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Research Brief

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Overview

This research is extracted from a book proposed for publication by United Nations University Press in 2006 that examines our vulnerability to hazards of natural origin, and explores the opportunities for adopting a pre-emptive rather than a reactive approach to natural disasters. The world may suddenly turn its attention to the suffering victims of catastrophes such as Hurricane Katrina and the Asian Tsunami, but by that time the disaster has already struck and we have failed to prepare for it. This document asks important questions about the very nature of vulnerability. How do we define vulnerability—does our definition relate to how susceptible we are before a disaster or how well we cope afterwards, or both? How can we measure vulnerability accurately, and how can we begin the process of making society—from local communities to the whole world—more disaster-resilient?

Research Brief written by
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UNU-EHS
Institute for Environment and Human Security

Danger need not spell disaster But how vulnerable are we?

Hurricane Katrina batters the southeast coast of the US, submerging New Orleans; a tsunami devastates South-East Asia; in China and Germany floods engulf cities, towns and villages; forests burn out of control in Portugal; droughts ravage countries in Africa … the whole world seems stricken by disasters, and the media shows the death, destruction and displacement caused by such catastrophic events. But focusing on disasters when they happen is not enough: we need to understand that disasters are the result of a complex relationship between a potentially damaging event and the general vulnerability of a society, its economy, and environment. And to reduce the risk of disasters happening in the future it is essential that we find out how vulnerable we are now.

Natural disasters should be seen as "un-natural disasters" (van Ginkel 2005). As Kofi Annan puts it, hazards only become disasters when people's lives and livelihoods are swept away (Annan 2003). If our ultimate aim is to develop a disaster-resilient society, the starting-point in the process of risk reduction should be to shift our focus away from quantifying natural hazards and towards identifying, assessing and ranking various vulnerabilities (Bogardi/Birkmann 2004). But the very concept of vulnerability is unclear, despite being recognised in various fields, such as disaster management, environmental change research and development studies. So what does vulnerability mean? And who is, and what is vulnerable—and vulnerable to what? Some approaches base vulnerability on loss of life: the number of people killed compared to the number of people exposed to natural hazards. But can we really measure our vulnerability now and in the future by analysing past events? If not, what are the alternatives?

To find a way of measuring vulnerability we need first to identify a framework for the concept, and decide whether that framework will cover mere susceptibility to disaster or also include how well a society, its economy, and its environment might cope in the event of a disaster. For example, current approaches to measuring risk and vulnerability often view urban agglomerations and megacities as hotspots of vulnerability, due to their high population density and the great number of people and values exposed. However, Cross (2001) argues that small cities and rural communities are more vulnerable to disasters than megacities, since megacities often have considerable resources for dealing with hazards and disasters, while such resources do not exist in smaller and rural communities. So is it possible to measure

Literature

Annan, K. (2003) "Message for the international day for disaster reduction 8 October 2003", available at http://www.unisdr.org/eng/public_aware/world_camp/2003/pa-camp03-sg-eng.htm

Bogardi, J. and Birkmann J. (2004) "Vulnerability Assessment: the First Step Towards Sustainable Risk Reduction", in: Malzahn, D.; Plapp, T. (Ed.) *Disaster and Society—From Hazard Assessment to Risk Reduction*, Logos Verlag Berlin, Berlin, pp. 75–82

Bohle, H.G. (2001) "Vulnerability and Criticality: Perspectives from Social Geography", in: *IHDP Update, Newsletter of the International Human Dimensions Programme on Global Environmental Change*, Bonn, pp. 1–7

Cardona, O.D. (1999) "Environmental Management and Disaster Prevention: Two Related Topics—A Holistic Risk Assessment and Management Approach", *Natural Disaster Management*, Ingleton J. (Ed.) IDNDR, Tudor Rose, IDNDR, London, UK.

Cardona, O.D. (2001) "Estimación Holística del Riesgo Sísmico Utilizando Sistemas Dinámicos Complejos", Technical University of Catalonia, Barcelona, available at http://www.desenredando.org/public/varios/2001/ehrisusd/index.html

Cross, J.A. (2001) "Megacities and Small Towns: Different Perspectives on Hazard Vulnerability", *Environmental Hazards*, 3 (2): 63–80.

