



Forensic Investigations of Disasters (FORIN)



A conceptual framework and guide to research

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Integrated Research on Disaster Risk (IRDR) 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 Office for Disaster Risk Reduction (UNISDR). It is a global, multi-disciplinary approach to dealing with the challenges brought by disasters triggered by natural hazards, mitigating their impacts, and improving related policy-making mechanisms.

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Preface

Disasters are often portrayed as acts of God, acts of Nature, *force majeure* or more recently as consequences of climate change. The recently adopted Sendai Framework for Disaster Risk Reduction 2015-2030 explicitly recognizes that a range of underlying causes and drivers participate in the social construction of disaster risk. However, in the media, policy discourse and research, disasters are still frequently characterized as unexpected, unforeseeable, overwhelming and fundamentally exogenous events.

In this fetishistic representation of disaster both the events themselves as well as the social actors involved are detached from their context and history, in a way that is analogous to poverty pornography. Those who experience disaster are stripped of their own histories, and often of their ethnicity, gender, social class and culture to become homogenized *disaster victims* affected by extreme events outside of human agency.

This objectification of disasters as decontextualized events and as *externalities* has been gradually codified over the years into sets of institutional and administrative practices which now characterize an increasingly professionalized and structured disaster risk management sector. The dominant focus of these practices is to reduce the impact of such *externalities* on communities, society and the economy. Research and case studies often tend to reflect and reinforce these codified practices, focusing more on the impact of disasters rather than provoking a serious enquiry into their causes.

Emerging empirical evidence on disaster loss patterns and trends, however, unveils a radically different picture. Ballooning investment in the disaster risk management sector at all scales has been accompanied by equally rapidly increasing levels of disaster related loss and damage, in particular associated with frequently occurring, localized extensive risks. Extensive risks are those that are most closely associated with underlying drivers, such as environmental degradation, social and economic inequality, poorly planned and managed urban development and weak or ineffective governance. This points to a fundamental contradiction in the contemporary practice of disaster risk management. Attempting to protect development from the socially constructed consequences of its own contradictions is by definition a schizophrenic endeavour.

Viewed from this perspective, transforming the direction of disaster research in a way that unveils the social construction of risk could potentially contribute to a profound redefinition of disaster risk management. This second version of the FORIN (Forensic Investigations of Disasters) conceptual framework and guide to research holds the promise to trigger just such a change. Underlying the FORIN conceptual framework is the understanding that historical processes, operating asynchronously at different spatial and temporal scales, configure the specific circumstances in which disasters occur. Disaster risk, as such, can never be considered an independent variable.

Disaster risk is usually defined in terms of three other variables, namely hazard, exposure and vulnerability. However, these in turn are also dependent variables. Most hazard is a reflection of both socially constructed as well as physical processes; exposure is a reflection of how social relations of production unfold in territory and geography; while vulnerability characterizes a range of social, economic, political and cultural conditions. The essence of the FORIN conceptual framework, therefore, is that all disaster risk is socially constructed. From that perspective disasters are not merely *not natural*, they also *don't exist* independently as things or as objects. They are only moments of space-time compression within broader social and historical processes.

This way of looking at disaster risk is certainly not new but can be traced back to contributions from many different intellectual and philosophical traditions. In the 2nd century Nagarjuna interpreted the theory of dependent origination to speculate on the emptiness of all phenomena. In the 14th century the philosophy of history presented by Ibn Khaldun laid the foundations for interpreting specific historical events in the context of broader cycles and processes. In the 18th century enlightenment thinkers such as Voltaire and Rousseau speculated on the causes of disaster in the wake of the Lisbon and Callao earthquakes and tsunamis. More recently the pioneering work of White, Burton, Hewitt, Wisner, Davis and others since the 1960s, prepared the ground for the emergence in the 1990s of a consolidated research tradition on the social construction of risk in Latin America. This in turn stimulated similar research in other regions and gradually influenced national, regional and global policy debates, including the Sendai Framework itself.

This second version of FORIN, however, not only clearly articulates a conceptual framework for understanding disaster risk. Equally importantly it codifies and presents a set of methodological principles to identify and analyse processes of risk construction. The methodology presented by FORIN moves from analytical and systematizing “description” to understanding underlying, root causes and dynamic processes. Only through a journey that links causes with effects is it possible to identify policies or practices that could manage processes of risk construction or at the very least lead to an *eyes wide open* ponderation of the trade-offs inherent in any process of risk management. At the same time, this version of FORIN discusses different pathways through which disaster research can become more socially relevant and effective, including retrospective longitudinal analysis, disaster scenario building, comparative case studies and meta-analysis.

It is to be hoped that with the publication of this volume, the FORIN methodology will become more widely applied as a mainstream instrument in disaster risk research. Only when the lens of research shifts in focus from analyzing the effects of exogenous events to the causes of endogenous risks will it be possible to assign responsibility to social actors for managing disaster risks. And, only when risk construction is fully accepted and understood will it be possible to contemplate success in the achievement of the targets and expected outcome of the Sendai Framework for Disaster Risk Reduction 2015-2030.

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A work of this nature is the product of a great deal of reflection and discussion on the part of many people. It is five years since the first FORIN framework document appeared, providing an initial set of ideas about the scope and methods of the FORIN project. Since then, a total of four FORIN workshops for young scientists have been held (Taipei 2012, Mexico City 2013, Orange, California 2013, Mexico City 2014). Some of these were initiated by the FORIN Working Group whilst others emerged spontaneously and were organized by research groups informed and inspired by the FORIN approach. We acknowledge the interest and enthusiasm shown by all those who took part in the events in question.

In 2013 an independent review of FORIN was undertaken by Mark Pelling (King’s College London) and Jörn Birkmann (University of Stuttgart). Their assessment provided a helpful and informative critique on the FORIN work to that date, and we express our gratitude to them.

On the basis of this experience and review, and in the light of recent developments in research and governance, three workshops were held – at the ICSU offices in Paris in November 2014, with the participation of FORIN working group members and invited IRDR and outside academic participants and, in Mexico City in February 2015, and San José, Costa Rica in August 2015 with solely working group members – to develop ideas and materials for a second version of the FORIN conceptual framework and guide to research. This, the new framework, is the result of that process.

We should like to thank the following people who generously gave of their time in providing advice, comments and case study material during the Paris workshop and the subsequent preparation of this second Report:

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IRDR-FORIN Working Group

1. Introduction

The present document provides a conceptual framework and guide to research for Forensic Investigations of Disasters – FORIN, that focuses on the investigation of root causes of disaster risk and occurrence. It represents a second version of such a guide, the first having been developed in 2010 as part of the newly established Integrated Research on Disaster Risk (IRDR) programme of ICSU, ISSC and UNISDR (see IRDR, 2013 and Cutter *et al.* 2015a).

The principal aim of these second-generation guidelines is to offer an approach to research that builds on the work presented in the first version of FORIN whilst drawing on existing, and at times long-established but still not mainstream or dominant, research principles and practice that help us better understand the existence of disasters in the contemporary world, their fundamental causes and their growing impacts. In doing so we recognize the many past efforts and experiences that have offered illustrative and illuminating ideas and explanations of disaster and disaster risk based on the idea of “underlying”, “structural” or “root” causes (see Wisner *et al.* 1977; Hewitt, 1983; Blaikie *et al.* 1994; Maskrey, 1994, 1996; Wisner *et al.* 2004, for example), and more recently “disaster risk drivers” (UNISDR, 2009, 2011, 2015a).

We are attempting to provide an accessible guide to research that allows us to widen, deepen and even modify certain aspects of such research ideas and practices in order to obtain more comprehensive knowledge and coverage of disaster risk construction processes. In this sense we hope to provide a method for progressing along a research front explored previously but not fully exploited or developed to date. FORIN proposes a research challenge that will allow the generation of more accumulated evidence as to risk construction processes, under the adage that action can only be based on adequate understanding and knowledge, and, we hope, contribute to changes in current disaster risk- and disaster-related management practices and the role of different stakeholders therein. A further implicit goal is to provide a text that may be used as a pedagogic “introduction” to the disaster and risk problematic, posing fundamental and easily understood questions as to how and why risk is constructed and disasters materialize in society.

The basic premises that inform this perspective and approach, and which will be more fully detailed in later sections, are:

- Disaster risk and eventual disaster are social constructs based on the presence of potentially damaging physical events but seriously and dominantly conditioned by societal perceptions, priorities, needs, demands, decisions and practices.
- The understanding of risk and disaster is still severely impeded by visions of “natural” disaster, the dominance of the physical factors affecting risk and the marginalization of more fundamental social processes.
- Disaster risk management practice is still very much dominated by reaction and response, to the detriment of development-based risk reduction and avoidance interventions.
- Research into the topic is still dominated by disciplinary approaches and overly concentrated on physical hazards and events and the more immediate causes of loss and damage.

The document is structured in the following way. The section that follows deals with the context of the present research endeavour. The major characteristics and objectives of FORIN are developed in a third section, whilst the fourth lays out the fundamental conceptual basis on which FORIN research is based, namely the idea of the social construction of risk. In the fifth section the basic themes and questions that can inform FORIN research are laid out, and in the sixth we provide a set of approaches that may be used to guide research. Section 7 deals with the need for integrated research and the importance of stakeholder involvement. A concluding section identifies issues and challenges to be faced by FORIN research in the policy context.



Photograph by Allan Lavell

2. The context and its relevance for FORIN investigations

2.1 Risk and disaster in the world

Over the past 50 years, our scientific understanding of hazards and the potentially dangerous physical events they precede has grown substantially. This knowledge covers natural, socio-natural and technological hazard events, and there has been increasing concern not only with their extreme manifestations but also their smaller- and medium-scale and more regular occurrences. Much more is known about the frequency and magnitude of events, and where they are most likely to occur, although today climate change introduces new uncertainties as climate variability is modified in its expressions from place to place. In many cases forecasting ability has improved, and better communications have enabled forecasts to be turned into warnings, and more effective disaster response plans have been formulated. This has been particularly so with hydro-meteorological events, where significant advances have been made in some places in reducing human loss from events such as hurricanes and flooding.

At the same time there have been improvements in our capacity to guide human settlements away from dangerous, exposed places, and for the large number of cases where building in hazardous locations does occur there have been improvements in the capacity to design and build higher quality, more resistant infrastructure, housing and public facilities. Consciousness has increased and actions taken with regard to the role of environmental degradation in the construction of disaster risk. And, the overall role of poverty and skewed development in the creation of this risk has also been increasingly recognized by many stakeholders (UNISDR, 2015a, 2015b).

Yet, large-, medium- and small-scale disasters are becoming more frequent, and damage and loss continue to increase at a rapid rate (UNISDR, 2009, 2011, 2015a). Reference has been made by some to a “disaster epidemic”. This use of the term “epidemic” to characterize the spread of disasters is, of course, metaphorical; it does not refer to the widespread incidence of a single triggering event and its impacts on a susceptible population, but rather to a set of similar social and economic processes now at work around the world that lead to disaster risk. Like an epidemic, the physical triggering events of a disaster can vary widely, but the existence of similar approaches to development that privilege economic growth over social and environmental values and priorities is a key factor in their occurrence.

Large-, medium- and small-scale disasters are becoming more frequent, and damage and loss continue to increase at a rapid rate.

Disasters are not confined to poorer countries, although they do impact poorer people disproportionately in rich and poor countries alike. Undoubtedly, the efforts to reduce and control damage and loss are well outweighed by the processes generating new risk in our societies (Lavell and Maskrey, 2014). The central question then becomes: why is this happening despite much greater scientific knowledge and technical capacity related to risk and disaster concerns? (White *et al.* 2001)

Disasters are not confined to poorer countries, although they do impact poorer people disproportionately in rich and poor countries alike.

The FORIN approach, developed within the general framework and objectives of the ICSU-ISSC-ISDR Integrated Research on Disaster Risk (IRDR) programme, hopes to contribute to the clarification of this dilemma.

2.2 Understanding and prioritization with regard to risk and disasters

Despite the efforts of science to dispel the well-entrenched but highly erroneous and conceptually dangerous notion of “natural disasters”, the most widespread shared understanding of disasters still seems to be that they are caused by extreme natural occurrences that are exceptional to any rule. This general view tends also to pervade much political discourse.

Seen from the angle of the popular media, which constitute the public’s first contact with the reality of disaster, many reports first come from governments to inform the public of the occurrence of a potentially damaging event in a specific location, and the media then take those reports as a basis for news development. Such reports on disasters frequently place great emphasis on the occurrence of a significant, potentially dangerous physical event. The coverage then quickly moves to impacts, damage, loss of life, and the numbers of people missing or trapped. Within a few hours of the initial report, information begins to flow about the rescue efforts, where help is coming from and at what level, and appeals for additional assistance. The relative success or shortcomings of the emergency response are described in detail. Scenes of suffering and loss are broadcast and the humanitarian relief efforts are described. As days go by, the humanitarian response coverage becomes less and switches to the processes of relief and reconstruction. The tone of the reporting is often first that of alarm and distress and then more optimistic and forward-looking towards the process of recovery.

Notably absent, or receiving little attention in a good part of media coverage, is any discussion of the social, economic, political or cultural root causes of the disaster. Those who try to turn attention to such factors are often edited out, marginalized or ignored, since they may strike sensitive chords among authorities and special group interests, apart from being seen as little newsworthy.

The media process characterized above with its impacts on public understanding and prioritization contributes to a primary concern for disaster response and recovery. Within the private sector and government, other mechanisms and concerns undoubtedly work in favour of disaster response over risk reduction and control concerns. For government, it is well recognized that response is far more highly rewarded politically than risk reduction or disaster mitigation. As for the private sector, the search for profit and growth generates a series of conditions and contradictions whereby disaster risk is constructed at the same time as profits are made. Unfortunately, much private sector disaster risk construction is likely, in its consequences, to fall on the heads of a more general public as risk “transferred” to third parties (UNISDR, 2015a). The outcome of such processes is a substantial contribution to the still-dominant preparedness and response approach, along with corrective risk reduction, to disaster risk and disaster.

Much private sector disaster risk construction is likely, in its consequences, to fall on the heads of a more general public as risk “transferred” to third parties.

It is hoped that the FORIN approach to research on risk and disaster will contribute to a change in the mind-sets of public, private sector and government stakeholders, and a more determined movement in favour of risk reduction and control, thus paralleling similar preventative measures and movements enacted historically as regards health, crime and even conflict and war.

2.3 The institutional context of disaster risk management

In the light of the dominant understanding – or at least pragmatic approach – to disaster, the paramount institutional focus is still on disaster management and emergency response, although there have been increased arguments and calls for risk reduction and control. Despite a variety of international institutional initiatives, including the International Decade for Natural Disaster Reduction (1990-99), the Yokohama Strategy and Plan of Action for a Safer World (1994), the Hyogo Framework for Action (HFA): Building the resilience of nations and communities to disasters (UNISDR, 2005) and most recently the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015b), integration of the basic aspects of disaster risk reduction (DRR) into national policy and practice has been slow and far from comprehensive (Cutter *et al.* 2015b). Indeed, of the five priorities of the HFA, little progress was recently reported on Priority 4, specifically addressing underlying causes of disaster.

Primary attention is still paid to how well the disaster was managed by the first responders and the emergency preparedness and response organizations. The maintenance of law and order is given priority, and the effectiveness of evacuations assessed. The availability and performance of hospitals and emergency treatment centres are evaluated, as is speed and efficiency of emergency or temporary shelter provision.

These and other concerns are very important issues that carry great immediate import and longer-term implications for better methods, technologies and strategies for disaster management and the resolving or amelioration of humanitarian crises. And these concerns are the prerogative of humanitarian-based organizations and institutions that have dominated the disaster scene for the last 50 years or more. Attempts to advance development-based understanding of disaster risk construction and accompany this with innovative organizational and institutional approaches have been severely hampered by the expansion and amplification of already-existing, response-dominated structures and logics, fuelled even more by increasing disaster impacts, damage and loss. A vicious circle of lack of prevention, future increased losses and then increased demand for response occurs. At the same time, with rare but notable exceptions, the development sectors and institutions that should be involved in promoting risk reduction and control are simply not on board, or are as yet not convinced of the need to be dynamically involved in solutions to the problem. Within this logic, what are increasingly known as corrective risk reduction practices (dealing with existing risk) dominate over prospective, risk-avoidance processes (UNISDR, 2015a).

