapse of buildings in Mexico City in 1985 or Izmit, Turkey in 2006. It is also clear why casualties among women and the elderly were disproportionate in the Kobe earthquake, and why exceptional losses were recorded among the elderly, the disabled, and poor African-Americans during the Katrina events in New Orleans. Moreover, within all the disaster zones of these events there were cases of schools, hospitals, high rise blocks, groups of women, children and the elderly who survived unharmed or were able to recover quickly mainly thanks to effective social and economic protection measures that others did not have. Thus there is a good deal of evidence that suggests losses were not the inevitable consequence of the earthquakes or storms, but of the failure to learn lessons from past events, the lack of applied normative behaviour, diverse decision making failures, poorly managed recovery and reconstruction following them amongst other humanly induced or promoted factors. It is a remarkable fact that very few places where recent major disasters have occurred lack a history of disasters, or events than can be shown to threaten major losses when they recur.

Forensic investigations are partly about looking more broadly at the conditions and profiles of risk and losses, more sophisticated analysis to identify causal relations of how, where and to whom losses occur; not ignoring where they do not occur and why. The point is to identify those causes about which something can be done, which in itself requires social, cultural and economic sensitivity to the type of society being considered and its opportunities and limitations; to find the best evidence of what was done, and if nothing could have prevented or withstood the forces involved, then what other options there are for avoidance and the use of more risk averse practices; and saving lives if not property. To the extent possible these forensic investigations will seek to emulate what a range of professional investigations have achieved in other fields such as industrial accidents, transportation safety, fire, and disease prevention: that is to identify key hazards or forms of endangerment that can be acted upon to limit or prevent harm.

In the development of this methodology considerations should be given to what can be learned from forensic investigations in these other topics.

4.1 Critical cause analysis

The foundation of the IRDR forensic investigations would be to recommend/carry out a series of studies which retrospectively reconstruct and specify the conditions, causes and responses involved in particular destructive events. They would be ‘forensic’ in the sense of a broad mandate to trace out and assign causal explanation of losses, and attendant or intervening conditions that magnified or limited losses. Conditions in the impact or crisis-emergency phases are of foremost concern and will usually serve to identify most of the losses to be explained. However, it is anticipated that careful attention would be paid to pre-disaster conditions, especially as they govern exposure and vulnerability to given hazards, and the role and effectiveness of responses to the emergency, and post-disaster recovery conditions. In each case the aim would be to identify key factors and points of risk, immediate loss and adverse consequences that follow. Equally, it would be important to cast a sufficiently wide

net within disaster zones to identify the measures and responses that served to prevent or limit the losses found elsewhere and for each process in the disaster sequence that caused harm or failed to offset it. The approach would be multi-disciplinary, aiming to integrate social, environmental and technical assessments, partly because of the complex range and interaction of factors in disasters, partly to be open to pursue whatever explanations or safety conditions may offer best opportunities for improvement. This would serve the main goals of identifying more effective mitigation and preventive measures.

The following factors are of critical importance:

(1) Conduct causal analysis of hazards and the processes involved in loss, injury, death and damage, with a view to identifying critical factors in the pre-disaster, impact and post-disaster recovery phases. And, attempt to identify the preventive measures that did or can apply to avoid, control, or limit the losses and for each process in the disaster risk sequence identify those that caused harm or failed to offset it. If possible engage, or consult, a relevant range of professional, technical, local assistance in events.

(2) Identify critical failure (or success) points, meaning a site, step, item or process where damage occurred that could be prevented, eliminated, or reduced to an acceptable level in the face of a particular type of hazard.

(3) Establish critical limits for failures and failure points --- maximum or minimum values for site, construction, behaviour, in relation to the warnings, evacuations, and building safety criteria to prevent, eliminate, or reduce loss to an acceptable level.

(4) Establish monitoring requirements, necessary to ensure that the community, item or process is constantly aware and protected at critical failure points.

(5) Establish corrective actions that are appropriate to conditions and funding in given contexts, and that can be taken when monitoring indicates a deviation from an established critical limit. This will require a plan to identify corrective action if a safety limit is not met, and to reduce exposure and vulnerability to potentially damaging physical events.

(6) Specify adequate record-keeping, documenting, and monitoring procedures for critical items, threshold points and limits.

(7) Identify who does, can, or should carry out corrective actions, and maintain the safety systems.

(8) Clearly identify where more recent prospective or proactive action could have been taken and

enacted in order to guarantee that less risk was constructed in reality-such as land use planning, enactment and enforcement of building norms and the like.

In carrying out forensic investigations it is important to anticipate what the implications of the results of analysis may be. In other areas of safety these include inspections, verification and validation: to move from analysis performed by qualified, independent inspectors to ensure disaster mitigation as well as emergency plans are adequate and working as intended and to check that procedures or items do what they were designed to do; that is, are successful in ensuring safety. This may include periodic or on-going reviews of records, critical limits, sampling and analysis and tasks to be performed by responsible personnel.

