

Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation

Frank Thomalla, Tom Downing, Erika Spanger-Siegfried, Guoyi Han and Johan Rockström¹

Over the past few decades, four distinct and largely independent research and policy communities—disaster risk reduction, climate change adaptation, environmental management and poverty reduction—have been actively engaged in reducing socio-economic vulnerability to natural hazards. However, despite the significant efforts of these communities, the vulnerability of many individuals and communities to natural hazards continues to increase considerably. In particular, it is hydro-meteorological hazards that affect an increasing number of people and cause increasingly large economic losses. Arising from the realisation that these four communities have been largely working in isolation and enjoyed only limited success in reducing vulnerability, there is an emerging perceived need to strengthen significantly collaboration and to facilitate learning and information exchange between them. This article examines key communalities and differences between the climate change adaptation and disaster risk reduction communities, and proposes three exercises that would help to structure a multi-community dialogue and learning process.

Keywords: climate change adaptation, disaster risk reduction, natural hazards, resilience, vulnerability

Introduction

Over the past few decades, the challenge of reducing socio-economic vulnerability to climate and weather-related hazards has been taken on by four distinct research and policy communities:

- disaster risk reduction;
- climate change adaptation;
- environmental management; and
- poverty reduction.

These communities have largely developed and operated independently from each other. Calls for better collaboration are increasing and there is an emerging perceived need to learn from one another and to identify opportunities to develop a joint agenda.

Based on a review of the literature and our own experiences, we discuss some of the key communalities and differences between two of these communities, climate change adaptation and disaster risk reduction (see Box 1), in relation to five provocative statements. Following this discussion, we propose three exercises that would help structure a multi-community dialogue and learning process. The broader context of planning

Box 1 General characterisation of the climate change adaptation and disaster risk reduction communities

Climate change adaptation	Disaster risk reduction
Approach	
• risk management • strong scientific basis • environmental science perspective • highly interdisciplinary • vulnerability perspective • long-term perspective • global scale • top-down	• risk management • engineering and natural science basis • traditional focus on event and exposure and on technological solutions • shift from response and recovery to awareness and preparedness • short term but increasingly longer term • local scale • community-based
Organisations and institutions	
• United Nations Framework Convention on Climate Change (UNFCCC) • Intergovernmental Panel on Climate Change (IPCC) • Academic research • National environment and energy authorities	• United Nations (UN) • ProVention Consortium (World Bank) • International Federation of Red Cross and Red Crescent Societies (IFRC) • International, national and local civil society organisations • National civil defence authorities
International conferences	
• Conference of the Parties (COP)	• World Conference on Disaster Reduction
Assessment	
• IPCC Assessment Reports	• IFRC Vulnerability and Capacity Assessment (VCA) • IFRC World Disasters Report • International disasters databases: * EM-DAT * NatCatSERVICE (Munich Re) * Sigma (Swiss Re)
Strategies	
• National communications to the UNFCCC • National Adaptation Plans of Action (NAPA) for Least Developed Countries	• UN International Decade for Natural Disaster Reduction (IDNDR) • Yokohama Strategy and Plan of Action for a Safer World • UN International Strategy for Disaster Reduction (ISDR) • Hyogo Framework for Action 2005–15
Funding	
• Special Climate Change Fund • Least Developed Countries Fund • Kyoto Protocol Adaptation Fund	• National civil defence/emergency response • International humanitarian funding (for instance, UN Office for the Coordination of Humanitarian Affairs (OCHA)) • Multilateral banks • Bilateral aid

Note: It is a simplification to refer to such policy research networks as communities. The International Work Conference on Climate Change and Disaster Risk Reduction, organised by the Red Cross/Red Crescent Centre for Climate Change and Disaster Preparedness in The Hague, Netherlands, in June 2005, reinforced the extent to which these networks share many of the same concerns and methodologies, and are themselves quite diverse and difficult to characterise. However, the workshop also reinforced the sense that the two groups have misconceptions about each other's concepts, aims and applications.

and development, drawing on the experiences of communities concerned with environmental management and poverty reduction, underpins climate risk management.