With rare but notable exceptions, the development sectors and institutions that should be involved in promoting risk reduction and control are simply not on board...

The FORIN approach hopes to contribute to a critique of this logic and an increased involvement of development actors in the disaster risk management (DRM) process at local, national and international levels.

2.4 The major gaps in existing risk and disaster research

Without trying to typify in a few lines the vast array of disaster risk and disaster-related research that now exists, it is possible to assert that much is still disciplinary-based, notably in the physical and engineering sciences, and driven by visions of natural and technological hazards and events, to the detriment of socially generated hazards and physical occurrences. In many cases there is over-emphasis on disaster response and preparedness concerns and the search for explanation and causality in more immediate and proximate contexts

and factors (referred to by Blaikie *et al.* 1994 and later Wisner *et al.* 2004 as unsafe conditions) as opposed to deep-rooted, fundamental or structural causes relating to development ideologies and processes and their role in the creation of risk and disaster.

The call for multidisciplinary and interdisciplinary research on disaster risk and disasters has been made frequently, as has the call for more development-framed, decision-based approaches to understanding risk construction (Alcántara-Ayala *et al.* 2015). The need for more participatory-action research approaches has often been argued for. And yet, despite this, and a relatively large number of attempts to advance on these fronts, such approaches are still in the vast minority and are far from being able to provide support for the assertion that disaster risk, and thus disaster, is socially constructed under the impetus of prevalent and historical “development” models and processes, and from there, consider the implications for DRM and development practice. The FORIN approach seeks to contribute to the development of such research and the creation of a solid and far-reaching evidence base that supports changes in DRM and development practice.



Photograph by Irasema Alcántara-Ayala

3. The nature and objectives of FORIN investigations

3.1 Basic characteristics

The need for this FORIN Framework/Guide is clear. It seeks to promote research that will support changes in the understanding and common conceptions and misconceptions of disasters, reconfirming and re-emphasizing the critical analysis undertaken to date. And perhaps most importantly, it accompanies such a critical approach by providing ideas and approaches that can be used in case studies focused on the underlying causes of disasters. The overall intent of the FORIN project is to help promote and produce integrated studies that are designed not only to further our understanding of disaster causation, but to be policy-relevant and to provide policy options and evidence-based prescriptions and alternatives for improved disaster risk reduction. Moreover, as stated earlier, the framework could provide an “easy” introduction to the disaster and risk problematic in university courses and as a support for the interested layman’s understanding.

FORIN investigations are not designed to be searches for guilt or culpability as such, although findings of such a kind cannot necessarily be ruled out at the outset. The term “forensic” is used to indicate a search for root causes, in effect to identify those social features and forces and the associated institutional and social actors that nourish and energize the risk drivers that are ultimately expressed in the patterns of vulnerability and exposure which, when affected by a natural or technological hazard, produce a disaster.

The overall intent of the FORIN project is to help promote and produce integrated studies that are designed not only to further our understanding of disaster causation, but to be policy-relevant and to provide policy options and evidence-based prescriptions and alternatives for improved disaster risk reduction.

There has been some concern expressed that our use of the term “forensic” seeks to assign blame and assess accountability for the occurrence of a disaster. Others see it as a prelude to the counting and accounting for deaths during disasters. Although we can appreciate such concerns, we believe neither is overly warranted. As will be discussed at greater length in Section 8.4, an approach based on the social construction of risk must not avoid questions of accountability where root causes and risk drivers have been specifically identified and associated with direct or indirect individual, collective or institutional actions or actors. We therefore recognize the concerns about the use of the term “forensic,” but equally assert that avoiding the question of causal responsibility would constitute a dereliction of both scientific and legal obligation. In reality, in almost all cases, responsibility for disaster losses is widely spread over institutions and social processes, and over place and time. So, the goal of FORIN investigations is directed toward more efficacious disaster risk management. The intended outcomes will not necessarily concentrate on the precise identification of any specific locus of responsibility, but rather will, we hope, help bring about a cultural shift in the ways disasters and risks are understood. This should provide the knowledge base on which more effective DRM may be promoted.

3.2 Objectives

The overall objective of forensic investigations of disasters and risk is to identify underlying causes in such a way that they can be evaluated and addressed. Within the scope of this overall objective are specific objectives for the research, educational and policy communities.

(i) Research objectives

- To confirm and demonstrate with strong evidence that disaster risks, where manageable, are socially constructed.
- To identify and assess the principal contributing causes of disaster risk and to identify ways in which they can be reduced or avoided.
- To adopt a diversity of approaches to research (see Section 6 below) and to combine their results in such a way as to identify common causes of disaster through the meta-analysis of results.
- To promote integrated and transdisciplinary research that engages the full range of stakeholders to enable a more holistic understanding of underlying causes and disaster risk.

(ii) Educational and extension objectives

- To provide a flow of research results that can feed into educational programmes at all levels (not just those related to disaster risk directly, but also to development- and environment-based educational opportunities), illustrating and substantiating the social construction of disaster risk and disasters and the value of forensic investigations.
- To engage a wider range of disciplines and professions than has previously been the case in disaster research.
- To develop a literature of quality case studies in association with IRDR, disaster research institutions and other agencies. Partners potentially might include RADIX, GNDR, Preventionweb, GEM, GFDRR or Understanding Risk, as well as many regional and national organizations.
- To disseminate high-quality forensic research results to local, national and international organizations and institutions, particularly in relation to the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015b).
- To strengthen and expand the existing research community and to build a strong “in-country” capacity of young researchers who may facilitate take-up of the results of forensic investigations in policy and practice.
- To help bring about a fundamental shift in the understanding of disasters in the media, (including social media) through key messages that can reshape values, perceptions and behaviour.

(iii) Policy objectives

- To broaden the scope of disaster risk reduction measures considered and used.
- To help integrate or consolidate a broader disaster risk reduction approach in a wider group of programmes and institutions at the international level, including UNESCO, FAO, WHO, the World Bank Group and regional banks, UNEP, UNDP, ILO, as well as national and regional development institutions and private sector developments and investment.

- To help change the paradigm of disasters away from "natural" causes to social construction and especially the underlying causes of risk construction.

- To recognize and demonstrate that generic causes can have diverse local manifestations.

(iv) *Development and equity objectives*

- To advance and disseminate understanding as to how conventional "development" processes (public- and privately financed) can lead to the expansion and creation of disaster risk, and how such development can have the perverse consequence of setbacks to sustainable development.

- To contribute to an understanding of the ways to incorporate disaster risk reduction and control permanently and organically into development planning decision-making and economic and social growth in all countries.



Photograph by Anthony Oliver-Smith

4. Understanding risk construction as a process

4.1 A conceptual foundation

A first task in the development of a guide and questions for research is to lay out an appropriate conceptual foundation. Once this is elaborated, research objectives may be formulated in context and practical approaches to specific research questions proposed.

Understanding causality should be seen as a basic rationale for disaster risk research and in substantiating disaster risk reduction practice (Burton, 2010, 2015). It is now widely accepted that hitherto conventional explanations for disasters and what can be done about their causes are not sufficient, can be misleading and may result in a misallocation of programmes and finances. The FORIN approach builds upon past insights and accumulations of knowledge but recognizes that a more critical stance is needed if the necessary transformations in and by DRM are to be achieved. It builds upon the fundamental notion that disaster risks are socially constructed: that is, they are the results of human choice (Oliver-Smith, 2013) or perception. The choices and processes involved are often quite diffuse and long-standing.

Understanding causality should be seen as a basic rationale for disaster risk research and in substantiating disaster risk reduction practice.

4.2 An evolving typology of the causes of disaster

Beliefs and explanations for disaster are as old as humanity itself (Etkin, 2015). This story is not a simple case of a succession of new ideas replacing the old, but, rather, a steady accumulation over time as new explanations are added but the preceding ideas often retained as part of the ongoing narrative. There is, therefore, an evolving typology of the causes of disasters. The forensic approach may be seen as a late (or the latest) addition, one which rejects some former explanations and builds upon others.

The FORIN approach builds upon past insights and accumulations of knowledge but recognizes that a more critical stance is needed if the necessary transformations in and by DRM are to be achieved.

The causal typology begins with Acts of God or Nature-based paradigms whereby disasters are seen to be completely out of the control of humans, and the physical events that trigger them are synonymous with disaster itself. Under this causal belief system, human society is a victim (innocent or not) of external forces and has little recourse except to prayer, improved moral behaviour and post-event mutual assistance.

Natural science and technology-based ideas later led to the belief that increased scientific knowledge of hazard patterns and processes leads to the ability to use technology to reduce disaster risk through mainly engineering solutions. While giving some greater sense of control or ability to counteract natural forces, such technocratic approaches (described as "physicalist" by Hewitt, 1983) have been insufficiently effective to prevent a continuing growth in losses as the global human population has expanded in both numbers and accumulated but extremely badly distributed wealth. Moreover, the deployment of technology has itself sometimes exacerbated the situation, as when flood control dams create a false sense of confidence and serve to encourage a greater level of occupancy of flood plains that are only partially protected.

The use of science and technology as the principle tools to combat disasters has been described as a "Man over Nature" approach. While there is a growing awareness of the limitations of science and technology, a strong belief in their potential persists, and considerable investment in the advancement of science and technology continue to be made in the interests of disaster risk reduction. In the lead-up to the third World Conference on Disaster Risk Reduction in 2015, the International Council for Science (ICSU), together with its IRDR programme and numerous other partners, worked to ensure a strong role for science (taken in its broadest sense) in the Sendai Framework for Action 2015-2030 (UNISDR, 2015b). The new Framework calls for science to support the understanding of disaster risk and promote risk-informed decisions and risk-sensitive planning from the local to the global levels. It also calls for an enhancement of the UNISDR Scientific and Technical Advisory Group (STAG) as a mechanism to scale up the mobilization of science for disaster risk reduction.

As concern for conservation and protection of the environment grew in the 20th Century, an alternative view of "Man in harmony with Nature" became more prevalent. This more ecological approach draws attention to the need to limit environmental degradation as a way of reducing disasters. It also became increasingly recognized that, by avoiding areas of high risk and by stronger and better design of homes and infrastructure, the incidence and impact associated with disasters could be reduced. While the ecological or "harmony with Nature" approach has had some beneficial results, it has also proved insufficient to offset the consequences of rapid population and economic growth. With the strengths and weaknesses of this approach added to a science and technology approach (with its own deficiencies) there is a sense of coming closer to understanding the immediate, if not root causes of disaster.

In the latter part of the 20th Century concern for the still-growing size and frequency of disasters increased further and led to a more critical examination of the causes. In this context, the notions of vulnerability and exposure have emerged as strong explanatory variables over the last 40 years. The concept of vulnerability is understood as the propensity or predisposition to suffer damage and loss, including life, livelihood and property. Exposure refers to the location of people, assets, livelihoods and infrastructure in hazard-prone areas. However, just as the ecological or "harmony with Nature" approach proved insufficient to counteract growing disaster risk, so too the focus on exposure and vulnerability has not gone far enough in searching for causal mechanisms that can influence and help to create effective policies and management strategies. Vulnerability and exposure seen simply as facts, conditions or contexts to be remedied belies a more thorough explanation of why and how such conditions exist in the first place and grow or change as time passes.

The focus on exposure and vulnerability has not gone far enough in searching for causal mechanisms that can influence and help to create effective policies and management strategies.

The search for explanation based on deeper causal analysis has subsequently led, over the last 20 years, to the development of models and paradigms based on the notions of root, fundamental, structural or underlying causes, dynamic pressures and disaster risk drivers (see Blaikie *et al.* 1994; Wisner *et al.* 2004, 2011; UNISDR, 2009, 2011, 2015a).

Parallel to such movements and perhaps as a result of them, the disaster risk literature has seen the growth in concern for "resilience" as a topic of interest and intervention, and the notion of "transformation" laid out as a path to overcome the structural barriers to risk reduction (see Pelling, 2011). The topic of resilience, while enthusiastically espoused by many especially in the "development community" and rapidly incorporated into the disaster risk "jargon" and vocabulary, is not without its many detractors and raises numerable issues,

including the idea that it distracts from the consideration of root causes. The notion of "transformation" expresses amongst other things a growing sense of frustration with the failure of current and earlier efforts, separately and collectively, to achieve sufficient results in disaster risk reduction.

4.3 The social construction of risk

While it is now more widely accepted that the degrees of exposure and vulnerability help to explain the continuing increase in losses and in disaster frequency and magnitude, there is no overall, systematic and generally accepted explanation for the persistence and growth of these conditions. Indeed, the extent to which such an explanation could exist or may be formulated is open to question.

The FORIN approach is based on the idea that the magnitude of losses and damage can in large part be explained by human actions and choices when faced with physical hazard, including the choice to ignore them or dismiss their significance. Today, in addition to the increasing inequalities that characterize most complex societies, there are many base or fundamental social processes underway that lead to particular "risk drivers" or dynamic conditions that accentuate existing or create new forms of risk at all levels. This is so not just in major cities but also in rapidly growing secondary cities, and is expressed in continuing migration to coastal areas, environmental degradation, terrorism and climate change, which are but a few of the processes that constitute the "drivers" of exposure and vulnerability, risk and disaster. Financial crises, and the lack of will or capacity to deal with causes rather than symptoms, also form part of a social process that complicates others, as well as accentuating known hazards.

The FORIN approach is based on the idea that the magnitude of losses and damage can in large part be explained by human actions and choices when faced with physical hazard, including the choice to ignore them or dismiss their significance.

These social processes and the risks they represent are all outcomes of human decisions as to how resources (including places) are allocated and used, by whom and for whom. Human decision-making is shaped by many forces and pressures, both as incentives and constraints. Structures themselves are social constructs and thus are based on human decision-making and choices. Hence our vocabulary should speak of natural events but not natural disasters. Disasters are anthropogenic.

Like much else in the age of the Anthropocene, things that appear to be natural are increasingly a product of human actions rooted in cultural and social models and the material relations they express. The distinction between anthropogenic disasters and natural events is itself subject to critique or revision. Tropical storms and drought may be conveniently classified as natural events, but even here their very nature is being modified by anthropogenic climate change and in the case of drought by changing land-use and water management practices. The pervasive character of the changes wrought upon planetary processes by human activity is now such that barely anything can be described as 100% natural. It might be better to speak of partly or quasi-natural hazards, or as is prevalent in all of Latin America, socio-natural hazards and events.

Like much else in the age of the Anthropocene, things that appear to be natural are increasingly a product of human actions rooted in cultural and social models and the material relations they express.

The forensic causal approach is in part based upon the pressure and release (PAR) model developed successively in Blaikie *et al.* (1994) and Wisner *et al.* (2004, 2011). The PAR model treats a disaster as the "crunch point" between a natural hazard and people's vulnerability, with the outcome being a result of the harm done when people are unable to deal with the scale or intensity of the hazard.

The forensic causal investigative approach includes the fundamental notion that disasters are not simply single "one-off" and "place-based" events, although they are often perceived as such, including in the early versions of the crunch model. In forensic terms they are not just independent events that can be clearly distinguished from each other; they are common expressions of underlying processes that need to be understood if disaster risk, its reduction and control, are to be better managed. In this sense disasters are not confined by boundaries of time and space. Their causes entangle quickly with deeper-lying social and economic, cultural and political problems and their impacts are prolonged, with further complication (Boin, 2005). Disasters loom as disruptions of the normal functioning of the social system, while actually being generated by that normalcy (Hewitt, 1983), and a part of the long-term misinformed development process. In fact, disasters are perhaps best understood as the unfolding of systemic pathological changes. They may also be seen as clear and relevant symbols, representations and indicators of skewed development.