4. 2 Meta-analysis, including existing literature and new research

Meta-analyses are systematic reviews of the extant literature to identify and quantify (if possible) consistent findings across diverse studies. The meta-analysis is an analytical procedure where the results of the observations (e.g. case studies) are coded and then statistically analyzed to look for causal linkages, the strength of relationships among factors (dependent or independent variables), and the effectiveness of interventions. The meta-analyses can focus on thematic attributes of disaster risk (e.g. role of insurance in loss prevention; differential impact of disaster loss on the poor; availability and utilization of knowledge); or they could focus on specific perils (e.g. earthquakes, windstorms, flooding). For example, Rudel (2007) did multivariate statistically-based meta-analysis of 268 empirical studies of deforestation looking at causal factors used to explain forest loss. He found both distinct temporal patterns in causation, but also a shift in institutional drivers from state-sponsored programs to more enterprise driven initiatives over time. On the other hand, Polsky et al. 2007 argued for a common protocol for vulnerability assessments (which they term the vulnerability scoping diagram) that would facilitate comparisons among dissimilar studies, but using qualitative assessments rather than quantitative comparisons.

Another approach to meta-analysis is to derive commonalities across findings based on a research design where the empirical studies all used a common template or set of protocols. In this respect, the meta-analysis is used as a procedure for synthesizing the results of similar studies based on a consistent research design. We might think of this approach as the ex-post assessment, where the archival literature approach is the ex-ante. Examples of the ex-post meta-analysis include White's (1975) pioneering work on hazard case studies ranging from local to global, and the comparative analyses of hazards in the world's megacities (Mitchell 1999a, b). One of the outcomes of such a research project is the identification of knowledge gaps in the existing research as well as contradictory findings on disaster impacts or loss reduction. This gap analysis would suggest where strategic investments could be made by IRDR to stimulate additional research to not only fill the knowledge voids but resolve some of the contradictions in findings. An example of the utility of such meta-analyses is seen in Box 1.

Box 1: Counting fatalities

One of the main mechanisms for understanding losses from disasters is the number of fatalities. Estimates of deaths vary widely depending on the source of the data and once reported they rarely are confirmed before entry into statistical databases such as EM-DAT. For example, the forensic investigation by Altez and Revet (2005) on the Vargas 1999 mudslides was only able to confirm 852 deaths compare to the 30,000 initially reported and thus recorded in the global databases, such as EM-DAT. A meta-analysis of how fatalities are recorded across disasters and regions would shed some light on the magnitude of over and underestimates of deaths attributed to disasters.

4.3 Longitudinal analysis

Longitudinal reconstructions are detailed, place-based re-analyses of particular disaster events and are used to more fully understand damaging processes and contexts that put people at risk; identification of prevention measures that could have made a difference; and lessons learned or unlearned. These reconstructions could be comparative geographically (e.g. two different but essentially comparable places with similar event characteristics where the sequence of actions, decisions, policies, etc leading to disaster risk and particular effects 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). The methodological approach to reconstructions employs archival and ethnographic techniques. They require sophisticated understanding of the particular place and its history, geography, and culture in order to reconstruct both the context and the driving forces that produced heightened the impact on that place. The most well-known disaster reconstructions are Kai Erickson's Buffalo Creek disaster (Erickson 1976); and Tony Oliver-Smiths work on the Peruvian earthquake in Yungay (Oliver-Smith and Hoffman, 1999).

An example of a current reconstruction that could be done would be to compare the effects of Hurricane Camille (1969) and Hurricane Katrina (2005) on the Mississippi coast (same spatially location) where they both made landfall in nearly the same location, but during different time periods. Another example would be a longitudinal reconstruction of the 2003 European heat wave comparing the impacts on urban areas in France compared to cities in central European countries, for example. Why was the mortality rate so much higher in one country compared to the other?

The value of longitudinal reconstructions is in providing in-depth understanding of the causes and consequences of disasters and the evolution of mitigation and/or risk reduction strategies. In the case of paired comparisons of a single place with multiple disasters, this approach permits an analysis of what mitigation strategies worked, what ones could have worked if implemented, the lessons learned, and the lessons not learned.

4.4 Scenarios of disaster

It is inevitable that a major cyclone will eventually strike again in Southeast Asia, or the Caribbean; an earthquake will strike again in China, Turkey, Pakistan, Haiti, Japan, the United States or South America; and there will be catastrophic flooding again in Mozambique, China or Europe. A tool to help decision makers advance disaster risk reduction may involve a rigorous assessment of potential future disasters particularly in areas already affected in the past and where information on those events and the causes of their impacts can be built into the new scenario building effort. Ideally, lessons society can learn from an assessment of disaster scenarios will be based on a detailed analysis of both possible adverse impacts and the identification of options for reducing the risk of loss. This type of "forensic" work could possible be referred to as "projective or predictive forensic" given it projects loss and its causes into the future as opposed to examining and explain real loss in the past.