Both communities have failed to reduce vulnerability

Natural hazards and climate change present considerable challenges for poverty reduction and sustainable development because they affect a wide range of social and ecological systems (IPCC, 2001). In many of the world's developing and least developed countries extreme events occur so frequently that they tend to overwhelm their coping capacity and hamper long-term progress because attention and resources desperately needed for poverty reduction and economic development are diverted to disaster relief and reconstruction. Many societies today are still ill-prepared to cope with extreme events and climate change threatens to undermine many decades of effort in the spheres of development assistance, poverty reduction and disaster risk management.

Even though significant achievements have been made to reduce the loss of life resulting from natural hazards, their impacts remain considerable. Statistics published by the International Disaster Database (EM-DAT) (<http://www.em-dat.net>) and the International Federation of the Red Cross and Red Crescent Societies (IFRC) in the *World Disasters Report* (IFRC, 2002; 2003; 2004) reveal that the number of people killed by natural disasters is still high and that the number of people affected and associated economic losses have increased substantially since the 1970s. The statistics also show that 90% of all people killed by disasters between 1970 and 1999 were victims of climate-related hazards. As the world's climate changes, climate variability and climate-related extremes are likely to become even more prevalent. Some regions are expected to experience more extreme events, such as heatwaves and cold waves, high levels of precipitation, extreme floods, droughts, tropical cyclones and storms (IPCC, 2001).

Both communities have been working in isolation

Many of the differences between the climate change and disaster management communities are related to differences in the perception of the nature and timescale of the threat. Disasters caused by extreme environmental conditions tend to be fairly distinct in time and space (except for slow-onset or creeping disasters like desertification) and present a situation where the immediate impacts tend to overwhelm the capabilities of the affected population and rapid responses are required. For many hazards there exists considerable knowledge and certainty about the event characteristics (type of hazard, geographical areas at risk, frequency, magnitude, probability of recurrence), as well as exposure characteristics (geology, elevation, number of people at risk), based on historical experiences. Most impacts of climate change, meanwhile, are much more difficult to perceive and to measure, since the changes in average climatic conditions and climatic variability occur over a long period and because a wide range of simultaneous environmental and socio-economic processes ameliorates vulnerabilities.

The disaster risk management community focuses on a vast assortment of natural and man-made hazards, of which climate-related hazards only represent one particular area. At the forefront of concern is vulnerability to current hazards and extremes. Disaster risk management has traditionally involved natural scientists and civil engineers and has concentrated on short-term single stressor responses through structural measures, such as flood embankments, community shelters and more resistant buildings, which were intended to control natural processes in a way that would either modify the threat or provide physical protection with regard to lives, property and critical infrastructure. There has been a strong emphasis on developing capabilities for hazard forecasting and providing immediate humanitarian relief once a disaster struck. Over the past decade or so, however, the UN International Decade for Natural Disaster Reduction (IDNDR), the 1994 Yokohama Conference and the 2004 World Conference on Disaster Reduction (WCDR) have contributed to a significant shift in disaster management towards a more comprehensive understanding of the underlying causes of hazard vulnerability and towards the development of a forward-looking and longer-term strategy for anticipating and managing risk.

The climate change community has a strong environmentalist approach and consists of a highly interdisciplinary group of people, including biological and biophysical scientists, social scientists and economists. Early work focused mainly on changes in extreme conditions, longer-term changes in climate (up to 2100) and the potential consequences of climate change under different scenarios of emissions stabilisation. The deep uncertainties of socio-economic scenarios and global circulation models (GCMs) in relation to the frequency, magnitude and spatial distribution of future climatic hazards result in particularly poor knowledge of impacts on the national, sub-national and local level. Efforts to advance climate change adaptation have increased significantly since the first meeting of the Conference of the Parties (COP) to the United Framework Convention on Climate Change (UNFCCC) in 1995, arising from the realisation that the reduction in emissions would be too little too late and that it was therefore necessary to anticipate the potential impacts of climate change and to enhance the adaptive capacities of the populations at risk. At COP 1, the decision for a three-stage approach to adaptation (planning, preparation, and facilitation) was taken and a funding mechanism was provided through the Global Environment Facility (GEF) to enable countries to prepare their first national communications. Since then a large number of impact, vulnerability and adaptation assessments have been carried out or supported by the World Bank, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) and non-governmental organisations (NGOs) and independent research entities. Most recently, much greater attention has been paid to understanding and addressing existing vulnerabilities to current climate variability and climatic extremes.