Disasters are not confined by boundaries of time and space. Their causes entangle quickly with deeper-lying social and economic, cultural and political problems and their impacts are prolonged, with further complication.

The unfolding process of risk construction and thus disaster creation starts from contradictions or contrasting or conflicting goals within the structures of the socio-cultural systems, leading to internal functional disorder or dynamic pressures. These, in turn, show themselves as symptoms or warning signs which jointly determine the system's conditions at the time. Hazards, along with the prevailing exposure, vulnerability and even resilience conditions, "cause" risk. Hazards, when materialized as a concrete physical event, can trigger escalation of the already unsafe conditions into a state of crisis or emergency.

The unfolding process of risk construction and thus disaster creation starts from contradictions or contrasting or conflicting goals within the structures of the socio-cultural systems, leading to internal functional disorder or dynamic pressures.

Figure 1 below illustrates the key relationships and processes in the social construction of risk. E stands for exposure; V stands for vulnerability; H stands for hazard with the categories N (natural), T (technological) and SN (socio-natural); DR stands for disaster risk.

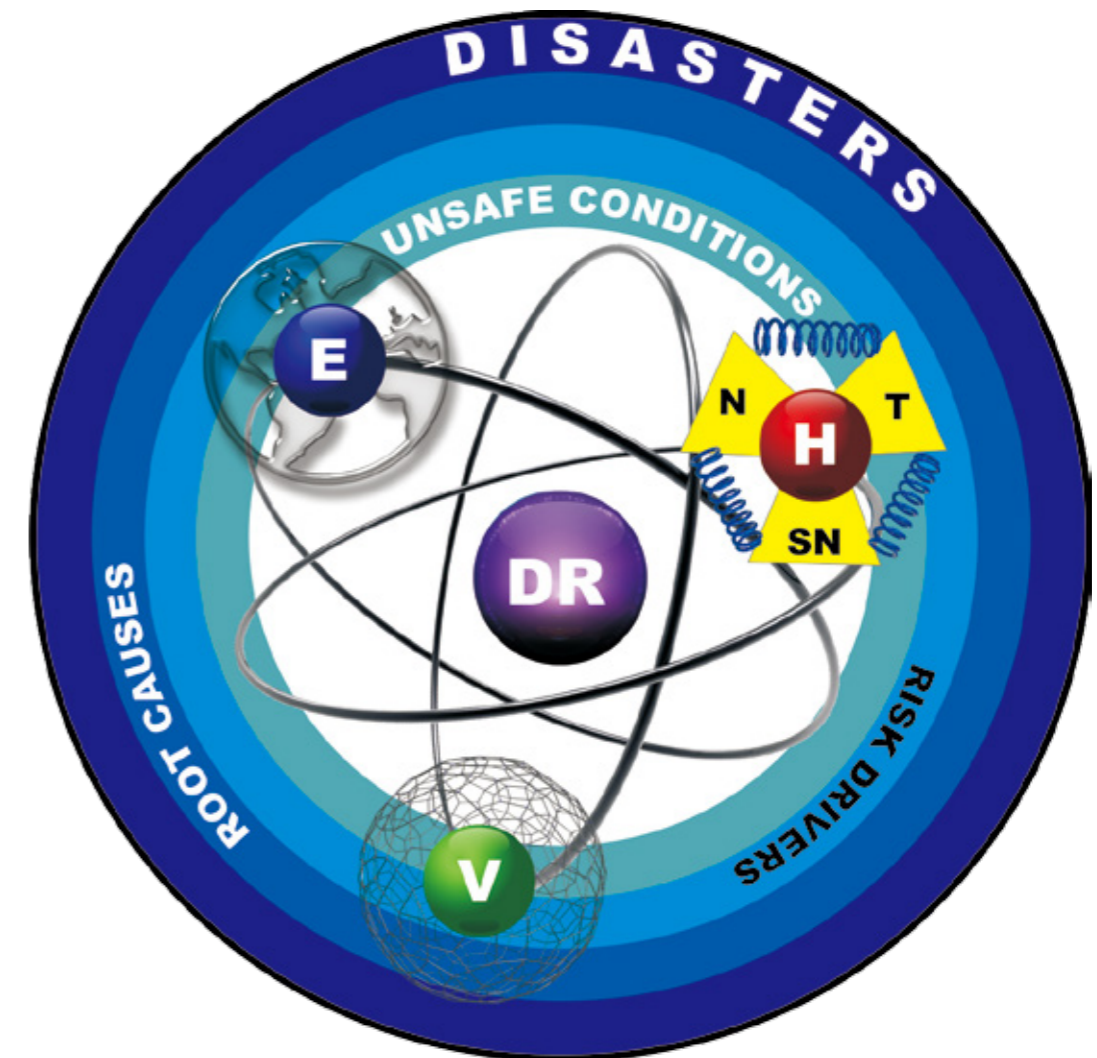


Figure 1 The key relationships and processes in the social construction of risk.

5. Central analytical themes and defining questions

5.1 Introduction

The study of the causal processes of disaster risk and disaster requires in-depth questioning and systematization of information regarding the fundamental dimensions of triggering event(s), exposed environmental and social elements, resilience (and capacities) and vulnerability patterns within the broader contexts of human-environment relations and the structure and organization of society. Understanding these issues in a meta-analytical way (see Section 6) allows us to better understand generic disaster risk conditions and also more specific idiosyncratic factors. This understanding, in turn, can help policy-makers and planners to better control and reduce risk and the factors that lead to its existence.

Unsafe conditions manifested in exposure to hazard in the context of vulnerable conditions are constructed through a series of risk drivers that derive from the processes, priorities, resource allocation and production/consumption patterns that result from different socio-economic development models. Risk drivers, such as population growth, migration and distribution, rural and urban land-use patterns, infrastructural construction, environmental degradation, ecosystem depletion and poverty itself, among many others, derive from the ways the basic goals and parameters for growth and development are established and implemented (Wisner *et al.* 2004). Some of the results of such processes may be structural and thus definitive of the model itself; others may be causal responses that are changeable or modifiable.

Unsafe conditions manifested in exposure to hazard in the context of vulnerable conditions are constructed through a series of risk drivers that derive from the processes, priorities, resource allocation and production/consumption patterns that result from different socio-economic development models.

Any attempt to offer deep-rooted explanations of the process of risk construction, and ultimately disaster, must first be able to discern and describe patterns of loss and damage and their social impacts, their spatial and social distribution and the nature of and reasons for the decision-making by private and public actors that led to such patterns and expressions. However, we need to go beyond simplistic analysis that attributes loss and damage, impact and effect, to more immediate “causes” such as collapsed houses and hospitals due to the application or ignorance of inadequate building standards and practice; loss of agricultural products due to location in flood-prone areas; or, loss of transport infrastructure due to location in landslide-prone areas. Such description, used as a step to explanation of what have been called “unsafe conditions”, must be followed up by deeper, more structural, underlying and root-cause process analysis; that is to say, analysis that allows us to explain why such unsafe conditions and the immediate causes that explain them may and do exist and their structural or non-structural nature. This analysis is critical in order to understand what processes and results are almost inevitable as a structural condition of a particular mode of development and growth, as opposed to those that may be considered as aberrations that can or could be resolved under other more propitious planning and process decisions even within the development mode or model followed.

We need to go beyond simplistic analysis that attributes loss and damage, impact and effect, to more immediate “causes”.

In effect, in order to delimit the themes that need analysis in most disaster-risk or disaster studies, we

distinguish between themes that deal essentially with “descriptive”, factual aspects, where analysis focuses on the various facets that both describe and contextualize the loss and damage suffered, from themes that relate more to the analysis of the underlying processes that have led to the hazard and unsafe social, infrastructural and production conditions in exposed areas as in the prior descriptive analysis.

FORIN analysis opts for a separation of basically descriptive, systematizing aspects of explanation from more deep-rooted causal analysis.

FORIN analysis opts for a separation of basically descriptive, systematizing aspects of explanation from more deep-rooted causal analysis in order to organize thought and research needs as opposed to dictating an order of enquiry as such. Each research project can and should decide how to deal with description and more process-related research.

5.2 Descriptive analysis of hazard, exposure, unsafe conditions and subsequent patterns of damage, loss and impact

The descriptive approach suggests the immediate relating of patterns of loss, damage and impact to the differentiated impact of hazards on exposed social elements. Vulnerability (and resilience) is a complex social condition often deriving from the workings and interaction of multiple dynamic processes and underlying “deep-rooted causes”. The descriptive systematization of loss and damage under determined hazard and exposure conditions allows a first-level introduction to vulnerability, particularly where social elements suffer more grievous impacts regardless of hazard intensity or location in the most exposed and hazard-prone areas. This perspective is also applicable to exposure, which can be described and “explained” in principle by a consideration of the existing or non-existing, applied or non-applied, socially established regulations on location. However, more underlying causal analysis is required if we are to understand why social controls existed or not, or why, when they did, they were not applied or were badly applied. This may be due, amongst other reasons, to economic interest and competing values and goals, corruption, lack of capacities and trained public servants, and other factors.

Vulnerability (and resilience) is a complex social condition often deriving from the workings and interaction of multiple dynamic processes and underlying “deep-rooted causes”.

The key areas of investigation to be developed at the descriptive level are: the triggering event(s), exposure of social and environmental elements, the social and economic structure of exposed communities, and institutional and governance elements. In addition, each discussion of these key areas for research is accompanied by basic questions that may be posed by researchers. The lists of questions are not intended to be exhaustive, but rather to indicate the nature of topics, direction and level of inquiry with which research should proceed.

(a) The triggering event(s)

There can be no disaster without a physical triggering event. Physical events or processes, however sudden or slow in onset, are a *sine qua non* of disaster, even if they do not “explain” them as such. In FORIN analysis hazard onset is generally the starting point for research as well. Disaster risk exists amongst other reasons because there is a perceived threat of a triggering event in the future. This threat may be preceded by previous

materialized expressions of the expected event manifest in past disaster. Or, under certain circumstances, the threat may be novel or recently constructed due to natural or socio-natural changes in the physical environment in which society exists. An example

Physical events or processes, however sudden or slow in onset, are a sine qua non of disaster.

of natural change would be where an earthquake changes river patterns and sedimentation rates and raises flooding propensity in certain areas previously not subject to flooding. An example of socio-natural construction of physical threats would be where constant erosion of slopes due to human-induced deforestation and sedimentation of rivers, increase or generate novel conditions for flooding; or where green-site urban development leads to conditions propitious to urban flooding in the future. FORIN research must always consider the physical event or events that trigger disaster, as well as key issues that influence how the physical event is perceived, and responded to, many of which will interface with questions of vulnerability, adaptation and resilience. Some key questions that must be posed by researchers are:

- What was the scale or intensity of the primary triggering event (that which led to direct effects or triggered other concatenated or related events and their effects) and what was its supposed period of return in historical terms?
- Was sufficient and adequate information available from reliable sources to identify realistic return periods of the triggering event(s)?
- To what extent were the physical triggering events “naturally” or “socio-naturally” constructed? How were the events described or explained by public authorities, the press, private sector groups, the insurance industry, communities, etc., after the event?
- How well developed and disseminated was knowledge of the physical threats? Was it translated into public knowledge and how – through public discussion, through incorporation in planning instruments and local building norms, etc.?
- How accurate were the predictions or projections of future events by government, universities or other monitoring systems? What were the principal failures in terms of understanding and prediction?
- What was the public perception of the triggering physical event? Was risk perception and interpretation taken into account for disseminating knowledge of the physical threats?
- What were or are the existing levels of consciousness, perception and knowledge of existing physical threats and how was this distributed between: different segments or sectors of the population, national and local government; different components of civil society; the private sector; different age groups, by gender, etc.?
- What were the major anomalies as regards the events and their manifestations as compared to what had been projected or predicted?
- Were there contrasting and even conflicting projections of event occurrence amongst different social groups, including academia, government, civil society, and private sectors? How did these play out in the public and governmental arenas?
- Was the primary event succeeded by related, but different physical events (for example earthquakes

succeeded by landslides and fracturing of dams and flooding)?

(b) Exposure of social and environmental elements

Exposure to hazards (and the future events they announce) is a fundamental component of disaster risk. Exposure is understood here in terms of people, infrastructure, production, wealth, natural resources, and other elements required for livelihoods and social well-being, being located in what may be called colloquially the “line of fire” of probable future physical events; that is to say, they are located where they are potentially exposed to different levels of intensity of the physical event and possible negative effects, bearing in mind that not all exposed elements will be affected in a serious way. This will depend on the levels of insecurity or vulnerability these elements exhibit when faced with the probable physical event).

Exposure is understood in terms of people, infrastructure, production, wealth, natural resources, and other elements required for livelihoods and social well-being, being located in what may be called colloquially the “line of fire” of probable future physical events.

So-called environmental services or natural resource elements may also be exposed to effects by different physical events. These may then pose a threat to society because that society has put a value on those resources in terms of their real or potential contributions to livelihoods and human welfare; that is to say, they are considered services and resources precisely because they have been given value or use by society. This value may be real and tangible or symbolic and intangible, such as in the case of the role of natural features in the construction of cultural identity.

However, in the analysis of the relation of exposure to disaster risk and, eventually, to loss and damage, the case of altered and/or severely degraded environmental elements due to human intervention provides a “special” case in need of attention and analysis in FORIN research. Understanding how human intervention has debilitated environments, exposing them to greater damage than would be the case without such human modification and intervention, is of major concern. Thus, in the same way as human intervention can construct new hazard conditions, human intervention in environments can increase their propensity to be damaged with the occurrence of physical events.

Understanding how human intervention has debilitated environments, exposing them to greater damage, is of major concern.

Some of the more relevant questions that may and need to be asked in pre- and post-disaster scenario contexts are:

- Where exposure is or has been measured according to the intensity or magnitude of an event, what was the spatial distribution of different social elements when faced with the differing levels of intensity predicted or suffered? This question may be answered according to different socio-economic strata and groups, types of infrastructure and housing, critical infrastructure such as schools and hospitals, etc. and is intended to show if spatial segregation of exposure levels exists, in ways that disfavour or favour different social elements.
- How has the distribution of exposure evolved through time and space in relation to (un)planned territorial development and the occurrence of specific types of physical threats?

development and the occurrence of specific types of physical threats?

- What was/is the nature of the social controls, norms, legal provisions, etc. that exist in relation to the restriction or promotion of location in hazard-prone areas? And, examining the patterns of loss and damage, to what extent were these norms obeyed or disregarded, and to what degree?
- Were zoning regulations, land use controls, and infrastructural codes adequate for the levels of risk existing in different places?
- How updated were the existing controls when disaster occurred, when were such controls updated and what were the major changes in exposure that had occurred over time and the nature of the controls introduced or not introduced to accommodate them?
- Were changes in exposure levels and patterns due to social decisions on location or rather to changes in the physical environment related to the hazard-inducing effects of social actions (deforestation, urban design and construction, etc.) or to such things as climate change?
- How were controls over exposure and construction *in situ* defined? Were these backed up by risk analysis and evaluation that adequately evaluated current exposure of social elements when faced with different hazard intensity or magnitude?

(c) Social and economic structure of exposed communities

Present paradigms for explaining disaster risk and disaster place great emphasis on the properties or characteristics of the social and economic structure of exposed communities that either accentuate or reduce the risk of loss and damage from hazards. Vulnerability (the intrinsic propensity or pre-disposition to suffer harm or damage) and resilience (capabilities and capacities) may help increase or overcome adverse hazard and exposure conditions and related post impact losses. In some definitions, resilience, defined as the capacity, or lack thereof, to respond adequately to a disaster, forms part of a profile of vulnerability (Wisner *et al.* 2004). Understanding recovery and post-impact reactions and improvement and advance due to these capacities has also led to increasing emphasis on “resilience” as a notion and a social condition. In effect, each concept is implicitly articulated with, and involved in, the formulation and application of the other.