IRDR forensic investigations will involve scenarios that may include cyclones, earthquakes, floods and other natural hazards. Other important risks, like pandemics and terrorist attacks, would not be included in this effort. The hazards explored would be realistic, low probability risks, with the potential for a major adverse impact in terms of loss of life and/or property damage. The investigation should include a multi-disciplinary assessment of the factors contributing to the risk that a natural hazard would become a disaster and an exploration of potential actions to mitigate the risk of loss.

The scenario should be science based, selected on the basis of a known hazard that may be rare, yet represents a realistic and possibly inevitable future event. Potential scenarios may assess a historic disaster event if it were to reoccur in the near future, assessment of a hazard experienced elsewhere relocated to the study community, or the impact of a natural hazard viewed to be realistic for the study area. The analysis would involve natural science with the capacity and experience to provide a detailed description of the potential hazard used to support the scenario.

The impact assessment should be multidisciplinary. This should involve experts with knowledge about the hazard, engineering and the social sciences. It would be useful to develop estimates of the potential loss of life, injuries, number of people displaced, damage to buildings and infrastructure, and other economic losses. It would be useful if financial estimates are generated for specific risks like potential damage to homes, interruption in business, destruction in public infrastructure, impact on employment, loss in expected tax revenue, and increase in government disaster relief spending. Detailed assessments would explore impact by gender, age, and socio-economic status. Rigorous analysis of potential adverse impacts will provide a strongest foundation for the identification of specific mitigation options.

The study must also set out specific options for mitigating and preventing the risk of future disaster losses. The most rigorous studies would have the potential for supporting a cost/benefit assessment of each option. Ideally the study will provide an assessment of the root causes that the natural hazard has the potential to become a disaster. This would involve study of the state of public infrastructure, disaster resilience of buildings, quality of emergency preparedness, and public awareness of disaster risk. Perhaps this may involve a comparative

assessment measured relative to some benchmark of best international practices. This should also include an assessment of social vulnerability.

Moreover, it is important that the findings from an assessment of potential disaster scenarios contribute to appropriate actions by decision makers. The studies should include active communication of findings to policy makers, private industry, the general public and other stakeholders. Involvement of decision makers in the study design and implementation will increase the likelihood that the knowledge generated will advance disaster risk reduction.

The ShakeOut Scenario is an example of this form of forensic investigation. More than 300 experts from academia, industry and the public sector assessed the impact of the potential 7.8 magnitude earthquake on the San Andreas Fault near Los Angeles California. The ShakeOut study estimates that the earthquake may cause 1,800 deaths and US$213 billion of economic losses.

A comprehensive, multi-disciplinary assessment was completed to identify actions to reduce the potential impact of the next major earthquake in Southern California. The study found that retrofitting programs have increased the seismic resilience of buildings, highways and other lifelines, yet much more can still be done. Five major areas of expected loss include older building designed to earlier standards, non-structural elements that are largely unregulated, vulnerable public infrastructure, business interruption due to failure of public infrastructure, and uncontrolled fire following an earthquake.

The findings from ShakeOut study have been communicated broadly to a wide range of stakeholders, including emergency managers and the general public.

The specific elements of a potential disaster scenario may never happen but it is inevitable that cyclones, earthquakes, floods and other natural hazards will continue to strike with great force. The assessment of scenarios can support enhanced preparedness and stimulate investments in mitigation. Rigorous scientific analysis of the natural hazard, the potential impact, and options for mitigation provide an important foundation of knowledge to support decision makers as they manage these perils. The study of potential disaster scenarios empowers users to identify what they can change now, before the hazard strikes, to reduce the catastrophic impact after the inevitable hazard occurs. Moreover, lessons learned from any given scenario could apply to a range of alternative risks.

5. Elaboration of problem dimensions

Each of the approaches elaborated above provide a well-reasoned advance on important research questions. In composite, they establish a medium and mechanism for developing a comparative understanding of the root causes and underlying processes that lead to disaster risk in diverse socio-economic, cultural, national, regional and local settings. As well, the methods offer an understanding of the processes by which risk reduction policies and instruments are, or are not, laid out on the ground in specific but comparable disaster risk contexts. However, beyond this lie a series of fundamental probing critical questions that should be

informed through the integration of results. These questions[1] synthesize into five general themes or focal points: a) disasters in the context of everyday life; b) knowledge creation, communication and relationships with decision-making; c) responsibility and governance; d) measurement of outcomes and differential impacts; and e) attribution of cause and effect by social actors.