The institutional frameworks, political processes, funding mechanisms, information exchange fora and practitioner communities have developed independently and remain largely separate to date (Box 1). While disaster management is frequently the responsibility of national civil defence offices, climate change experts can typically be found in environment or energy departments and in academic institutions (Sperling and Szekeley, 2005).

Scale and the underlying causes of vulnerability have been ignored

We know from the disaster statistics that natural hazard impacts are unevenly distributed around the world. Certain countries, regions and areas are more vulnerable than others because of their geographic location, climate, geology and their capacity to cope with extreme conditions. Developing countries are particularly affected by climate change because climate-sensitive sectors, such as agriculture and fisheries, tend to be very important from an economic standpoint and because they have limited human, institutional and financial capacity to anticipate and respond to the effects of climate change (IPCC, 2001).

Climate-related hazards and climate change affect a wide range of ecological systems, including forests, grasslands, wetlands, rivers, lakes and marine environments, and human systems, including agriculture, water resources, coastal resources, health, financial institutions and settlements (IPCC, 2001). Complex interactions of social, economic and environmental factors operating on different spatial and temporal scales give rise to vulnerability as they affect the ability of individuals and communities to prepare for, cope with, and recover from, disasters. Population density and growth, unplanned urbanisation, inappropriate land use, environmental mismanagement and loss of biodiversity, social injustice, poverty and short-term economic vision are important determinants of vulnerability (ISDR, 2002; for an earlier statement on social vulnerability, see Bohle et al., 1994). Many poor and marginalised people are directly dependent on ecosystem services for their livelihood activities and are therefore particularly vulnerable to changes in environmental conditions and factors that may limit their access to such resources (Task Force on Climate Change, Vulnerable Communities and Adaptation, 2003). In addition to access to natural resources, people's vulnerability to climate-related hazards is determined by their access to social and financial resources, information and technology, as well as by the effectiveness of institutions. Those most vulnerable to natural hazards tend to be particular social groups (including women, the elderly, children, ethnic and religious minorities, single-headed households), people engaged in marginal livelihoods, socially excluded groups (such as 'illegal' settlers and others whose rights and claims to resources are not officially recognised) and those with inadequate access to economic (credit, welfare) and social (networks, information, relationships) capital.

So far, many efforts by both communities have concentrated on reducing the vulnerability of specific sectors to a particular hazard at the local scale. Disaster risk management addresses some important scale processes by sharing the burden of disaster impacts through insurance mechanisms (Mechler and Pflug, 2002).

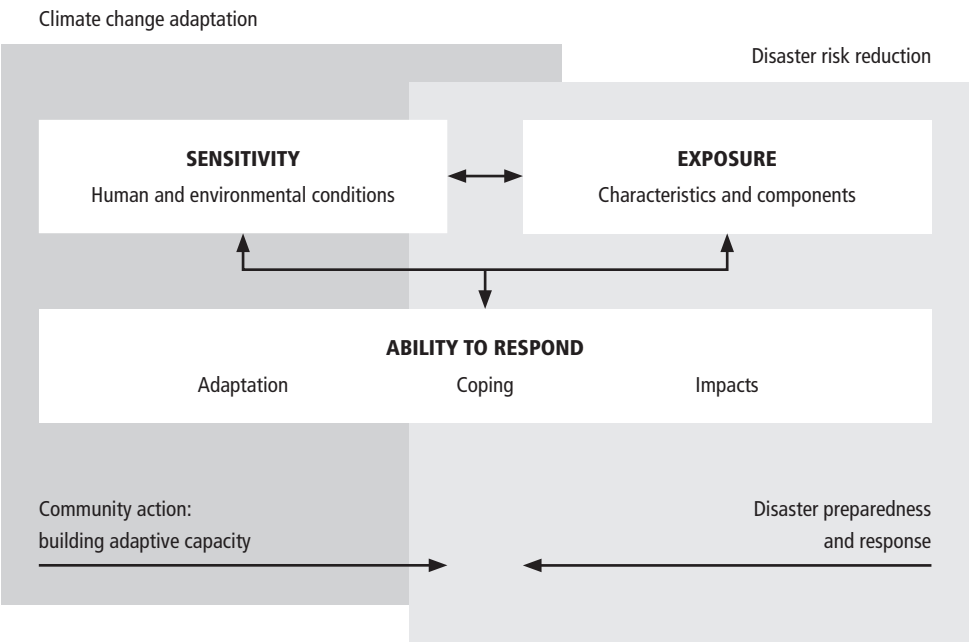
Climate change adaptation has largely focused on how individual actors and sectors may be able to adapt to shifting environmental conditions (for example, change of crops) rather than tackling the wider structural constraints that determine vulnerability.