Resilience forms part of a profile of vulnerability. Understanding recovery and post-impact reactions and improvement and advance due to these capacities has led to increasing emphasis on “resilience” as a notion and a social condition.

From a more descriptive angle these conditions may be delimited through a response to certain questions in pre- or post-impact contexts. While such conditions may be identified and described through *ex post* or *ex ante* systematization of data and facts, understanding such conditions, and their existence or not requires more process-oriented research, as described in the next section. Here, we concentrate only on questions that allow us to identify existing conditions but not explain them as such. This, of course, is the starting point for a deeper understanding of causal factors, seen from a more structural perspective.

Vulnerability

- How were loss and damage, impact and effect differentially distributed between different areas, social groups, types of infrastructure and production?
- Were there notable aberrations in the sense that less exposed and hazard-prone social and economic elements suffered greater impacts than more exposed and hazard-prone elements? In what sense was this materialized?
- What were the principal pre-disaster differentiated expressions of livelihood and human vulnerability, and what were the principal manifest, immediate, symptomatic causal factors? This could include such things as: building collapse with loss of life or loss of livelihood inputs and support infrastructure; loss of transport and energy infrastructure and its impact on livelihoods, health and employment, etc.
- How were the post-impact relief and rehabilitation processes carried out, and how just, equitable and efficient were they with regard to different social groups and their needs? Did the existing political agenda play a role in the response and rehabilitation processes?

Resilience

- What resource access pathways were available to the community that facilitated an adequate response to the events and processes of hazard impact?
- How did material components (housing and infrastructure) as expressions or results of social priorities and choices fare in the disaster?
- In the case of successive place-based disaster events, were there identifiable response/recovery processes and pathways that exacerbated the likelihood of loss – or, conversely, contributed to reduced damage and hardship?
- What role, if any, did insurance play in local resilience?
- Were there notable differences in the ability of different social and economic groups to face up to and recover from the disaster and its secondary impacts? How can these be depicted, and what were the main elements that explain the social and spatial differentiation in such processes?
- What was the role of social organization, social ties and networking in building resilience? What specific social organizational forms and practices were activated by the hazard and its impact that enabled the community to organize and work on its own behalf to adequately respond to the disaster? How are these institutions and actions related to questions of root and underlying causes?
- What were the specific dimensions of resilience for a given population?
- What was the composition of societal disaster response networking and coordination?
- Did social conflicts or tensions regarding development priorities, disaster risk, employment, agriculture and/or tourism affect resilience?

- What was the balance between the resilience of communities and local governmental policy and practice?
- What, if any, were the cases of social groups that clearly were highly vulnerable to hazard impacts but which also showed important capabilities and capacities to recover and reconstruct their livelihoods and lives? What were the defining characteristics of their vulnerability and, on the other hand, their resilience, when faced with damage and loss?

(d) Institutional and governance elements

- Does appropriate legislation exist at national and local levels, including additional regulations such as building codes, degree of enforcement and their specificity on risk management issues, as well as policies and programmes?
- Is insurance against loss and/or liability available? Is it required?
- Did organizational arrangements (whether focused on risk or emergency management) exist and at what level of authority, multi-sectorial and multi-stakeholder involvement, degree of participation in policy and decision-making?
- Was DRM integrated into other relevant policy areas such as urban and land-use planning, environmental management, insurance, etc.?
- Are there research and educational capacities focusing on risk issues, awareness and insurance cover, etc.?

5.3 The move from analytical and systematizing “description” to understanding underlying, root causes and dynamic processes

The preceding identification of central themes and questions that allow a basic knowledge of damage and loss, impacts and effects and their immediate descriptive causal relations, must be accompanied by more structural, deep-rooted, underlying causal analysis that allows us to understand why such unsafe conditions exist as such. Essential to the analysis of root causes is the delineation of derived risk drivers, sometimes referred to as dynamic processes (Wisner *et al.* 2014).

The role of different risk drivers is more immediately observable and explicable than are the underlying root causes or structural processes that lead to such processes. Relating specific dynamic processes to specific or generic underlying root causes is not at all easy. Neither is research which allows us to distinguish between an inevitable relation between any one specific risk driver and particular root causes, and those relationships that are spurious or un-necessary from a causal analysis perspective and which, even accepting the underlying processes, could be avoided, while achieving the same if not a better economic growth or development outcome. Moreover, risk drivers rarely operate as single factors, but rather in combination with others, usually in non-linear fashion, to cause disasters. Distinguishing between inevitable and evitable consequences in the root cause–risk driver equation is fundamental because whilst DRM

Risk drivers rarely operate as single factors, but rather in combination with others, usually in non-linear fashion, to cause disasters.

can hope to resolve the evitable relations, it cannot hope to resolve the underlying structural dependencies and causal relations. The latter requires fundamental changes in the development paradigm and its ideological foundations that are out of reach, although part of the concern, of DRM specialists and practitioners as such.

For the purposes of FORIN research we suggest an entry point for more profound explanation which takes risk drivers or dynamic processes as a pivot. Once the relations between such drivers and existing risk patterns and processes has been elucidated, researchers may attempt to ascribe causality by moving back one more link in the causal chain to reach out to more profound, culturally, socially, ideologically, pragmatically and politically assigned values and outcomes and their relation to the dynamic processes or risk drivers identified in each case. This inevitably requires a consideration of governance and governability concerns, resource exploitation, the organization of production, culture, institutional history, practice and norms, ethical, moral and behavioural aspects.

Thus, what follows is the identification or reiteration of the more and well accepted risk drivers referred to in disaster risk literature and debate and the posing of some significant research questions associated with them. While some researchers may propose as many as 16 risk drivers, each of which could generate many questions, FORIN analysis addresses what are fundamentally the strong drivers, while others, such as deforestation, soil erosion, local market failure or lack of local capacity and lack of press freedom (Wisner *et al.* 2004), to name only a few, may be considered as contributing or compounding risk drivers. Some of the questions that accompany the discussion of these main risk drivers are clearly parallel to, or even, repeat, those postulated in our “descriptive” analysis section. Researchers would need to merge or separate such questions and their resolution according to the dictates of their research goals and formats. Rather than a strict order and logic, what is important here is the nature of the questions that the researcher formulates and the level of explanation that response to these achieves. Appropriate specific methodologies can then be selected to elicit the data and information necessary to answer the research questions.

(a) Population growth and distribution

- What were the major trends in population movements, migration and settlement in hazard-prone areas, and the driving factors and underlying causes of them?
- In existing populated hazard-prone areas, what were the dynamics of natural growth in those areas and role of the provision of new housing for new family structures?
- In the dynamics of population growth in different areas what were the principal factors that explain the sequences of territorial expansion (land use planning norms, cost, urban rent considerations, pre-existing settlement, etc.), and were the more safe areas occupied first, to be followed by the more hazard-prone areas?
- Are there any areas not susceptible to hazards near the exposed human settlements?

(b) Urban and rural land use patterns and processes

- How did spatial and land-use organization and planning evolve in the area? Had there been organization and planning since an early stage? Was territorial use improvised, and if so, for how long?
- Who are the actors/decision makers for the organization and planning of land? Have they ever been

linked to DRR and DRM concerns? Have they ever considered risk deriving from exposure or vulnerability to natural events in their planning?

- Were there any legal frameworks related to land-use planning – either urban or rural? If so, are they enforced?
- In relation to hazard-prone areas, what was the logic behind the location of different socio-strata, businesses and industry, infrastructure, etc.?

(c) Environmental degradation and ecosystem service depletion

- Where environmental change and degradation can clearly be related to impacts on hazards, livelihoods and human security in general, what were the principal motivating factors and actors involved in such degradation and change, and who were the beneficiaries as opposed to the victims of this?
- Did environmental law and norms in the area establish concerns and processes to avoid hazard and vulnerability conditions affecting the population?
- What is the relationship between economic growth and overall business considerations and human security and disaster risk concerns in terms of the generation of environmental degradation in affected areas?
- What were the pre-existing levels of knowledge and debate on the relations between environmental degradation and disaster risk in the affected areas?

(d) Poverty and income distribution

- In what concrete and provable ways did poverty and income distribution amongst affected groups influence their levels of disaster risk, taking into consideration their impacts on hazard, exposure and vulnerability as well as potential or actual resilience of the population?
- Was there any clear relationship between exposure to hazards and the levels of poverty of affected population? How did the existence of chronic, everyday risk factors such as unemployment, poor health, drug addiction, personal and social violence increase disaster risk and impact?

Figure 2 overpage illustrates the process from the social construction of risk to the social production of disaster. The rings at the base engage the dynamics among exposure, vulnerability and hazard (natural, socio-natural and technological) in the production of disaster risk that is then materialized by the onset of a hazard and unfolds as a disaster producing damages and losses that reflect the characteristics of the base.

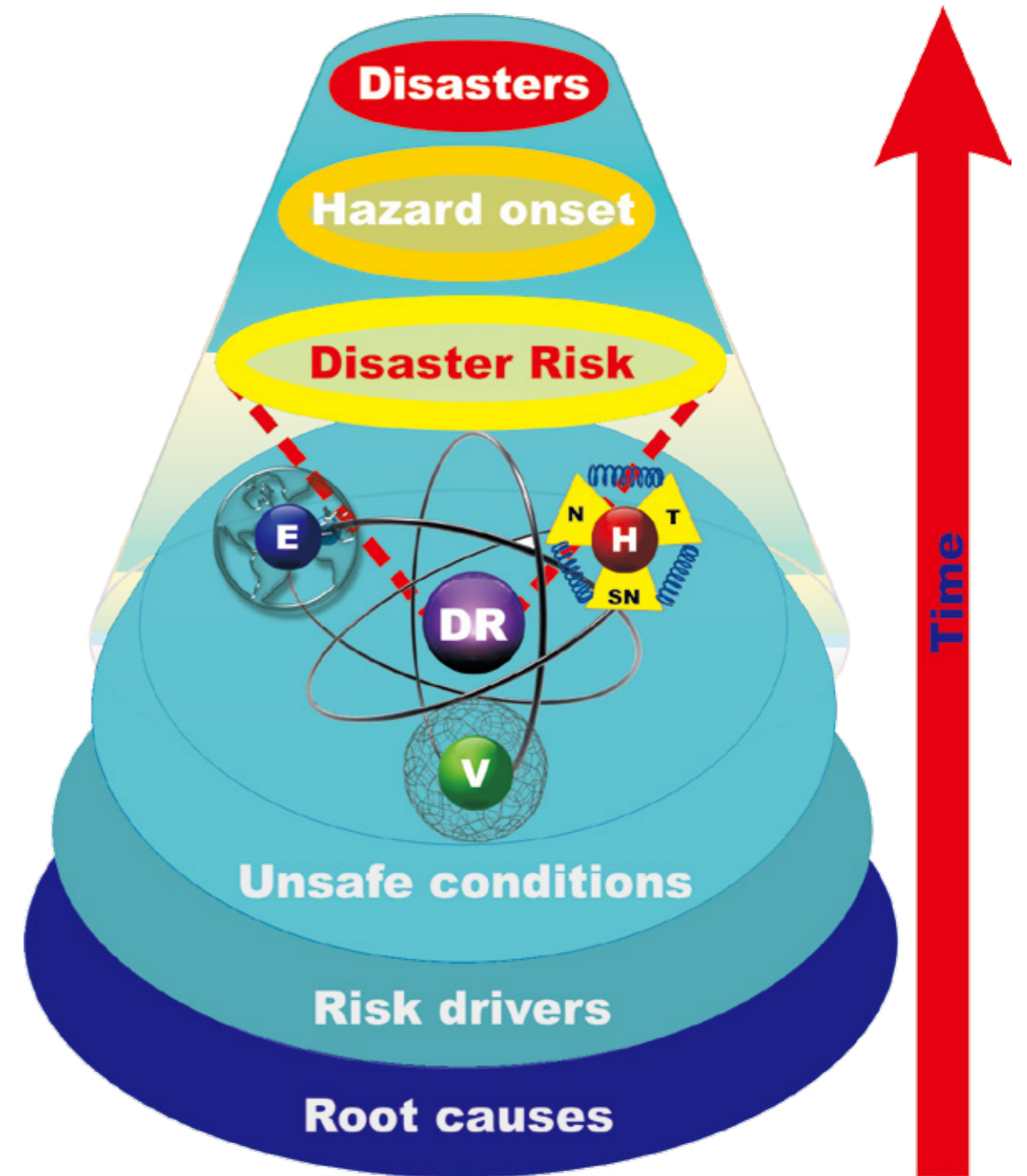


Figure 2 From the social construction of risk to the social production of disaster.

Once the basic descriptive level of analysis of hazard, exposure, unsafe conditions and subsequent patterns of impact, damage and loss is accomplished (Section 5.2), and the risk drivers and their dynamics have been identified (Section 5.3), the next step engages the more complex analysis of linking these phenomena to the larger social and cultural processes, practices and priorities (i.e. root causes) that put risk drivers in motion. In general, the research questions that inform this stage are largely directed at the basic institutions of social, economic, political and environmental relations as they have evolved in conjunction with historical circumstances of the society in question. Section 6 offers a framework of interrelated pathways or approaches to the forensic investigation of root causes.

6. Approaches to forensic research

The choice of methods and approaches in forensic disaster investigations is guided by their potential value in achieving the objectives described in Section 3 above. Forensic research may be undertaken following any one or combination of four basic approaches that together provide an overall general guide to research.

The four suggested FORIN research approaches are:

- 1) **Retrospective longitudinal analysis (RLA)**, concerned with the temporal development of the processes that have produced disasters in the past.
- 2) **FORIN disaster scenario building (FDSB)**, selected on the basis of a known hazard that preludes a possibly inevitable future event that is considered a factor in future disaster (basically looks forward into the future scenarios).
- 3) **Comparative case analysis**—an event-based analysis that seeks to identify underlying causes of disasters by comparing disaster impacts or contexts in different social contexts.
- 4) **Meta-analysis**—an event- or system-based review of the available literature carried out to identify and assess consistent and contrasting findings across diverse studies.

All four analytical approaches in one way or another privilege a longitudinal approach. The actual methods employed will be dictated by the research questions and context and the kinds of data deemed necessary for their analysis.

Longitudinal analysis is based on the fact that disasters involve far more than one-off, spatially delimited, temporally demarcated, physical triggering events. Rather, disasters are systemic processes that unfold over time. Their causes are deeply embedded in societal history, structure and organization, including human-environmental relations. The approaches all aim to reveal the root causes of disaster by examining existing or potential contradictions in underlying structures and on-going social processes.

The approaches are based on the premise that a causal chain must be empirically established between the patterns of damage and loss in a disaster and those social forces that mobilize the construction of risk, examining root causes and particular expressions of exposure and vulnerability. In effect, research on disasters should be informed by a life history methodology, based on the fact that the life history of a disaster begins prior to the appearance of a specific event. This perspective presents a significant methodological challenge in that the roots of causality are real in a phenomenological sense, but may not be empirically observable. They do, however, operate as structural mechanisms with enduring properties that generate actual conditions that can be directly observed. However, root causes must be seen from the perspective of their potential for alteration, or the extent to which they can be managed or changed. Some root causes are more subject to management or control than others, and an objective of forensic analysis is to identify causes and open pathways to their reduction or elimination by policy and practice.

A causal chain must be established between the patterns of damage and loss in a disaster and those social forces that mobilize the construction of risk, examining root causes and particular expressions of exposure and vulnerability.

Longitudinal analysis requires a shift from the all but exclusive focus on the disaster site to greater attention to the multiple sites where both policies and practices are developed and outcomes play themselves out. Unsurprisingly, spatial and temporal scale analyses are co-dependent in that the further the analysis goes back or prospectively forward in time, the wider the spatial/institutional dimensions of causality become (Oliver-Smith, 2004).