(a) Disasters in the context of everyday life

This theme appeals to a broader construction of risk that is not divorced in time or space from everyday life and experience. Are disasters only, or mainly, caused and explained by environmental extremes, unprecedented conditions, unscheduled events, or 'a few bad apples'? Or rather are the degrees and forms of risk established by pre-existing conditions and, in most cases, those of the 24/7 fabric of home, family, community, work, services, entitlements, expectations and leisure? Evidence for the latter implies that people and property damaged in disaster were already and specifically exposed and vulnerable to more or less well-known threats—but lacked protections that others had. Triggering agents like earthquakes or storms are clear points of reference, contributing to threats and facilitating damage, but are not fundamental in the disaster risk management equation, which must always be based on human intervention filtered through an understanding of societal conditions and habitat relations.

Taking this line of inquiry further, one questions whether everyday life has been treated as simply the opposite of and, therefore, irrelevant to, disaster. In causal explanations of why, where, and to whom disaster happens, evidence points to this as a convenient 'myth'. Whether coincidental or intentional, the fabrication serves to subvert attention away from essential avenues of responsibility. Everyday life is contrasted as opposite that of disaster by way of its 'normalcy'—traditional, predictable, and static—an illusion that only occasionally if ever presents itself in the modern world. What is more often meant by 'global change', not to speak of 'globalization', is the deliberate, if not always well-planned, transformation of everyday life. So when one speaks of 'everyday life' as a precursor of disasters, it is rarely because it remains unchanged. Nor does it mean that life would have been only benign, stable or secure in the absence of disaster. Slums and risky jobs, not to speak of driving or fast food, have their everyday dangers. For these reasons too, it is essential to address the links to and role of 'development' in disaster.

'Development' or modernization is essentially a reconfiguring of everyday life and it too has been the site of a false dichotomy—that disaster is the opposite of development. Although this may be the intention of development proponents, in practice a world is revealed where both lack of development and ill-considered, risky forms of development have been major precursors of magnified or novel damages. That is pretty obvious when dams fail, tunnels collapse, or mining makes river and lake water toxic. But there is very little about the modern world that is not being changed with, or usually without, a precautionary accounting of the risks that

[1] A more complete series of questions raised during the ad hoc working group meeting and synthesized into section 5 are listed in Annex 2.

may follow—for some if not most people. Recognizing the links between 'everyday' and disaster is the basis for acknowledging that efforts to reduce disaster risk require real advances in development parameters and indexes and that disaster risk reduction and management are or should be an integral part of development planning.

Finally, it is hard to imagine day-to-day life not pervading and controlling to some degree the form, extent, and success of disaster responses—which are far from independent of pre-disaster life. That 'everyday' capacities, skills, and values of people at risk are fairly decisive in how they influence disaster response exposes another often ignored reality. In a majority of disasters, lives saved that would otherwise be lost, and most evacuation, sheltering, feeding, comforting, in the hours or days before outside relief arrives (if it does at all), are overwhelmingly the product of actions taken by relatives, neighbours, local service and professional persons still able to function. Since it does not have the stamp of something special to disaster, this is usually neglected in mainstream research and media coverage.

(b) Knowledge availability, creation, communication and relationships with decision-making

The assertion that society and its institutions have failed to fully apply existing knowledge concerning disaster risk and disasters—the wisdom of past successes and failures—is a motivating rationale for the IRDR effort. However, the many issues surrounding it deserve much more careful and critical attention.

In some cases, massive and important gaps exist in basic information that must be resolved for utility to be derived from ideas and lessons learned elsewhere or from those long ago. For example, many of the major disasters that have affected Central America in the last 20 years were never seen to be likely given the lack of physical analyses and projections, or forgetfulness of past experiences—often decades or even centuries ago. Understanding how this lack of information or the application of knowledge based on incomplete information or erroneous assumptions, leads to poor decisions will enable the unpacking of precursors to disaster.

The process of generating or creating knowledge may offer important clues as to why results have not been successfully transformed into policies, practices, standards, investments, and other actions to the extent envisioned or possible. Taking cues from environmental assessment and general risk management literature, one would expect that response uptake, application, and effectiveness improve when local experience (tacit knowledge) is combined with and given standing alongside 'expert' knowledge in participatory research and decision-making processes. It is not clear whether these qualities actually produce 'better' knowledge or simply build credibility and trust. What is evident is that strongly held local knowledge claims concerning disaster causes are not easily supplanted with outside expert opinion and that institutions, politics, and social organization play primary roles in establishing, reinforcing or breaking down barriers to information.

The divide between expert and lay perceptions and opinions concerning risk and response are but one illustration of difficulties associated with knowledge translation and communication. Much of the available knowledge may exist outside of a particular region and in a form that may be foreign to decision makers (e.g., journal articles) or inappropriate for their particular problem (e.g., precision, certainty). Understanding how

information flows and modifies when translated and interpreted across languages, cultures, media, regions/locations, hazards, disciplines, institutions, gender, age, and through time will permit identification of factors that influence cognition, use, and ultimately disaster outcomes.