Recent research on the causal structures of current patterns of human vulnerability to environmental change (Kasperson and Kasperson, 2001; Turner et al., 2003; Pelling, 2003) has improved our understanding of how human agency and socio-political structures interact with physical systems in creating hazardous situations. The multi-disciplinary vulnerability framework jointly developed by researchers at the Stockholm

Environment Institute (SEI) and Clark University in the US illustrates the complexity of, and interactions involved in, vulnerability analysis, drawing attention to how multiple socio-political and physical processes operating at different spatial and temporal scales produce vulnerability within the coupled human–environment system (Turner et al., 2003). Fundamental to this conceptualisation of vulnerability is the distinction between three major components of vulnerability (exposure, sensitivity and resilience), the factors that contribute to each dimension of vulnerability and the linkages between them. Figure 1 has been adapted from this framework and relates the traditional foci of the climate change adaptation and disaster risk communities to the three components of vulnerability identified by Turner et al. (2003) (for simplification we have renamed ‘resilience’ the ‘ability to respond’).

The above conceptual framework (Figure 1) as well as the evolving debate within and between the different communities point up increasing recognition of the fact that, in order to reduce vulnerability to extreme natural phenomena successfully, there needs to be clear understanding of who is most vulnerable to the impacts and how the interactions between nature and society shape the underlying factors that contribute to vulnerability.

Figure 1 Traditional conceptual and operational foci of the climate change adaptation and disaster risk management communities



Note: Diagram adapted from the vulnerability framework developed by Turner et al., 2003.

Fact or myth?

Effective adaptation requires accurate prediction

Disaster practitioners have focused largely on a warning/response/relief model where technological advances in climate monitoring and short-term forecasting are linked to effective dissemination of hazard information and responses that at least save lives. The aftermath of the December 2004 tsunami saw, for instance, competing bids to install a regional early warning system. Of course, land use regulation and preparedness are also in the 'toolkit', but are more difficult to implement.

Within the climate change adaptation community a common assertion is that an improvement in our ability to predict the magnitude and frequency of severe events will enable us to provide more effective adaptation strategies. For this reason, there is a strong emphasis on developing hazard forecasting and early warning systems. An alternative view is that if we could cope better with present climatic risks (possibly based on improved current forecasts), we could significantly reduce the impacts of future climate change. While most people would agree with these two statements, they have not really been tested and it is not clear how this information can be used in reducing social vulnerability (see Bharwani et al., 2005).

Baseline assessments of the dynamics of vulnerability are still lacking

Both communities (and many others) have emphasised the construction of a baseline vulnerability assessment as a procedural and technical means to target urgent adaptation (for example, in the National Adaptation Programmes of Action), to identify critical relief needs (for instance, the World Food Programme) and for project planning (including various forms of rapid appraisal adopted by donors and NGOs) (see Box 2). However, there is little formal evaluation of vulnerability assessment techniques (see, though, Stephen and Downing, 2001) and indifferent experience as to whether the baselines actually inform decision-making.

Perhaps more salient for climate change adaptation is the focus on snapshots of indicators and status rather than the dynamics of individuals, groups and societies vis-à-vis their perception of risk, evaluation of alternative actions and the evolution of complex behaviour in response to multiples of goals and stresses. Most of the widely distributed protocols still concentrate on what is exposed instead of understanding the processes and dynamics of exposure and responses.