Figure 3 below displays both the design path of forensic disaster research and the actual path through which forensic research proceeds. The design path of forensic disaster research starts with the immediate causes affecting impacts and moving through risk drivers, vulnerability and exposure factors toward root causes in explaining the disaster event. The research path starts with the disaster event and moves outward through immediate causes to risk drivers, vulnerability and exposure toward root causes.

Longitudinal analysis requires a shift from the all but exclusive focus on the disaster site to greater attention to the multiple sites where both policies and practices are developed and outcomes play themselves out.

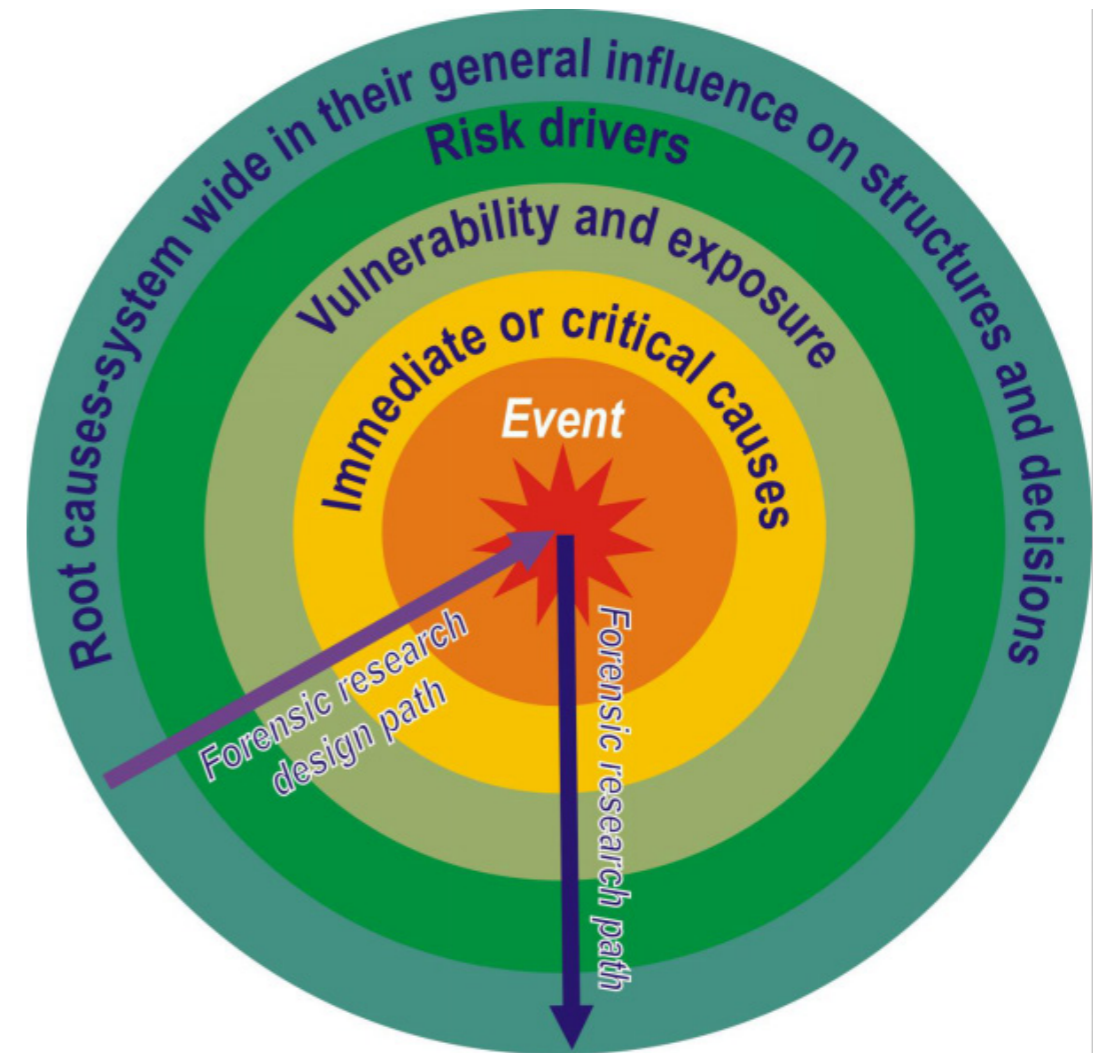


Figure 3 The design path of forensic disaster research and the actual path through which it proceeds.

6.1 Retrospective longitudinal analysis (RLA)

Retrospective longitudinal analysis starts with particular patterns of disaster damage and loss and works backwards, examining the social and environmental processes and conditions that drive risk, and the underlying organizational forms and institutions that condition choices and decisions about human relations and uses of the environment. In effect, RLA provides an historical narrative of risk construction, based on both qualitative and quantitative methods and data. Major patterns of destruction and loss are traced to critical causal factors. Locally specific processes of development planning, sectoral management, pre-disaster preparation and post-disaster recovery should be analysed. Preventive measures that were or could have been applied to avoid, control or limit the losses may be identified, and for each process in the disaster risk sequence those that caused harm or failed to offset it should also be identified.

As discussed, disaster risk (including vulnerability) is a social construct, the outcome of identifiable social processes that transpire over various lengths of time, ranging from centuries to relatively short periods. While these historical processes play out within the distinctive evolution of each society, they are manifested in culturally specific results, as for example vulnerable settlement patterns in hazard-prone areas, lack of building codes or their enforcement within largely, but not exclusively informal housing sectors, poor health conditions undermining individual, family and societal resilience, rural and urban environmental degradation and pollution, lack of institutional capacity, corruption and generalized impunity before the law, patterns of social domination, and radically skewed distributions of wealth.

Disaster risk is a social construct, the outcome of identifiable social processes that transpire over various lengths of time, ranging from centuries to relatively short periods.

The longitudinal issue of organizational scale is also important. No matter how local a disaster may be, nowadays affected communities are part of larger networks that have evolved over varying periods of time and that are generally arranged hierarchically in terms of function and responsibility. Institutional hierarchies also move down to greater specificity, employing variables occurring at one level to explain variables at a lower or later level. The importance of this scalar perspective is that it enables the conceptualization of self-organizational properties at various levels that in themselves have their own dynamic within the overall system. Thus, specificity within overall pattern, and therefore, variation and non-linearity are not only admitted but part of the system itself.

At the root-cause level the links between the increase and expansion of disasters and the dominant ideas, institutions and practices of the contemporary world as they allocate and distribute resources and entitlements should be established. However, the linkages of ideologies to specific dynamic processes and unsafe conditions must be related empirically to pinpoint causation of specific events. The kinds of data, and the appropriate methods for collection that are necessary to establish chains or loops of causality will vary by socio-historical context and hazard type and their expression in terms of both the natural and social sciences.

Case Study: Haiti

In the case of the 2010 earthquake in Haiti, RLA reveals that some aspects of risk and vulnerability have very deep roots in colonial history. However, the poverty and domination that characterized Haitian society were compounded by much more recent trends in international economics that worked to produce even greater conditions of widespread vulnerability and exposure. After the original indigenous population of

Haiti was decimated by European diseases, the colony came under the control of France, and by the end of the 17th century had the addition of an African slave population, “imported” to work on plantation crops of sugar and coffee for export, which constituted a foundational element in the long-term political economic construction of Haiti’s vulnerability. When Haiti achieved its independence through revolution, the European and subsequently American powers isolated Haiti both politically and economically, through debt obligations that extracted and exported the nation’s resources and its income, largely from sugar, coffee and indigo, toward metropolitan nations. The Haitian government and elites brokered the extraction process with foreign powers, and began accumulating power and wealth while draining the nation’s resources. Impoverishing the population with brutality, militarism, mismanagement and corruption, Haitian élites did little to construct a viable infrastructure or a functional institutional framework in the country (Dupuy, 1989).

Following the brutal dictatorship of François “Papa Doc” Duvalier, the ruinous reign of his son, Jean-Claude (“Baby Doc”), left the nation in even greater debt to foreign lenders through either misappropriation or outright theft. The second Duvalier regime, a virtual kleptocracy, coincided with the catastrophic USAID-ordered slaughter of all of Haiti’s pigs to limit the spread of African swine flu virus. The loss of the pig population – the source of peasant savings, emergency capital and nutrition – left rural people, the majority of the population, even more impoverished and vulnerable.

USAID programmes, working with large landowners, encouraged the construction of agro-processing facilities, while IMF-imposed tariff reductions opened Haitian markets to subsidized US rice surpluses, undercutting local production of the nation’s staple crop and dismantling the rural economy. The goal of these measures was to develop Haiti’s cities into centres of export production for US companies. The destruction of the rural economy and investment in urban export production stimulated a massive migration to the nation’s cities, where impoverished migrants took up residence in festering slums and hillside shantytowns with few services of any sort (Lundahl, 2004). The demand for jobs by displaced rural people quickly outstripped the supply, deepening the impoverishment of ever-denser populations in informal housing and vulnerable locations in cities. Political instability during the last 20 years has also led to a reduction of companies available to offer jobs (Chavla, 2010).

Moreover, few development efforts, misguided and mismanaged as many were, had privileged the issue of environmental security or hazard mitigation. A lack of building codes, together with informal settlements, widespread undernourishment and hunger, disease, poor access to clean water or electricity, inadequate educational and health facilities and services at the national and municipal levels, and crime and corruption, led to the construction of extreme vulnerability. In addition, Haitians were largely unaware of the seismic risk on the island, although seismologists had been warning of the possibility of a strong earthquake. Because of this social construction of extreme vulnerability, Haiti suffered a reported 222,750 deaths, 300,000 injured, 1.5 million displaced, and more than 3 million affected. The unregulated and informal housing stock of the city of Port-au-Prince was flattened, its basic service lifelines, inadequate as they were, destroyed.

6.2 FORIN disaster scenario building (FDSB)

Since hazards are systemic features of most environments, with appropriate methods the effects of their

eventual onset can be assessed. FORIN Disaster Scenario Building (FDSB) is an approach designed to create scenarios to inform government, civil society and community of the specific risks that exist in their social and physical environment and how they will play out in the case of hazard onset.

Scenario building is a well-known strategy to produce alternative images of how the future might unfold, and is used in a wide variety of situations ranging from commercial ventures to policy and military contexts. Scenarios are an appropriate tool with which to analyse how driving forces may influence future hazard outcomes, and to assess the associated uncertainties. Scenarios help in the assessment of disaster impacts, adaptation and mitigation and the analysis of disaster risk reduction analysis strategies. The possibility that any disaster will occur as described in scenarios is highly uncertain. Creating scenarios is important, not because they are necessarily accurate or true, but because they require improving our understanding of the problem in order to be able to frame things properly. Scenarios require policy makers and practitioners to consider a broader range of eventualities and responses.

Creating scenarios is important, not because they are necessarily accurate or true, but because they require improving our understanding of the problem in order to be able to frame things properly.

However, FDSB differs from standard scenario building, which is informed by a synchronic focus on present conditions, by retaining a diachronic concern for cause. A standard synchronic scenario-building exercise for disaster would be the Shakeout Scenario that gathered together more than 300 experts from academia, industry and the public sector to assess the potential impact of a possible future 7.8-magnitude earthquake on the San Andreas fault near Los Angeles, California. The scenario they created, forecasting 1,800 deaths and US \$213 billion of economic losses, was based on the assessment of earthquake impact on current actual conditions, with less attention as to how such conditions developed (Perry *et al.* 2008).

An FDSB-derived diachronic scenario or set of scenarios can be developed to represent the trajectories and ranges of root causes, driving forces and potential impacts so as to reflect current understanding and knowledge about underlying uncertainties. All scenarios necessarily include subjective elements and are open to various interpretations. FDSB scenarios should be based on an extensive assessment of root causes, driving forces and alternative modeling approaches, and an “open process”.

However, scenario construction in general is precarious because not only are we dealing with projected hazard onset intensity, but also with various future physical, societal and infrastructural trajectories. However, tracing past trajectories from root causes to risk drivers is an appropriate approach for charting future dynamics of demographic change, migration trends, infra-structural development, mitigation strategies, adaptive capacities, vulnerabilities and patterns of economic change, all of which will play out in different ways, according to the political, economic and socio-cultural dispositions of national governments, international organizations and general populations.

Generally, scenario construction can be either top-down, carried out by experts based on scientifically collected data, or bottom-up, in which case it is collaborative. In many ways, the two varieties correspond to the scale at which the scenario is being built. That is, if the scenarios are being constructed at the macro-scale of national or regional levels, the top-down, expert-based strategy is probably the most indicated. Alternatively, if the scenarios are focused on local settings and circumstances, a collaborative format holds the most promise, in addition to coinciding with the transdisciplinary nature of FORIN research (see Section 7).

In either case, the scenario should be science-based, selected on the basis of a known hazard that represents a realistic and possibly inevitable future event. FORIN scenarios may assess root causes underlying on-going social processes that create or exacerbate both exposure and vulnerability, forecasting an outcome of their impacts when triggered by a natural hazard. These findings can then be employed to create scenarios to assist DRM policy makers and practitioners for a future hazard onset.

Case Study: Hurricane Mitch in Honduras

One of the most accurate of disaster scenarios, previewing the FORIN approach, can be seen in the research of Stonich (1992), which rooted vulnerability in Honduras in human use of the environment and the socio-economically-derived conditions in which much of the population lived and still lives. Her work demonstrated clearly that in the context of local topography and climate a development model based on agricultural diversification and export-led growth promulgated practices that impoverished local people and degraded the environment, making them more vulnerable to the impact of climatological hazards. These practices in turn led to a series of risk drivers expressed as environmental degradation, land concentration, population displacement, migration and intense urbanization, ultimately producing the unsafe conditions of insecure housing, unstable terrain, contaminated water supplies, disease, malnutrition and poverty.

The deteriorating environmental situation compounded the social conditions that located Honduras among the poorest of the poor of Latin America. In the 1990s Honduras had the fourth lowest GDP per capita in Latin America (higher only than Bolivia, Haiti and Nicaragua). Seventy percent of the total population and 80 percent of the rural population were living below the absolute poverty level. Honduras ranked last among Central American countries according to the UN Human Development Index – a composite measure calculated from multiple indicators of life expectancy, educational attainment and income (Stonich, 1992). Rapid population growth coupled with increasing land concentrations and scant economic opportunities forced many rural peoples to adopt unsustainable agricultural practices that destroyed forests and degraded soils and other natural resources. Thus, rural poverty produced waves of migration to cities like Tegucigalpa, where people occupied unsafe structures on hillsides made unstable by deforestation. In the lowland cities, migrants occupied areas prone to flood, creating extremely densely populated urban neighborhoods along river banks and in flood plains. These urban settlements suffered from lack of potable water and sanitation as well as public health facilities, resulting in diarrhoeal and parasitic diseases that produce high levels of mortality and morbidity among vulnerable populations such as the poor, women and children (Stonich, 1992).

To all intents and purposes, Stonich constructed an accurate assessment of Honduran exposure and vulnerability, and created a scenario that came very close to predicting a disaster such as that associated with an event like Hurricane Mitch. Given the enormous size of Mitch and the unprecedented rainfall associated with it, she may be forgiven for underestimating the scale of the damage and destruction. However, she was exactly accurate as to the nature of the impacts. As Figure 4 overpage demonstrates, Stonich precisely identified the root causes that were undermining the rural and urban populations as well as the environment in Honduras, and demonstrated the progression that such forces were following in driving dynamic pressures to produce unsafe conditions.