(c) Responsibility and governance

Complementing the quest for the root causes of disasters is the search for responsibility, which naturally extends into the realm of management, institutional arrangements, and other processes associated with governance. How can 'responsibility' be assigned to social actors? Clearly this depends on the type and form. Deliberate acts of corruption, deceit, and gross negligence perpetrated by a few 'players' usually make their way into and through legal proceedings or inquiries—especially in developed countries. This contrasts with situations where participation in the creation of risk is *en masse*, unknowing or coincidental with efforts that, by many measures, produce tremendous societal benefit (e.g., jobs and livelihoods produced through coastal development, urbanization, deforestation). It is these broader areas of responsibility that must be carefully examined in greater detail, teasing out the evolution of institutions, social norms, and basic incentives for encouraging or discouraging risk reducing behaviour from well before to well after the disaster in question.

(d) Measurement of outcomes and differential impacts

Establishing the various causes of disasters, identifying and assigning responsibility for damages, and recommending mitigating actions, demands a common interpretation of desired and undesired outcomes. A partial list of these includes: mortality with cause of death; morbidity with kinds and numbers of injuries; number of displaced and homeless; direct economic losses; property losses, other losses, business disruption and discontinuity; losses covered and not covered by insurance; disruption of access to basic services, mobility and communication; and longer-term stress and psychological effects. Although there are many important practical and methodological challenges of obtaining such information, a more compelling question is whether such measures are adequate for evaluating aggregate impacts such as 'social disruption' or conceptions of system qualities like 'resilience'? Depending on how many indicators are considered and how they may be subjectively weighted (e.g., lives take precedence over livelihood or insured loss) by researcher and decision-maker alike, one might derive a very different assessments of success, failure, damages, and responsibilities. In disaster and risk analyses, the outcome or damage indicators noted above are often used as dependent variables whose variability (i.e., differential impacts) can be connected to corresponding changes among independent variables (e.g., land use, income, education, dwelling age). The resulting correlations, when coupled with a plausible mechanism or process, become valid sources of explanation that are strengthened even further when repeated in multiple locations (within a disaster area and between different regions) and time periods for multiple forms of hazard. This suggests that considerable effort needs to be spent on identifying and evaluating potential plausible mechanisms and independent variables for application across a wide variety of disaster contexts.

(e) Attribution of cause and effect by social actors

Understanding different interpretations of the causes and effects of disasters may yield insight into why certain actions were undertaken while others were not. Maybe another fundamental one is how the disaster was interpreted in causal terms by different social actors, in newspapers, on television, in reports. What was revealed or argued to be the initial or fundamental causes.

How do physical interpretations play off against more social explanation?

Additional generic question sets could include a section on how disaster is explained by different social groups and interests.

6. Guiding the investigations

There is a wide range of possibilities for forensic investigations and it is appropriate that selection criteria be established. These criteria should be seen as flexible guidelines since there will undoubtedly be opportunities which require pragmatic response. However, it is important that selected investigations address the core principles of the IRDR. Thus they should be inherently integrated across the disciplines and be appropriate to relate to other hazards and other geographical regions than the ones specifically in the investigation. Further since the outcome of IRDR is to 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 selected investigations should specifically contribute towards this legacy and these contributions should be identified clearly in the project objectives. When developing the rationale and work plan for the investigations, clear links to policy issues need to be identified. It is important that the outcome of these investigations be such that there is a definite positive impact; part of the research will need to be on how to make the benefits of the investigations most effective and useful and ensure that they are actually implemented.

In view of expected forensic investigations, it is particularly important that they address the institutional levels of governments, the private sector and civil society and their roles in disaster risk reduction. Institutional analyses should be undertaken to clarify relative roles and responsibility. For this reason, the participation of local partners should be part of the selection criteria.

For these selected forensic investigations, the IRDR should bring together teams of experts and practitioners, including appropriate expertise in the relevant fields of natural and social sciences, as well as decision-makers, to address the key questions to be answered. The selection of investigations should include those where there is potential for arriving at objective views or assessments of responsibility.

The IRDR co-sponsors all have policies with respect to openness and the free distribution of information, appropriate privacy and ethics, and on issues of balance. These policies must be respected.

As outlined in the IRDR Science Plan, in relationship to Objective 3, (Reducing risk and curbing losses through knowledge-based actions) it is proposed that some initial forensic investigations be carried out on recent disasters. Following the suggested methodologies and approaches outlined above, detailed examination of a number of cases should be carried out to gain experience in combining and integrating the diverse areas of knowledge that are necessary for any practical programme of risk reduction and include vulnerability assessments and the analysis of effective (and ineffective) approaches to risk reduction.

In addition to the other criteria, it is proposed that in the next few years, forensic investigations be carried out to identify major research needs and gaps at the interface of natural and social sciences. These studies would also test methodologies and approaches in a systematic way. The selected investigations would involve a wide range of hazards, scales, geographical regions, cultural and economic contexts, including the social contexts from hazards affecting, for example, large mega-cities to rural communities, from the most impoverished countries that have limited resources to highly sophisticated communities in the developed world.