What are the similarities and areas of convergence?

Natural hazards and climate change impacts affect numerous natural, economic, political and social activities and processes. Hence, these challenges need to be addressed in a holistic and integrated manner at all scales and on all political levels and involve all sectors of society. The following points have been recognised as key areas of convergence

Box 2 Baseline Vulnerability Protocols

Common elements of Baseline Vulnerability Protocols include:

Who and what are the exposure units? The baseline vulnerability assessment needs to define the entities that integrate the analysis. The choice of exposure units should be based on common characteristics of their vulnerability. For example, livelihoods are a meta-level of description of an economic system, in between the household and national accounts. They would be appropriate for a generalised national description of vulnerability (as in the World Food Programme's food needs methodology). Alternatively, if the main climatic hazard is flooding, a spatially explicit analysis at a high resolution might need to be combined with spatial demographic data to define relative risk and adaptive capacity related to the physical hazard, differences in income, rates of insurance coverage and social networks.

What hazards and stresses are they exposed to? A simple matrix of the exposure units (such as livelihoods) and climatic hazards provides a rapid screening tool with which to identify the relative levels of risk (and gaps in knowledge).

How resilient are the exposure units to current stresses? The other side of vulnerability is adaptive capacity—the ability to absorb stresses and disasters and avoid unacceptable consequences. Resilience is related to the ramifications of stresses and hazards (from health to livelihood; from immediate to long term; from individual to societal).

Are the exposure units and stresses changing? In what ways? The dynamic nature of vulnerability makes predictions of future conditions tenuous. The sense in which vulnerability changes quickly over time is a key difference between disaster response assessments (where to intervene following a disaster) and managing climatic risks over the longer term (where to invest resources to reduce the toll of future disasters).

What is a core set of indicators? The identification of exposure units and hazards leads to the selection of indicators that target specific conditions of vulnerability. It is rare that one indicator will be relevant (at least to the same degree) for many people at risk and hazards.

Note: See <http://www.VulnerabilityNet.org> for vulnerability assessment training material, protocols and documents.

(Sperling and Szekely, 2005; Task Force on Climate Change, Vulnerable Communities and Adaptation, 2003; World Bank et. al, 2003; IATF Working Group on Climate Change and Disaster Reduction, 2004):

- Both communities have developed a large range of analytical tools and methodologies based on risk management approaches to assess risk and vulnerability and to identify opportunities for action.
- The disaster risk management community is increasingly adopting a more anticipatory and forward-looking approach, bringing it in-line with the longer-term perspective of the climate change community on future vulnerabilities.
- Climate change adaptation increasingly places emphasis on improving the capacity of governments and communities to address existing vulnerabilities to current climate variability and climatic extremes, bringing it within the remit of the disaster risk management community.
- For both communities poverty reduction is an essential component of reducing vulnerability to natural hazards and climate change because poverty is both a condition and determinant of vulnerability.
- Both communities increasingly recognise the importance of sustainable resource management and biodiversity for ecological resilience and livelihood security.
- Climate change adaptation and disaster risk management both need to be linked (mainstreamed) with sectoral activities and development processes.

Conclusion: developing a multi-community dialogue and learning process

One of the main challenges in addressing vulnerability to environmental extremes lies in the integration of many different types of information, knowledge and experiences, and in the development of collaborative projects involving scientists, practitioners and policymakers from communities that are, as we have seen, in many ways very distinct. We propose three experiments:

1. A resilience/vulnerability dialogue. Resilience is a dominant theme in natural resources management over the timescales relevant to climate change adaptation, while vulnerability has roots in disaster planning at a shorter (and often more local) scale. Placing this dialogue in the context of disaster–climate change adaptation would provide a focus for what might be seen as an overly academic debate.
2. Identifying regions of large-scale vulnerability. Vulnerability and adaptive capacity are unevenly distributed, both among regions and populations. A relatively small set of regions are of high interest with regard to understanding the most critical needs for adaptation to climate change—the Sahel, mega-cities in deltas, and polar regions come to mind. A comparative set of regional studies would seek to integrate vulnerability to present and future hazards, evaluating the potential for unmitigated disaster. The experience should help to sharpen vulnerability assessment protocols and to evaluate adaptation that integrates the present and future risks and opportunities.
3. Meta analysis of vulnerability. Case studies of vulnerability should be evaluated using a formal methodology to identify common and unique characteristics and effective interventions. By including present risks and future climate change, it may be possible to disentangle the relative importance of predictions of future climate change. A framework based on the value of information would be essential.