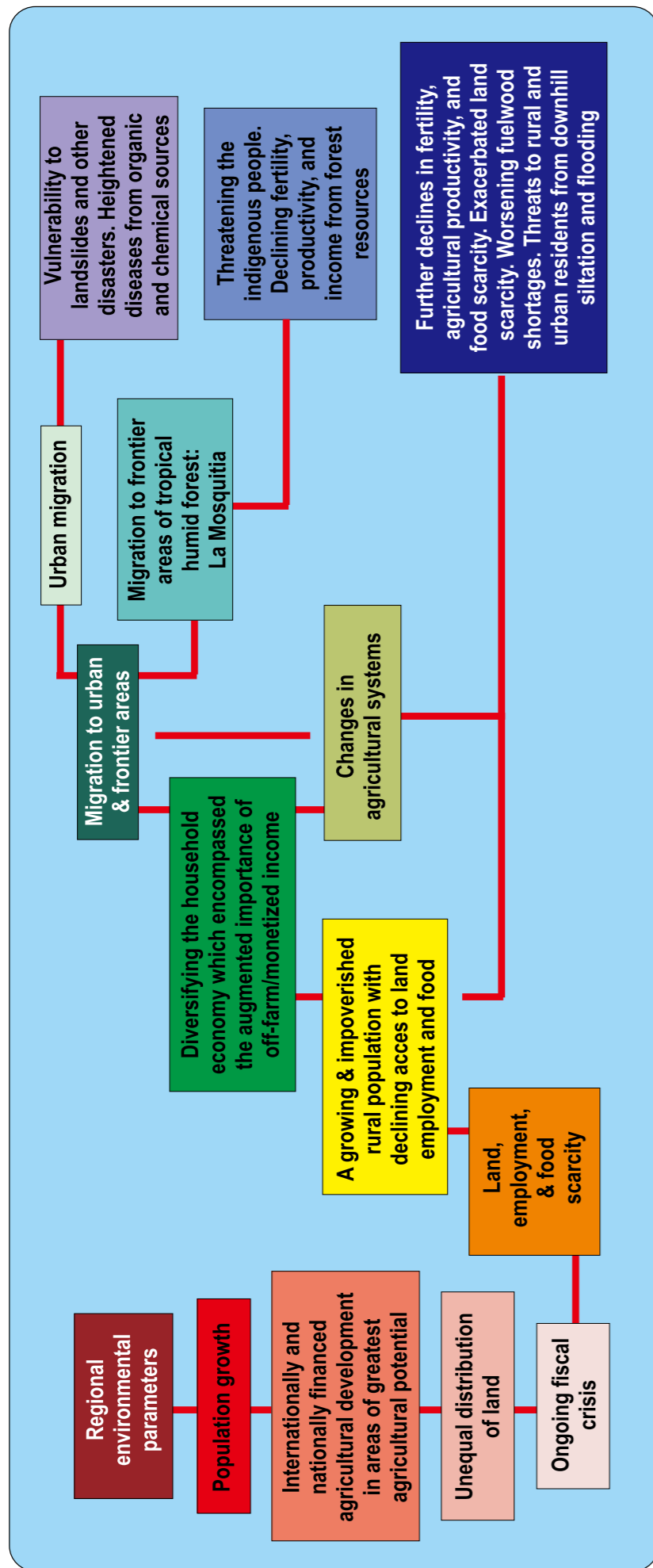


Figure 4 A disaster scenario preceding Hurricane Mitch in Honduras (based on Stonich, 1992).

6.3 Comparative case analysis

Comparative case analysis focuses on current conditions of exposure/vulnerability and/or disaster occurrence across a limited range of cases that show elements or aspects in common. Comparative analyses are detailed, place-based analyses of several disaster events in order to more fully understand the differential contexts and processes that expose people and their assets to risk. These reconstructions can be geographically comparative (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). In the case of paired comparisons of a single place with multiple disasters, this approach permits an analysis of which mitigation strategies worked, which ones would have worked if implemented, the lessons learned and the lessons not learned over time and across hazard types.

Comparative analyses are detailed, place-based analyses of several disaster events in order to more fully understand the differential contexts and processes that expose people and their assets to risk.

Basically, the comparative method provides a means of researching two or more comparable disaster risk and disaster cases, their causal processes and impacts. This can be done using “similar” or “dissimilar” cases, where the hazards and the context-urban, rural, etc., are in common but the political regime under which legal and normative aspects are designed, or the cultural aspects of society, the economic structure, etc. differ or are in common. The idea is to illustrate how processes work out in comparable but different situations under different or similar socio-economic, political or cultural conditions, thus providing evidence for the idiosyncratic or generic conditions that may exist and that finally explain disaster risk and disaster impacts.

Case Study: Hurricane Luis impacts on island of St Maarten

An example where comparative study has been useful is the case of Hurricane Luis impacts on the distinct French and Dutch parts of the NE Caribbean island of St Maarten in September 1995. Despite there being more intense winds and rainfall on the French side of the island, damage and loss was considerably less than on the Dutch side. In the case of the Dutch territory the damage was catastrophic. There, direct losses were equivalent to the annual gross domestic product (GDP), whilst indirect losses accounted for a similar amount.

This was explained essentially by the normative and control frameworks that existed on building, location and infrastructure use on the French side, which in themselves derived from the application of different legal precepts deriving from the cultural, social and political histories of the contrasting colonial régimes that occupied the island. According to the analysis by Gibbs (1996), the buildings on the Dutch side were designed in accordance with a variety of standards, including those of the Netherlands. The oversight authority was the government Public Works Department, although this role was occasionally contracted out to private firms. On the French part of the island construction had to comply with French norms, with the design and construction checked by *bureaux de contrôle*, and according to popular notions, "you have to do it right". The involvement of the *bureaux* in projects was necessary if decennial (10-year) and insurance cover were to be obtained by the building's owner. Lending agencies also demanded certification.

The differences outlined by those familiar with construction on the two sides of the border include: better

attention to conceptual design, greater consistency and uniformity of standards of design for earthquakes and hurricanes, and the involvement of *bureaux de contrôle*, all on the French side.

Similar studies could usefully be undertaken between Anglophone islands and mainland territories in the Caribbean and those of French, Dutch and Spanish origins under similar risk conditions and hazard incidence, but vastly different social, legal and cultural conditions (Vermeiren, 1996).

6.4 Meta-analysis

In its original sense, meta-analysis is based on statistical methods for contrasting or comparing results from different studies in order to identify patterns or commonalities across and among a wide array of different studies. It is research about and based on previous research. In its simplest form meta-analysis is carried out by identifying a common statistical measure that is shared among many studies.

Meta-analysis refers to systematic reviews of the available literature on a specific topic carried out to identify and assess consistent findings across diverse studies.

The term meta-analysis is also used more broadly to refer to systematic reviews of the available literature on a specific topic carried out to identify and assess consistent findings across diverse studies. This analytical approach offers potential for systematic investigation of disasters where the findings of the case studies or research observations are sufficiently comparable for one or multiple variables.

The focus of such an analysis may vary from a specific type of hazard (flood or earthquake for example) to some thematic attributes of disaster such as risk, the role and availability of insurance, or differential vulnerability due to poverty, inequity, poor quality of governance and other hypothesized underlying causes. An example may be seen in the Rudel (2007) multivariate, statistically-based meta-analysis of 268 empirical studies of deforestation, looking at causal factors used to explain forest loss.

Meta-analysis can be used to establish statistical significance across a broad range of studies in which there may be inconsistent or conflicting results. In particular, meta-analysis can be applied to identify sub-groups whose members are not statistically significant in single studies. It is also useful in developing a broader evaluation of the range of magnitude of an effect or impact, as well as providing a more complete and detailed analysis of the range of damage from a particular class of event. Meta-analysis can also be used as a procedure or approach for synthesizing the results of similar studies based on a consistent research design.

Such analysis can be applied to the existing research and literature on disasters which were designed and carried out without any anticipation of subsequent meta-analysis. In such a case, however, it may be difficult to identify the appropriate or adequate studies for inclusion in the analysis. Care must also be taken to assure a similar standard of quality of both the data and the studies to be included. It is also important that all the studies provide the necessary data to be included and analysed. And a further difficulty in social research involves the heterogeneity of study populations, which in meta-analysis may involve wider regional or even global scales. The FORIN project programme for

Meta-analysis is useful in developing a broader evaluation of the range of magnitude of an effect or impact, as well as providing a more complete and detailed analysis of the range of damage from a particular class of event.

IRDR proposes a broad research programme with specific case studies that are designed as a set in such a way that they facilitate or support meta-analysis. The implication is that a number of new disaster case studies are required that will conform to a common design, use common questions, with common measurements and variables that can be used in a meta-analysis while still allowing for the important documentation of the unique features that characterize every disaster.

The use of meta-analysis in FORIN studies may take two forms or pathways. Either on the basis of a set of case studies specifically designed for the purposes of meta-analysis, or using existing studies that have been designed and carried out without the anticipation of their use in a meta-analysis. In point of fact, the use of meta-analysis in the formal statistical sense is relatively rare in disaster research. However, a number of studies have adopted a meta-analytical perspective to arrive at and assess consistent patterns of causes, conditioning factors and outcomes of natural hazard occurrence and disasters across a number of defining categories.

Case Study: Crucibles of hazard

The research led by the Study Group on the Disaster Vulnerability of Megacities of the International Geographical Union and the subsequent book “Crucibles of hazards: mega-cities and disasters in transition” (Mitchell, 1999) is informed by a meta-analytical perspective. Seeking to identify those features of urbanization manifested in mega-cities (populations greater than nine million inhabitants) that increase the risk of disaster, the project examines how patterns of change in disaster agents as well as their management and their investigation, in concert with changes in the composition, structure, governance and identity of megacities to understand how these new patterns of urban development increase disaster susceptibility. The changing patterns of urbanization, including the rapidly increasing size of megacities, both in terms of population and spatial expansion, and the effects of city form and structure on natural hazard potential are examined across cultural and geographic lines, focusing on similarities and differences. Similarities across the megacity sample included location on sea coasts and economic importance as nodes in financial markets. Significant differences were found in megacity disasters between global impacts in rich countries, such as Tokyo or Miami where impacts may reverberate throughout the world economy. Nineteen megacities together composed a global polycentre that controlled the international entrepreneurial system and at the time of the study fifteen of them accounted for 70% of all electronic data flows. Meanwhile, megacities of the peripheral regions of the global south, such as Manila, Dhaka, Ankara or Lima, differed in terms of increased losses of life and material destruction rather than economic and communication disruptions as the major outcomes of disaster. The study also revealed that along with these changes in megacities and their societies, there were changes in the way disasters were addressed in megacities in policy and practice, particularly in terms of a broad conceptualization of complex emergencies, including the interaction of natural hazard onset and political conflict. There were also signs of increasing public dissatisfaction in megacities across geographic and cultural lines, with disaster and emergency management agencies, including growing doubts about the effectiveness of policies and practices of these institutions.

7. FORIN research: integration and transdisciplinarity

7.1 Introduction

Given the complex processes leading to disaster risk, it stands to reason that it is beyond the capability of any single discipline to capture and analyse the full array of causes and effects that a disaster presents. FORIN investigation on the root causes of disasters must therefore be an interdisciplinary undertaking. Moreover, because both the causes and effects of disasters are found in the nexus between human communities and their environments, FORIN research must also be transdisciplinary, engaging and involving the various stakeholders fully in the research enterprise

Given the wide range and considerable diversity of the many questions listed in Section 5, FORIN research must also include those natural and physical sciences related to the triggering natural hazard events such as: the atmospheric sciences in the case of storms, floods and droughts; the geophysical sciences for earthquakes, volcanoes and landslides; and the biological sciences in the case of such hazards as pest infestation and vector-borne diseases.

FORIN research must be transdisciplinary, engaging and involving the various stakeholders fully in the research enterprise.

The progression of specializations expands to include expertise in the many social, economic, cultural and behavioural (psychological) dimensions. The circle of relevant knowledge and practice further extends to fields of professional expertise such as engineering, health and law. And there is still more. Since forensic investigations are directed towards understanding human choices and decisions, in many institutional frameworks other fields of expertise such as governance, decision-making communications, and the like are necessarily involved. Which disciplines, areas of expertise and methods are to be drawn upon depends on the specifics of each research project. For example, in analysing the root causes of flood, it is essential to include understanding from atmospheric sciences in the case of tropical storms. Similarly, agricultural economics is likely to be relevant in the case of droughts, but not so important in the case of urban floods, where the economics of urban functions and activities is central. For each FORIN research project there has to be a selection of the relevant knowledge and expertise and the involvement of the specialists who can bring such knowledge to bear in an authoritative way. The selections depend upon the research questions being addressed and on relevance to the advancement of understanding in a forensic sense, as elaborated in Sections 2 and 3.

7.2 Towards integrated research

The fundamental challenge for FORIN, then, is the design and organization of integrated research projects on root causes of disaster that move beyond multidisciplinary to inter- and transdisciplinary approaches. Integration is a process of convergence leading to a new body of knowledge that is more than the sum of its separate and component parts. The process may be thought of as a bringing together of ideas, facts and findings in a fundamentally social process where mutual understanding can

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develop over time and a new and distinct body of knowledge is created. The main driving force in this process derives from the research questions and the project goals. What these are in forensic research on disasters, focussed on root causes, has been elaborated in general terms in Sections 2, 3 and 4. The specifics depend upon the particular case study and project goals. The selection, design and organization of the case study is where the process of integration takes place.

7.3 Overcoming the obstacles

However, such integration is not easily achieved. The difficulties faced in amalgamating the natural and social sciences has been a major hindrance in the development of integrated research projects on complex socio-ecological issues in general. Beyond the natural science–social science divide, inter- and transdisciplinary research presents a number of conceptual and operational challenges that must be confronted in order to be successful. Research must be problem-focused and frame and focus on questions that no single discipline can answer alone. Because the participants in transdisciplinary research are so disparate in perspective and orientation, efforts must be made to create bridges among them to achieve enough common purpose and ground to enable the kind of close communication that is necessary for integrated research (Alcántara-Ayala, 2002). The principal conceptual difficulties that must be bridged are the epistemological challenges of identifying research questions that multiple disciplines and stakeholder communities can embrace, and in which different methodologies can pursue relevant information of different qualitative-quantitative natures across time/space/organizational scales. Variations in definitions, terminologies, languages, lack of compatible methodologies and data categories all militate against finding the common ground necessary for framing research questions. Concretely, this means that, In effect, the orienting research question must be one in which each discipline requires the perspective and information that can only be supplied by each of the other disciplines.

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Operationally, integrated research must also overcome other obstacles. Different disciplines respond to different reward structures, and aim toward different research products. In addition, integrated research requires higher levels of trust and confidence in working together among representatives of different disciplines that operate within a social structure of science that allocates rewards unequally. This trust and equality must not only be shared across the social structure of disciplines but be extended as well to participants from the various stakeholder communities to achieve transdisciplinarity. Moreover, within this experiment that requires that each discipline participates as an equal, strong leadership is paradoxically required to keep the project headed in a coherent and organized direction. In effect, truly integrated research constitutes an experiment in social relations among representatives of very disparate disciplinary and stakeholder communities.

One strategy that can contribute to bridging these differences is the organization of research interactions whose starting points are situated in the field. By being together on the spot, a real understanding of disaster risk and acknowledgment of the value of each scientific and technological and local stakeholder perspectives can be achieved. These interactions would move the merging of the basic and applied disaster risk research

perspectives forward, by fostering data sharing and risk communication among scientists and community members, building the notion of visioning and appropriating disaster integrated science as an imperative, crucial and on-going collaborative effort (Button and Peterson, 2009).

7.4 Stakeholder involvement and the co-design of research projects

In addition, the major purposes and objectives of FORIN can only be achieved if the research is strongly and continuously engaged with locally involved communities, as well as with policy and practice. Transdisciplinary research requires the active engagement of diverse local stakeholders to help frame the questions to be investigated in order to reflect local perceptions and priorities (Stokols, 2006). Since local communities are internally diverse, efforts must be made to reach all affected groups, such as women, children, the elderly, the handicapped and other socially disadvantaged groups who are among the most exposed and vulnerable, and who may lack a voice in local affairs. Engagement with the policy and practice organizations on the part of the research community is also not an easy or straightforward task. The people engaged in policy and practice tend to be too busy and preoccupied with everyday and sometimes urgent matters to give much time to researchers, or to see much benefit in doing so. It is therefore necessary to find entry points or points of contact through which the research findings and insights can be communicated effectively into policy and practice. Importantly in the promotion and application of FORIN research are stakeholders (who may not actually see themselves as such) who make daily management and development decisions that help to create (or fail to prevent) the growth in vulnerability and exposure. Equally important, if not more so, are those practitioners engaged in activities that may seem to be remote from the causes of disasters, because they are involved in what turn out to be underlying or root causes. These are probably numerous and largely unrecognized. It is the task of FORIN investigations to bring these to light and make them evident, and engender a sense of responsibility.