7. Potential outcomes

Several potential outcomes can be identified at this time. The following list of three broad sets of outcomes needs further elaboration. As in all scientific research there can be other unanticipated outcomes which though unforeseen can add to knowledge and point to future research.

i) These forensic investigations have the potential to improve understanding of the causes of disasters in ways that can lead to improved practice in disaster risk reduction and management, especially by identifying options for future action that can reduce exposure and vulnerability. A key element is the identification and location of responsible decisions in ways that permits or mandates improvement.

ii) To the extent that new understanding is achieved these investigations have the potential to set disaster risk reduction on a new path that will begin to slow down the rate of increase in losses and could eventually lead to stabilization and reduction. In making this claim the Working Group is keenly aware that while there is hope for a safer environment it cannot be achieved easily or soon.

iii) An important part of the research is to develop and improve the research methods and approaches themselves. To the extent that these newly designed forensic investigations prove to be effective when conducted by the research community, they may provide a new model and a new paradigm for official investigations conducted under public authority.

8. Recommendations.

The a- hoc Working Group recommends to the Scientific Committee for IRDR (SC IRDR) that:

1. This report be reviewed (subject to modification and expansion as necessary) and accepted at its next meeting in April 2010,.
2. The SC IRDR formally establishes a Working Group and charges it with the further development and implementation of Forensic Investigations.
3. Invite the Working Group on Forensic Investigations to:
    - participate in a coordinated way with funding activities,
    - initiate as soon as feasible some research for early completion, specifically meta-analysis based on existing literature,
    - convene meetings and workshops as required for the furtherance of its agenda,
    - seek opportunities for collaboration among the sponsoring organizations (ISCU, ISSC, ISDR) and other agencies, and
    - convene groups of experts to design templates and elaborate common methodologies for forensic investigations.

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Annex 1: Participants in the ad hoc Working Group meeting on Forensic Investigations, Toronto, 1-4 February 2010.

i) Ian Burton (Chair)
ii) Susan Cutter.
iii) Ken Hewitt.
iv) Paul Kovacs.
v) Allan Lavell.
vi) Gordon McBean (Chair SC IRDR)
vii) Brian Mills
viii) Caroline Rodgers
ix) Tarik Islam.
x) Dan Sandink.

Annex 2. A preliminary formulation of questions derived from meeting documents and discussions.

1. Disasters in the context of everyday life

What is the influence non- or less than-disaster events (however defined)—some might say as being more routinely managed risks—on disaster management?

Are disasters only, or mainly, caused and explained by environmental extremes, unprecedented conditions, unscheduled events, or 'a few bad apples'? Or are the degrees and forms of risk are set up by pre-existing conditions and, in most cases, those of the 24/7 fabric of home, family, community, work, services, entitlements, expectations and leisure?

Is it a convenient myth that everyday life has been treated as simply the opposite of and, therefore, irrelevant to, disaster?

Is everyday life really 'normal', static, benign, and secure or is it constantly in flux and therefore compellingly complex as important precursor to disaster?

Is disaster really the opposite of 'development' as some (and experience) might suggest? Or can development (or at least that which fails to account for future risks) and the lack of development both contribute to disasters or at least the amplification of damages?

Are research and popular media so skewed by the 'special' (or unique) features of disaster response (outside assistance) that they neglect the role that 'everyday' capacities, skills, and values of people at risk play in determining outcomes?

How do fundamental development issues, in particular poverty, interact with disaster processes to affect vulnerability and impacts?

2. Knowledge availability, creation, communication and decision-making

Does the process by which knowledge was created and characteristics of those who created impact uptake and application?

Does the incorporation of local tacit knowledge and engagement of local decision makers in the design and execution of research enhance the likelihood that recommendations will be adopted?

How does understanding how information flows and modifies when translated and interpreted across languages, cultures, media, regions/locations, hazards, disciplines, institutions, gender, age, time, etc. permit identification of factors that influence cognition and use.

How does awareness that knowledge and experience exist, timeliness of the information relative to the decision, and the ability to retain, store or archive the experience for later application affect the use of knowledge in decision-making?

What appeared to be the immediate, proximate causes of the disaster or the initiating event(s)? Would the removal or shift in one or two key factors dramatically altered the outcomes?

What this event forecast or predicted? What was the state of scientific knowledge about the event (or category of events)?

Was the existing knowledge widely available and accessible?

Were there any decision-makers, other actors, stakeholders or victims (or those at direct risk) who were unaware of the information (or less aware than they might have been)?

How was the risk of this event (or similar events) perceived and understood by all the categories of stakeholders?

How long had the scientific knowledge been available and had it significantly changed or improved in the recent past?

What was the past record of the occurrence of this particular type of initiating event?