Each of these experiments is under way to a greater or lesser extent. Often relatively small groups are involved, sometimes on the margins of other assessments. A concerted effort, particularly to engage new researchers and sustain prolonged dialogues with stakeholders, is warranted.

Acknowledgements

Financial support for this paper was provided by the SEI's Programme on Poverty and Vulnerability (<http://www.sei.se/risk/poverty.html>), which is funded by the Swedish International Development Cooperation Agency (Sida).

Correspondence

Frank Thomalla, Stockholm Environment Institute, Lilla Nygatan 1, Box 2142, 103 14 Stockholm, Sweden. E-mail: frank.thomalla@sei.se.

Endnotes

- ¹ Frank Thomalla, Tom Downing, Guoyi Han and Johan Rockström represent the Stockholm Environment Institute (SEI), and Erika Spanger-Siegfried represents the Union of Concerned Scientists.

References

- Bharwani, S. et al. (2005) 'Multi-agent Modelling of Climate Outlooks and Food Security on a Community Garden Scheme in Limpopo, South Africa'. *Philosophical Transactions of the Royal Society*. B 360.
- Bohle, H.G., T.E. Downing and M.J. Watts (1994) 'Climate Change and Social Vulnerability: The Sociology and Geography of Food Insecurity'. *Global Environmental Change*. 4(1). pp. 37–48.
- IATF (Inter-Agency Task Force on Disaster Reduction) Working Group on Climate Change and Disaster Reduction (2004) *Draft Report of the Tenth Session, 7–8 October 2004, Geneva, Switzerland*.
- IFRC (International Federation of Red Cross Red Crescent Societies) (2002) *World Disasters Report 2002*. IFRC, Geneva.
- IFRC (2003) *World Disasters Report 2003*. IFRC, Geneva.
- IFRC (2004) *World Disasters Report 2004*. IFRC, Geneva.
- IPCC (Intergovernmental Panel on Climate Change) (2001) *Climate Change 2001: IPCC Third Assessment Report. Working Group II: Impacts, Adaptation and Vulnerability*. Cambridge University Press, Cambridge.
- ISDR (United Nations International Strategy for Disaster Reduction) (2002) *Living with Risk. A Global Review of Disaster Reduction Initiatives*. ISDR, Geneva.
- Kasperson, J.X. and R.E. Kasperson (2001) *International Workshop on Vulnerability and Global Environmental Change, 17–19 May 2001: A Workshop Summary*. Stockholm Environment Institute, Stockholm.
- Mechler, R. and G. Pflug (2002) *The IIASA Model for Evaluating Ex-ante Risk Management: Case Study Honduras*. Report to the Inter-American Development Bank, Washington, D.C.
- Pelling, M. (ed.) (2003) *Natural Disasters and Development in a Globalizing World*. Routledge, London.
- Sperling, F. and F. Szekely (2005) *Disaster Risk Management in a Changing Climate*. Informal discussion paper prepared for the World Conference on Disaster Reduction in Kobe, Japan, 18–22 January 2005, on behalf of the Vulnerability and Adaptation Resource Group (VARG), Washington, D.C.
- Stephen, L. and T.E. Downing (2001) 'Getting the Scale Right: A Comparison of Analytical Methods for Vulnerability Assessment and Household Level Targeting'. *Disasters*. 25(2). pp. 113–135.
- Task Force on Climate Change, Vulnerable Communities and Adaptation (2003) *Livelihoods and Climate Change*. International Institute for Sustainable Development, International Union for Conservation of Nature and Natural Resources and Stockholm Environment Institute.
- Turner, B.L. et al. (2003) 'A Framework for Vulnerability Analysis in Sustainability Science'. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*. 100(14). pp. 8074–8079.
- World Bank et al. (2003) *Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation*. World Bank, Washington, D.C.