Transdisciplinary research requires the active engagement of diverse local stakeholders to help frame the questions to be investigated.

When the list of stakeholders is understood to be so all-encompassing, the task of engagement is formidable. Stakeholder involvement will include a wide array of potential activities for the disaster research community. There is no one simple prescription, except perhaps to encourage researchers to use all options to engage stakeholders at all levels, and not limit this to local stakeholders, but reach out also to higher-level decision-makers and the media, including both conventional and established and the expanding social media.

In summary, transdisciplinary integrated research projects must bring together multiple disciplines, synthesizing theory and method in such a way as to create hybrid or even new disciplines around a thematically based goal. The project must cross epistemological boundaries and follow a pluralist methodology that admits both quantitative and qualitative approaches. The research must be coordinated and problem-focused and involve implementation of results as part of a process involving the full spectrum of disciplines and affected communities of stakeholders. The co-design and organization of integrated research projects has proved to be very challenging, such that it has become something of a subfield in the methodological literature itself. Indeed, there is an extensive literature

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on integrated and transdisciplinary research design that should be consulted for specific project planning (Fry 2001; Fuller 2001; Tress *et al.* 2005; Hadorn *et al.* 2008; Pohl, 2008; Collins *et al.* 2011).

For the reasons and conditions described above, FORIN research will never be an activity that can be mounted and accomplished quickly. Transdisciplinary, integrated research projects are complex to plan and run properly, and they normally require financial and human resources pitched at a reasonably realistic level. While smaller case studies carried out on fairly limited budgets certainly have their contribution to make, major FORIN projects will require substantial funding.

Case Study: Multi-sectoral narratives for Metropolitan Manila

Metropolitan (or Metro) Manila, with more than 11.8 million people (NSO, 2010) over 636 km² of land on a semi-alluvial flood plain, is one of the most populated coastal megacities in Asia (Bankoff, 2003). On average, 20 tropical cyclones per year form and/or cross the Philippine Area of Responsibility (PAR) (PAGASA, 2011), several of which have recently strained the limited capacity of the metropolis to address the risks associated with extreme rainfall.

FORIN narratives (IRDR, 2011) were employed as the initial scoping tool to develop a multi-sectoral analysis of Metro Manila's risk of flood in the face of climate change. The narrative format can help with identifying gaps in available data or literature, while also highlighting trends and issues requiring more comprehensive analyses in a full FORIN research project (Gotangco *et al.* 2014). Experts representing the physical, social, economic and health sectors were engaged to produce a compendium of multi-sectoral narratives which were predominantly longitudinal in nature, tracing historical, current and, if possible, projected components of risk.

A key factor identified across the multi-sectoral narratives is urbanization. Land cover has changed through the expansion of impermeable surfaces, the encroachment of people and infrastructures into floodplains and waterways, and the denudation of the watershed. In 1972, more than 50% of the area of Metro Manila was covered with vegetation, but by 2009 more than 80% of land had been converted to impermeable built-up areas. Development has also resulted in the narrowing of river channels, lost estuaries and waterways, and the siltation of rivers and land subsidence, all of which greatly increases the potential for flooding. Increasing urban density leads to restrictions in land use and increasing land prices, which drives vulnerable urban populations into informal settlements and hazardous areas. All of these physical and socio-economic factors also lead to living conditions that degrade human health and increase vulnerability.

Metro Manila also illustrates the cascading or compounding nature of risk and its elements. Primary hazards such as rainfall interact with the city's physical characteristics on the ground, generating secondary and, potentially, more damaging hazards in the form of floods. These floods, interacting with water-quality and solid-waste-management problems, pose further hazards, both immediate and indirect to health. Direct economic damage brought about by typhoons and flooding, translates into further indirect losses in productivity and income, and secondary macro-economic losses. These dynamic interactions can then intensify vulnerabilities of different stakeholder groups.

In the field of risk research, an interdisciplinary approach is necessary in analysing risk as a complex, multi-dimensional issue. While, on the one hand, having different paradigms or approaches does pose a challenge for integrative work, on the other hand offering different perspectives from which to analyse the context of

Metro Manila can contribute to a more holistic case study. Results of such a multi-dimensional approach, if integrated and communicated effectively, can prove to be useful not only to researchers but also to decision-makers and practitioners, as well as community members on the ground in developing more proactive approaches for prevention, mitigation and disaster risk reduction (Gotangco *et al.*2014).



Photograph by Anthony Oliver-Smith

8. FORIN in policy contexts: current issues and future challenges

8.1 The challenge of FORIN

Imagine that the challenge of FORIN has been met by a new generation of disaster risk studies focussed on root causes, and that enough case studies have been accumulated to permit some broad meta-analysis. Under such circumstances it is to be expected that some substantial policy issues will have emerged. Prominent among these are questions that relate to the reasons for the growth in hazard, vulnerability and exposure. There will likely be evidence to show that the efforts towards DRR continue to be substantially outweighed by the processes of disaster risk creation. It will be more widely understood that the root causes of disasters are deeply embedded in the dominant economic and socio-cultural choices and values. The voices calling for cultural change and transformation will no longer be marginal cries from research scientists, but more widespread and based on evidence from research.

There are now numerous candidate explanations. At one level these include: persistent poverty and inequity; the distribution of power and its misuse; the scramble for economic advantage among peoples, in the private sector and governments; the misuse and appropriation of common property resources for individual, local and national benefit, and contrary to the good of the whole; and support for the continuance of these in the form of corruption, conflict, and privilege. At another level the explanations may be found in the lack of adequate policies and insufficient strength or authority in the public domain to counteract and place limits on the actions of those who benefit privately at public expense. FORIN research and analysis must confront these and other similar issues and establish with hard evidence of the links that tie them into causal chains that produce disaster risk and then disasters.

8.2 Cultural change and transformation

Thus, the challenge of FORIN leads to the question of how the desirable changes are to be brought about from the analysis of root causes and risk drivers. The results of FORIN research, provided that they are sufficient and persuasive, will help to identify steps, actions and policy changes that can bring about change in the right direction and accelerate the momentum towards transformation, in the sense of a change in the basic features of a socio-ecological system in terms of altered approaches, goals and values. Such a set of tasks is clearly beyond the reach of DRM and thus falls squarely within the development portfolio. We do not suggest that wholesale cultural change can happen quickly or evenly. Some countries, some communities, some nations, some private corporations and state enterprises will take the lead and see the credits and benefits in doing so. Others will resist change strongly. Nonetheless, what is urgently required is a cultural change to avoid or at least reduce substantially the use of the term "natural disaster", in order to explain the social character of disasters and social vulnerability as their main cause (Briceño, 2015). From this basic shift in understanding, a more widespread comprehension of the need for the forensic analysis of root causes can be established and more effective approaches to DRR developed.

The results of FORIN research, provided that they are sufficient and persuasive, will help to identify steps, actions and policy changes that can bring about change in the right direction.

However, most development policies and practices today foster approaches that more deeply embed current

environmental relations, power and wealth differences and exploitation (Cannon and Müller-Mahn, 2010; Felli and Castree, 2012). DRM policies and strategies that do not contest current systemic practices may promote or exacerbate vulnerability. Thus, root cause analysis is a virtual necessity if development informed by DRM is to have any transformational potential. As currently practiced, DRM, or for that matter, development, rarely address the major challenge, which requires questioning the beliefs, values and interests that create and perpetuate the structures, systems and behaviour that drive disaster risk (O'Brien, 2012). Indeed, most DRM interventions are aimed more at emergency management than at challenging the causes and drivers, leaving current development approaches essentially unquestioned and uncontested (Pelling, 2011).

DRM policies and strategies that do not contest current systemic practices may promote or exacerbate vulnerability. Root cause analysis is a virtual necessity if development informed by DRM is to have any transformational potential.

In order to support positive moves and to meet the resistance, new laws, regulations, incentives and penalties are required. Sooner or later such innovations will require some international harmonization and agreements. The elements of such a movement towards the transformation of how disasters are understood and reduced need to be more than scraps of paper. A sense of responsibility and a capacity for enforcement are necessary accompaniments.

8.3 Climate change and the FORIN perspective

The social roots of both disasters and climate change suggest an additional application of the FORIN perspective for DRR and climate change adaptation (CCA). It is now fairly well agreed that climate change will in most cases exaggerate the effects and frequencies of existing events, the impacts of which are largely conditioned by existing patterns of exposure and vulnerability. Indeed, climate change effects will also increase the vulnerability of people to geological and other hazards not related to climate change. Even in cases where the climate change-driven hazard is novel, its impacts will still be expressed through local vulnerability patterns. Regardless, it is fairly clear that the outcomes of many climate change effects will be seen and felt as disasters by the affected populations. Consequently, both CCA as well as DRR must be framed and designed to address those social and economic features that render people vulnerable to environmental hazards in general. In effect, climate change adds to the array of hazards experienced by people and thus CCA constitutes a subset of DRR and must therefore address systemic vulnerabilities as well as the hazards posed by specific climate change effects (Kelman and Gaillard, 2010). It is also possible to say that DRR is a sub-set of CCA, which addresses many more policy objectives, going beyond risk reduction.

The outcomes of many climate change effects will be seen and felt as disasters by the affected populations.

However, rather than a focus on “extreme events” in a physical sense, the central concern should be on “high impact events and contexts”, where analysis of the social conditioning factors associated with risk should be a priority. In effect, an “extreme” event is not one where there is the greatest discharge of physical energy, but, rather, one where there is more associated damage and loss. This should be in the centre of both DRM and CCA and implies a consideration of the social, economic,

An “extreme” event is not one where there is the greatest discharge of physical energy, but, rather, one where there is more associated damage and loss.

political, historical and cultural conditions which lead to the vulnerability that affects very large numbers of people and their livelihoods, principally the poor. The FORIN perspective offers a fruitful avenue towards developing a holistic framework for the analysis of the links between climate and weather events to permit the analysis of common variables that affect both risk and disaster impacts. The FORIN focus on root causes provides a unifying perspective that brings to the fore issues of risk construction as opposed to biophysical impacts, which in effect constitutes a return to a physicalist emphasis on hazards. The use of FORIN for the analysis of root causes of risk factors and their role in restricting development options at the national and local levels can inform the identification, elaboration, promotion and implementation of policies, strategies, instruments and actions that permit society to face up to or anticipate climate change extremes and anomalies as well as the accumulative effects of many non-extreme events.

The FORIN focus on root causes provides a unifying perspective that brings to the fore issues of risk construction as opposed to biophysical impacts.

8.4 Legal and judicial requirements

The legal and judicial implications of the application of FORIN research remain to be explored more fully in both international and national contexts. In so far as FORIN research is aimed at discovering and analysing root causes and risk drivers, the questions of potential legal liability and responsibility must be addressed. In many cases in which root causes are deeply embedded in the historical development of a society, such as in the case of Haiti (see Section 6), establishing legal responsibility for some root causes would be impossible. However, in less temporally remote situations, for example the 1985 earthquake in Mexico City, legal action was contemplated, but never actively undertaken, against developers and construction companies that built many of the collapsed structures in the city. The case of legal responsibility and accountability for the damage incurred in the earthquake in L'Aquila, Italy, in which seven seismic scientists were initially convicted of manslaughter and given 6 year sentences for failure to adequately warn about the probability of the earthquake which devastated the city, also brings the responsibility issue to the fore (Scolobig *et al.* 2014). They were not prosecuted, however, as scientists, but as public functionaries who failed to examine the evidence before providing misleading information (Alexander 2014). Recently, in November of 2015 six of the scientists-three seismologists, a volcanologist and two seismic engineers- were acquitted on appeal. The seventh scientist, at the time of the quake the deputy head of Italy's civil protection department, remained convicted but had his sentence reduced (Cartlidge 2015).

These brief examples pose important questions on the issue of liability and consequential damages for the application of FORIN research in the analysis of contemporary disasters. Legal liability is often pursued in cases where buildings collapse due to inferior construction. Should there be legal accountability in cases where buildings have not been built to code in earthquake- or hurricane-prone regions? Proving direct causality in a legal sense involves establishing both intent and action in the construction of risk or in loss and damage, and this is clearly more challenging, but nonetheless, has potential for curbing risk construction if responsibilities can be formally identified and legally pursued. In effect, responsibilities for DRR must be formally articulated in legal terms, because if they are not well-defined, there can be no grounds on which to bring those who construct

Proving direct causality in a legal sense has potential for curbing risk construction if responsibilities can be formally identified and legally pursued.

risk to accountability. Thus, the legal value of FORIN research that reveals the active participation of known actors in the creation of root causes or risk drivers that result in a disaster triggered by a natural or socio-natural phenomenon depends before anything else on embedding DRR in legal frameworks by national governments.

8.5 The acceptability of FORIN research

These questions regarding possible outcomes and implications of FORIN research will undoubtedly cause hesitation and perhaps opposition in some quarters. The use of the word forensic may suggest an attempt to lay blame or to find those responsible for what has been called the disaster epidemic. Some have expressed concern over the very use of the word "forensic" because of its association with police or criminal investigations. A concern has sometimes been expressed by participants in FORIN meetings that some stakeholders may be uncomfortable with the very idea of such probing research. It has been suggested that for some government agencies and private sector investors the forensic approach may seem to be a threat. Such concerns may be strengthened by the discussion in Section 8.4 above on legal and judicial requirements.

However, the assessment of blame is not the primary intent of the FORIN approach. The intent is to convey the need to go beyond some of the current explanations for disasters such as the growth in exposure and vulnerability and to probe into the reasons for these processes. The underlying hypothesis or theory is that the root causes of disaster are deeply embedded in the dominant economic and socio-cultural development path. From the present evidence of disaster studies it is understood that sometimes individuals or agencies make mistakes or knowingly take decisions that create or increase risks. While FORIN disaster studies may sometimes help to identify such errors, it is not the primary purpose of the perspective to establish any basis for legal claims. Nonetheless, it would be unfortunate if FORIN research were to be held back by such apprehensions.

Root causes of disaster are deeply embedded in the dominant economic and socio-cultural development path.

At this stage in the development of FORIN research it is not possible to predict with confidence where it might lead in terms of understanding or policy actions. That it may reveal mistakes or errors of judgement is not surprising. In the management of risks, agencies and individuals are faced with choices involving costs and benefits and which often involve considerable uncertainty. Post-disaster event investigations have often pointed to poor choices and decisions that led to severe consequences. Some of the hardest choices centre on risks that are understood to be of low probability and high adverse consequences.

An objective of FORIN research is to accumulate lessons and experience in a systematic way that can lead to improved choices in the future. That such investigations might reveal some culpability or avoidance of responsibility cannot be ruled out. It is not for FORIN research to make judgements on such matters but to lay out the facts as far as they can be determined. Not to pursue such questions would be a failure of responsibility on the part of the research community itself.

That investigations might reveal culpability or avoidance of responsibility cannot be ruled out. It is not for FORIN research to make judgements on such matters but to lay out the facts as far as they can be determined.

8.6 International institutional change

Concern over the enormous violations of human rights during World War II formed the basis on which the international community began the effort to establish international human rights standards and norms. The Universal Declaration of Human Rights was adopted by the UN General Assembly on 10 December 1948 to guarantee and protect the rights of all people throughout the world. Since the end of World War II, there has been a relatively continuous spread and institutionalization of global norms and principles of various types, including regulatory, constitutive, practical and evaluative (Khagram, 2004). Among the many rights accorded to all human beings was the right to a safe environment. A global normative framework of principles and organizations regarding disaster risk and loss has also taken shape within the framework of such international organizations, beginning with the UN Disaster Relief Organization (UNDRO) in 1972.