How certain and precise must the evidence of pending hazard events, consequences, and efficacies of particular actions be to support decisions across the spectrum of disaster management (preparedness, response, recovery, mitigation, etc.)? In addition to scientific validity, what other factors influence these decisions.

How are risks communicated within the areas directly affected by a disaster? What are the relative roles of different communication media? How might current social networking capabilities have affected past disasters?

How engaged were citizens in risk management processes prior to (since) the disaster? What formal or informal means were available for people to identify and express concerns, debate evidence (knowledge claims), and contribute to the formation of actions?

Were public and community leaders (and the institutions/organizations they represent) perceived as credible and trustworthy?

For a given hazard and aspect of vulnerability or exposure, what are the current "best practices/standards" at regional, national and international levels relative to those in place in the disaster area? How much impact could have been avoided/lessened if these were implemented?

Are community experiences with disaster/hazard embodied in art, culture, traditions, and architecture? Does this have any effect on community attitudes toward disaster management?

Do we really have more knowledge or do we have a lot of information? Or do we have many more people with a little knowledge finding it difficult to share, integrate, apply?

Who possesses this knowledge and how transferable is it/has it been?

Has knowledge increased equally for both physical hazard and "consequence" elements?

What knowledge (modern and traditional) existed, what was taken up on in terms of policy, practice, etc., and what was not utilized and why? How successful were various methods used to gain and distribute knowledge? What knowledge did not exist and why? In multi hazard areas, how was knowledge of some factors skewed in favor of some risks and not others.

How does centralization versus decentralization, participatory versus top down approaches to knowledge and intervention critically affect intervene in explaining risk?

Are policies being informed by the current, existing knowledge? If not, why?

What strategies, policies or measures had been put in place? Were any options rejected? Explain the reasons why the reported decisions were taken or not taken. To what extent were these consistent with prevailing scientific and stakeholder knowledge?

3. Responsibility, power and governance

Were there groups or individuals in the community (or outside the community) who clearly benefited from the disaster event?

Was there any sense of unfairness or recrimination in the community before, during or after the disaster? Describe and explain.

What is the power structure in the community? Who makes decisions and how are they made? Has the changed pre- and post- disaster?

Were persuasive communication, social marketing and fear appeals used to encourage action? Is it ethical to portray potential harm/impact in excess of that supported by scientific evidence—even if shown to be an effective motivator for evacuation or other behaviours?

How can "responsibility" (whether direct, indirect, informed, misinformed) be assigned to social actors?

How does the varying capacity of nations to institute change relatively easily affect issues of responsibility and the utility of recommendations (from research)?

How do social, political, economic, and legal system characteristics limit or enable the assignment of responsibility for risk? Does the lack of a translatable and accepted delegation of responsibility negatively influence the rebuilding process which requires the responsible government to work with international community that has found them negligent etc. ?
Are there inherent inequalities in the proposed actions to reduce risk?

What were the drivers of risk and can they be separated from issues of neglect, failure etc that will demand accountability/responsibility? Which aspects have contributed to increasing risk over the past 50 years?
Are there any cases where specific responsibilities have been assigned for mitigation of disaster impacts? Should we review these cases as part of the pilot test to identify whether or not responsibilities *can* be identified?
What were the roles of key personnel and agencies throughout the course of the disaster?

4. Measurement of outcomes and differential impacts

What were the impacts of the disaster in qualitative and quantitative terms: mortality with cause of death; morbidity with kinds and numbers of injuries; direct economic losses; property losses, other losses, business disruption and discontinuity; losses covered by insurance and not covered; access to basic services, mobility and communication; longer-term stress/psychological effects?
What disaster response measures were taken, including: numbers made homeless or trapped; numbers evacuated or migrating; the nature and effectiveness of the emergency response including short term and longer term rehabilitation and reconstruction?
Are common measures of impact (such as deaths, injuries, property loss) adequate for evaluating the extent of social disruption?
Is the return to “normalcy” (with or without substantive adjustment—a new normal) taking longer and coincident with the troubling trends noted for the common measures?
How are success and failure defined? Does a level of acceptable or tolerable loss exist? What has been the effect of wrong or imperfect predictions? What has been the effect of good predictions?
How do institutional setups for urban, rural, development, sector or territorial planning influence risk creation and eventual disaster contexts?
How does the structure and capacity of institutions affect resilience?
How does placing focus on resilience or risk reduction as a desired outcome affect the research? Building resilience assumes that event is going to occur and cause damage but in some cases risk reduction could imply acting so that events do not occur.
What was the distribution of losses (impacts) within the community in special terms and by socio-economic status or type of occupation or employment? Were the impacts differentially felt by people or groups according to level of education or other variables such as location, size of household/family unit, or access to information and communication?

How are sub-populations differentially susceptible to risks?
How does geographic scale affect the distribution of risks and impacts?
What was the economic/social status of the community in the immediate predisaster period and what were the current development trends?
How has the community been affected in the longer term? Is the community making a good recovery and in what period of time? Have predisaster trends been continued, exacerbated or reversed? (Comments from Brian : This must be linked into how it contributes to understanding disaster risk preexisttng before the event)

Is it possible to determine the influence of past (2-3 decades) disaster management efforts? Had they not occurred would it have been much worse than the storyline above?

5. Attribution of cause and effect by social actors
Is there an overall community shared view of the disaster? Is it seen as an 'act of God or fate"? Are other explanations offered and if so what are they?

6. Generic questions.
What strategies, policies or measures had been considered to prevent the event or reduce its consequences?
Where damage prevention or reduction measures had been put in place or adopted were they effective? What contributed to their effectiveness or lack of it?
What are the conditions, causes and consequences of losses in disasters? What conditions limit or prevent loss?

What factors affect or cause damage (e.g., primary, secondary hazards, settlement, land use, built environment…) and what are key factors that explain the expanding numbers or losses in disasters during the past 50 years?

What were the critical transitions in recent history as regards development models or facets and transitions that can be used to explain risk and stakeholder participation in this (risk discourse?)? For example, search for rapid but environmentally degrading development in landslide and flood prone areas; rapid urban growth to accommodate need for rapid industrial growth but with few building controls or lands use regulations.
How does culture, history, societal norms and setups influence risk?

What are critical factors that explain the "second disaster"—that that occurs after first level impacts have been consolidated—for example, lack of ability to distribute emergency supplies and attention to dispersed outlying populations which results in unnecessary and preventable death?

What were the drivers of disaster prevention/resilience by broad categories: social characteristics; economic activity and livelihoods; institutional and governance structures; environmental; infrastructure (critical infrastructure and residential environments); community competence (including prior experience with events; social cohesion; social networks).

How do culture, language, and other factors act as barriers and opportunities for disaster risk reduction enhancement?

What are the implications of trans-boundary risk management issues?

How are disaster risks in countries, regions or communities constructed over time through complex inter-play of various development factors and geo-physical and atmospheric processes that generate conditions of exposure, vulnerability and hazard?

What are the dynamic aspects of disaster risk configurations in particular locations or regions? What are the synergistic effects of multiple, simultaneous hazards and those of slowly shifting risks (e.g., sea level rise) which may escape detection/attention until exposed by an acute event (e.g., tropical cyclone)?

7. Suggested template questions:

(1) What appeared to be the immediate, proximate causes of the disaster or the initiating event(s)?
(2) What this event forecast or predicted? What was the state of scientific knowledge about the event (or category of events)?
(3) Was the existing knowledge widely available and accessible?
(4) Were there any decision-makers, other actors, stakeholders or victims (or those at direct risk) who were unaware of the information (or less aware than they might have been)?
(5) How was the risk of this event (or similar events) perceived and understood by all the categories of stakeholders?
(6) How long had the scientific knowledge been available and had it significantly changed or improved in the recent past?
(7) What was the past record of the occurrence of this particular type of initiating event?
(8) What strategies, policies or measures had been considered to prevent the event or reduce its consequences?
(9) What strategies, policies or measures had been put in place? Were any options rejected? Explain the reasons why the reported decisions were taken or not taken.
(10) Where damage prevention or reduction measures had been put in place or adopted were they effective? What contributed to their effectiveness or lack of it?

(11) Provide a detailed description of the disaster from beginning to end including to role of key personnel and agencies.

(12) Provide a list of the impacts of the disaster in qualitative and quantitative terms specifying is detail the following: mortality with cause of death; morbidity with kinds and numbers of injuries; direct economic losses; property losses, other losses, business disruption and discontinuity; losses covered by insurance and not covered.

(13) Describe the disaster response measures including numbers made homeless or trapped; numbers evacuated or migrating; the nature and effectiveness of the emergency response including short term and longer term rehabilitation and reconstruction.

(14) What was the economic/social status of the community in the immediate predisaster period and what were the current development trends? How has the community been affected in the longer term? Is the community making a good recovery and in what period of time? Have predisaster trends been continued, exacerbated or reversed?

(15) What was the distribution of losses (impacts) within the community in special terms and by socio-economic status or type of occupation or employment? Were the impacts differentially felt by people or groups according to level of education or other variables such as location, size of household/family unit, or access to information and communication?

(16) Were there groups or individuals in the community (or outside the community) who clearly benefited from the disaster event?

(17) Was there any sense of unfairness or recrimination in the community before, during or after the disaster? Describe and explain.

(18) What is the power structure in the community? Who makes decisions and how are they made? Has the changed pre- and post- disaster?

(19) Is there an overall community shared view of the disaster? Is it seen as an ‘act of God or fate”? Are other explanations offered and if so what are they?

(20) Other. Question 20 stands for the many other questions not yet on the list.