While the basic perspective that informs FORIN has been part of international dialogues since the 1980s, progress toward focusing research on root causes has not been particularly noteworthy, nor have improvements in institutional and technical mechanisms to address the full range of risk drivers and elements.

Shifting from a single focus on humanitarian assistance, institutional initiatives on DRR began to be developed in the late 1980s when the United Nations established the International Decade for Natural Disaster Reduction (IDNDR) (1990-1999) and in 2000 the International Strategy for Disaster Reduction (UNISDR). During the IDNDR a first major conference on disaster reduction was held in Yokohama (1994) and a little more than a decade later, a second major conference was held in Kobe, Hyogo leading to the adoption of the Hyogo Framework for Action: Building the resilience of nations and communities to disasters (HFA) (UNISDR, 2005) that brought to the fore the issue of root causes and risk drivers. In 2015, a third major conference was convened in Sendai, resulting in the adoption of the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015b), providing further details for more effective international policy guidance in reducing risk. Moreover, a wide variety of non-governmental and international organizations has emerged to engage with the issue of root causes. However, progress toward actual support for research on root causes has been scant and implementation of measures to address underlying causes, although advancing, is still far from sufficient. In effect, these international initiatives have not yet affected the direction of research in the scientific world, while the attention of the policy world remained focused on emergency management and recovery processes. FORIN seeks to contribute to the remedy of that situation.

To engage national governments and international institutions, a more robust research base establishing the links between root causes and risk drivers and disaster occurrence is urgently needed. The FORIN perspective directly addresses that need and that goal. Research oriented and organized by FORIN will provide the knowledge base that is needed to move national and international agendas toward addressing the systemic features of local, national and global social and economic organization that are the root causes of disasters.

References

Alcántara-Ayala, I. (2002) Geomorphology, natural hazards, vulnerability and prevention of natural disasters in developing countries. *Geomorphology*, 47, 107-24.

Alcántara-Ayala, I., O. Altan, D.N. Baker, S. Briceño, S.L. Cutter, H. Gupta, A. Holloway, A. Ismail-Zadeh, V. Jiménez-Díaz, D. Johnston, G.A. McBean, Y. Ogawa, D. Paton, E. Polio, R.K. Silbereisen, K. Takeuchi, G.B. Valsecchi, C. Vogel, G. Wu and P. Zhai (2015) Disaster Risks research and assessment to promote risk reduction and management, ICSU-ISSC Ad-hoc Group on Disaster Risk Assessment, In: Ismail-Zadeh, A. and S.L. Cutter (eds.) ICSU-ISSC, 47 pp. (<http://www.icsu.org/science-for-policy/disaster>)

Alexander, D.E. 2014. Communicating earthquake risk to the public: the trial of the "L'Aquila Seven". *Natural Hazards* 72(2): 1159-1173. Comment and reply, *Natural Hazards* 75(1): 991-1003.

Bankoff, G. (2003) Constructing vulnerability: The historical, natural and social generation of flooding in Metropolitan Manila. *Disasters*, 27, 95-109.

Blaikie, P., T. Cannon, I. Davis and B. Wisner (1994) *At Risk: Natural Hazards, People's Vulnerability and Disasters*. New York: Routledge.

Boin, R.A. (2005) From Crisis to Disaster: Towards an Integrative Perspective, pp. 153-72 in Perry, Ronald W. and Enrico Louis Quarantelli, (eds). *What is a disaster? New answers to old questions*. Xlibris Corporation.

Briceño, S. (2015) Looking Back and Beyond Sendai: 25 Years of International Policy Experience on Disaster Risk Reduction. *Int. Journal of Disaster Risk Sci.*, 6, 1-7.

Burton, I. (2010) Forensic Disaster Investigations in Depth: A New Case Study Model, *Environment: Science and Policy for Sustainable Development*, 52(5), 36-41.

Burton, I. (2015) The forensic investigation of root causes and the post-2015 framework for disaster risk reduction. *Int. Journal of Disaster Risk Reduction*, 12, 1–2.

Button, G., and K. Peterson (2009) Participatory action research: community partnership with social and physical scientists, pp. 209-17 in: Crate, S.A. and M. Nuttall (eds.) *Anthropology and Climate Change: from encounters to actions*. Walnut Creek, CA: Left Coast Press.

Cannon, T., and D. Müller-Mahn (2010) Vulnerability, Resilience and Development Discourses in Context of Climate Change. *Natural Hazards*, 55(3), 621-35.

Cartlidge, E. (2015) Italy's Supreme Court Clears L'Aquila Earthquake Scientists for Good," <http://news.sciencemag.org/europe/2015/11/italy-s-supreme-court-clears-l-aquila-earthquake-scientists-good>

Chavla, Leah (2010) Has the US Rice Export Policy Condemned Haiti to Poverty? *Hunger Notes*, April 23.

Collins, S.L., S.R. Carpenter, S.M. Swinton, D.E. Orenstein, D.L. Childers, T.L. Gragson, N.B. Grimm, J.M. Grove, S.L. Harlan, J.P. Kaye, A.K. Knapp, G.P. Kofinas, J.J. Magnuson, W.H. McDowell, J.M. Melack, L.A. Ogden, G.P. Robertson, M.D. Smith and A.C. Whitmer (2011) An integrated conceptual framework for long-term social-ecological research. *Frontiers in Ecology and the Environment*, 9 (6), 351–7. <http://dx.doi.org/10.1890/100068>

Cutter, S.L., A. Frasier, J. Birkmann, T. Blatgen, M. Witting, T. Huang, W.S. Li, I. Burton, A. Oliver-Smith, A. Lavell and I. Alcántara-Ayala (2015a) The FORIN project: understanding the causes of disasters. Beijing: Integrated Research on Disaster Risk, IRDR. (<http://www.irdrinternational.org/2015/03/09/forin-project>)

Cutter, S.L., A. Ismail-Zadeh, I. Alcántara-Ayala, O. Altan, D.N. Baker, S. Briceño, H. Gupta, A. Holloway, D. Johnston, G.A. McBean, Y. Ogawa, D. Paton, E. Porio, R.K. Silbereisen, K. Takeuchi, G.B. Valsecchi, C. Vogel and G. Wu (2015b) Global risks: pool knowledge to stem losses from disasters. *Nature*, 522 (7556), 277-9.

Dupuy, A. (1989) *Haiti in the World Economy: Race, Class and Underdevelopment since 1700*. Boulder: Westview Press.

Etkin, D. (2015) *Disaster Theory: An Interdisciplinary Approach to Concepts and Causes*, Waltham, MA: Butterworth-Heinemann (Elsevier).

Felli, R. and N. Castree (2012) Neoliberalising adaptation to environmental change: foresight or foreclosure? *Environment and Planning*, A 44.

Fry, G. L. (2001) Multifunctional landscapes—towards transdisciplinary research. *Landscape and urban planning*, 57(3), 159-68.

Fuller, S. (2001) Strategies of knowledge integration. In: M. K. Tolba (ed.) *Our Fragile World: Challenges, Opportunities for Sustainable Development*. Oxford: EOLSS Publishers for UNESCO, p. 1215-28.

Gibbons, M. (1999) Science's new social contract with society. *Nature* 402, C81-C84.

Gibbs, T. (1996) The role of independent design and building checking agencies in disaster prevention. In: *Stop Disasters IV* (30), 18-19.

Gotangco, C. K., G. Narisma, J. Wong, N.D. Marquez, R. Clarete, E. Porio, F. Cruz, E. Gozo, C. Vicente, P. Sanchez, J. Sescon, P.A. Tuaño, J.P. Dalupang, E. Roque and J. C. See. (2014) Harmonizing FORIN for Climate Change Adaptation and Disaster Risk Management to Develop Multi-sectoral Narratives for Metro Manila, Volume 2: Compendium of Multi-Sectoral Narratives of Metro Manila. IRDR International Centre of Excellence, Taipei Technical Report No. 3. (<http://www.start.org/download/2014/ai-irdr/gotangco-forin-projectreport.pdf>)

Hadorn, G., S. Biber-Klemm, W. Grossenbacher-Mansuy, H. Hoffmann-Riem, D. Joye, C. Pohl, U. Wiesmann and E. Zemp (2008) The Emergence of Transdisciplinarity as a Form of Research. In: Hadorn, G.H., H. Hoffmann-Riem, S. Biber-Klemm, W. Grossenbacher-Mansuy, D. Joye, C. Pohl, U. Wiesmann and E. Zemp (eds.) *The Handbook of Transdisciplinary Research*. Zurich: Springer-Verlag, pp 19-39.

Hewitt, K. (1983) *Interpretations of Calamity*, Boston: Allen and Unwin.

IRDR (2011) *Forensic investigations of disasters: The FORIN Project* (IRDR FORIN Publication No. 1). Beijing: Integrated Research on Disaster Risk.

IRDR (2013) *Integrated Research on Disaster Risk: Strategic Plan 2013-17*. Beijing: Integrated Research on Disaster Risk. (<http://www.irdrinternational.org/wp-content/uploads/2013/04/IRDR-Strategic-Plan-2013-2017.pdf>)

Kelman, I. and J.C. Gaillard (2010) Embedding Climate Change Adaptation within Disaster Risk Reduction. Chapter 2, pp. 23-46, in: Shaw, R., J.M. Pulhin and J.J. Pereira (eds.), *Climate Change Adaptation and Disaster Risk Reduction: Issues and Challenges. Community, Environment and Disaster Risk Management*. Bingley, UK: Emerald Group Publishing Ltd.

Khagram, S. (2004) *Dams and Development: Transnational Struggles for Water and Power*. Ithaca: Cornell University Press.

Lavell, A. (2011) Unpacking Climate Change Adaptation and Disaster Risk Management: Searching for the Links and the Differences: A Conceptual and Epistemological Critique and Proposal. IUCN-FLACSO Project on Climate Change Adaptation and Disaster Risk Reduction.

Lavell, A. and A. Maskrey (2014) The future of disaster risk management. *Environmental Hazards* 13 (4).

Lundahl, M. (2004) *Sources of growth in the Haitian economy*. Inter-American Development Bank, Regional Operations Department II.

Maskrey, A. (1994) *A world safe from natural disasters: the journey of Latin America and the Caribbean*. Washington DC: Pan-American Health Organization

Maskrey, A. (ed.) (1996) *Terremotos en el trópico húmedo: La gestión de los desastres del Alto Mayo, Peru (1990, 1992), Limon, Costa Rica (1991), y Atrato Medio, Colombia (1992)*. Red de Estudios Sociales en Prevención de Desastres en América Latina. Santafé de Bogotá, Colombia: La Red; Rugby, UK: ITDG Publishing.

Mitchell, J. K. (ed.) (1999) *Crucibles of Hazard: mega-cities and disasters in transition*. Tokyo: United Nations University Press.

NSO (2010) *Population by Region*. National Statistics Office (of the Philippines). Available from: http://www.nscb.gov.ph/secstat/d_popn.asp.

O'Brien, K. (2012) Global Environmental Change II: From Adaptation to Deliberate Transformation. *Progress in Human Geography*, 36(5), 667-76.

Oliver-Smith, A. (2004) Theorizing Vulnerability in a Globalized World: A Political Ecological Perspective. In: Bankoff, G., G. Frerks, and D. Hilhorst (eds.) *Mapping Vulnerability: Disasters, Development and People*. London: Earthscan. pp. 10-24.

Oliver-Smith, A. (2013) A matter of choice, *Int. Journal of Disaster Risk Reduction*, 3(1), 1-3.

PAGASA (2011) *Climate Change in the Philippines*. Philippine Atmospheric, Geophysical and Astronomical Services Administration. Available from: <http://kidlat.pagasa.dost.gov.ph/index.php/climate-change-in-the-philippines>.

Pelling, M. (2011) *Adaptation to climate change: from resilience to transformation*. London and New York: Routledge.

Perry, S., D. Cox, L. Jones, R. Bernknopf, J. Goltz, K. Hudnut, D. Mileti, D. Ponti, K. Porter, M. Reichle, H. Seligson, K. Shoaf, J. Treiman, and A. Wein (2008) *The ShakeOut Earthquake Scenario—A Story That Southern Californians Are Writing*. Circular 1324 jointly published as California Geological Survey Special Report 207 Washington DC: US Department of the Interior, US Geological Survey.

Pohl, C. (2008) From science to policy through transdisciplinary research. *Environmental Science & Policy*, 11(1), 46–53.

Rudel, T.K. (2007) Changing agents of deforestation: From state-initiated to enterprise-driven processes, 1970-2000. *Land Policy*, 24(1), 35-41.

Scolobig, A., R. Mechler, N. Komendantova, L. Wei, D. Schröter and A. Patt (2014) The Co-Production of Scientific Advice and Decision Making under Uncertainty: Lessons from the 2009 L'Aquila Earthquake, Italy. *Planet@Risk*, 2(2), 71-76, Davos: Global Risk Forum GRF Davos.

Stokols, D. (2006) Toward a science of transdisciplinary action research, *American Journal of Community Psychology*, 38, 63-77.

Stonich, S. (1992) *I Am Destroying the Land*. Boulder: Westview Press.

Tress, B., G. Tress and G. Fry (2005) Integrative studies on rural landscapes: policy expectations and research practice. *Landscape and Urban Planning*, 70(1/2), 177-91.

UNISDR (2005) *Hyogo Framework for Action (HFA): Building the resilience of nations and communities to disasters*. Geneva: United Nations International Strategy on Disaster Reduction. (http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf).

UNISDR (2009) *Global Assessment Report on Disaster Risk Reduction 2009*. Geneva: United Nations International Strategy on Disaster Reduction.

UNISDR (2011) *Global Assessment Report on Disaster Risk Reduction 2011*. Geneva: United Nations International Strategy on Disaster Reduction.

UNISDR (2015a) *Global Assessment Report on Disaster Risk Reduction 2015*. Geneva: United Nations International Strategy on Disaster Reduction.

UNISDR (2015b) *Sendai Framework for Disaster Risk Reduction 2015-2030*. Geneva: United Nations International Strategy on Disaster Reduction. (http://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf).

Vermeiren, J.C. (2000) Risk transfer and finance experience in the Caribbean. In: Kreimer, A. and M. Arnold (eds.) *Managing disaster risk in emerging economies*. Washington DC: World Bank.

White, G.F., R.W. Kates and I. Burton (2001) Knowing better and losing even more: the use of knowledge in hazards management. *Global Environmental Change Part B: Environmental Hazards*, 3 (3/4) Sept.–Dec. 2001, 81–92.

Wisner, B., P. O'Keefe and K. Westgate (1977) Global systems and local disasters: the untapped power of people's science. *Disasters*, 1 (1), 47-57.

Wisner, B., P. Blaikie, T. Cannon and I. Davis (2004) *At Risk: Natural Hazards, People's Vulnerability and Disasters* (2nd ed.) New York: Routledge

Wisner, B., J.C. Gaillard and I. Kelman (2011) *Routledge Handbook of Hazards and Disaster Risk Reduction*. New York: Routledge.

Acronyms used in text

CCA	Climate change adaptation
DRM	Disaster risk management
DRR	Disaster risk reduction
FAO	Food and Agriculture Organization of the United Nations
FORIN	Forensic investigations of disasters
GAR	(UNISDR) Global Assessment Report
GEM	Global Earthquake Model
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GNDR	Global Network of Civil Society Organizations for Disaster Reduction
ICSU	International Council for Science
ILO	International Labour Organization
IMF	International Monetary Fund
IRDR	Integrated Research on Disaster Risk
ISSC	International Social Science Council
RADIX	Radical Interpretations of Disasters
RLA	Retrospective longitudinal analysis
PLA	Projective longitudinal analysis
STAG	Scientific and Technical Advisory Group (of UNISDR)
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organization
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations Office for Disaster Risk Reduction
USAID	United States Agency for International Development
WHO	World Health Organization