Cutter, S.L., Boruff B.J. and Shirley W.L. (2003) "Social Vulnerability to Environmental Hazards", *Social Sciences Quarterly* 84 (2): 242–261

Millennium Ecosystem Assessment (2005) "Ecosystems and Human Well-being: Synthesis". Island Press, Washington, DC., available at http://www.albatrosedizioni.it/arcadiscienza/documenti.pdf/ecosystems_human_wellbeing.pdf

Turner, B.L., Kasperson R.E., Matson P.A., et al. (2003) "A framework for vulnerability analysis in sustainability science", *Proceedings of the National Academy of Sciences*, 100 (14): 8074–8079

UNDP (United Nations Development Programme) Bureau for Crisis Prevention and Recovery (2004) "Reducing Disaster Risk: a challenge for development. A global report" [Pelling, Mark; Maskrey, Andrew; Ruiz, Pablo; Hall, Lisa (editorial team)]. John S. Swift Co., USA, p. 146

United Nations (2005) "Hyogo Framework for Action 2005-2015, Building the Resilience of Nations and Communities to Disasters", available at http://www.unisdr.org/

United Nations/ISDR, (2004) "*Living with Risk; A Global Review of Disaster Reduction Initiatives*", UN Publications, Geneva, p. 429

van Ginkel, Hans (2005) "Introduction Speech Regarding the Expert Workshop Measuring Vulnerability" held on January 23–24 2005, Kobe, Japan; in: UNU-EHS Working Paper No. 1, Bonn, Germany

Vogel, C., O'Brien K. (2004) "Vulnerability and Global Environmental Change: Rhetoric and Reality" *AVISO—Information Bulletin on Global Environmental Change and Human Security*, Issue No. 13/2004.

vulnerability without also considering a society's coping capacities?

Other questions arise: does vulnerability include exposure, or is exposure related to the hazard? Should we focus mainly on human vulnerability, or is vulnerability better viewed within the broader human-environmental context, as Turner et al (2003) suggest. And, why should we measure vulnerability anyway? All these questions have been discussed already by the UNU-EHS Expert Working Group on Measuring Vulnerability and Coping Capacity to Hazards of Natural Origin, as well as in various UNU-EHS research projects. Their findings, and the numerous approaches to measuring vulnerability presented in the Expert Working Group, are to be published in a book by UNU Press early in 2006.

What Hyogo called a 'key activity'

The Hyogo Framework for Action, the final document of the World Conference on Disaster Reduction in Kobe (2005), defines the following as a "key activity":

> *"Develop systems of indicators of disaster risk and vulnerability at national and sub-national scales that will enable decision-makers to assess the impact of disasters on social, economic and environmental conditions and disseminate the results to decision makers, the public and populations at risk."*
> (United Nations 2005, Hyogo Framework for Action 2005–2015).

Although the international community does not give guidelines on how to develop indicators or indicator systems to assess risk and vulnerability, the Hyogo Framework calls for such indicators to be used in examining the impact of disasters on social, economic, and environmental conditions. Here, however, we are dealing with a paradox: we aim to measure vulnerability but we cannot define it precisely. And as no universal definition exists, various disciplines have developed different understandings of what vulnerability means. That said, a basic consensus has emerged, that the concept of vulnerability addresses the susceptibility of people and communities exposed, along with their social, economic, and cultural abilities to cope with the impacts of a hazardous event.

One of the best-known definitions of vulnerability was formulated by the International Strategy for Disaster Reduction (ISDR), which regards it as:

> *"The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards".* (ISDR 2004)

In contrast, UNDP defines vulnerability as:

> *"A human condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard".* (UNDP 2004: 11)

While the ISDR definition encompasses conditions that have an impact on a community's susceptibility, the UNDP definition sees vulnerability primarily as a human condition or process. UNDP's human-centred definition is reflected in their method of calculating the Disaster Risk Index. The contributions by M. Pelling and P. Peduzzi stress that, within the Disaster Risk Index, vulnerability—especially relative vulnerability—is calculated by dividing the number of people killed by the number of people exposed. This corresponds with the idea that vulnerability is primarily a human condition. Also the lack of appropriate data globally has restricted UNDP's attempts to establish a broader index.

Although human society is the main focus of the concepts of vulnerability, can human vulnerability be adequately characterised without considering the vulnerability of the "surrounding" eco-sphere. Vogel and O'Brien (2004) point out that vulnerability is

- *multi-dimensional and differential* (varies across physical space and among and within social groups)
- *scale-dependent* (with regard to time, space and units of analysis such as individual, household, region, system)
- *dynamic* (characteristics and driving forces of vulnerability change over time)

in terms of susceptibility alone, and as encompassing exposure, susceptibility and different response strategies. UNU-EHS proposes a conceptual framework—the BBC concept (Bogardi/Birkmann 2004, Cardona 1999/2001)—that views vulnerability as a link in the hazard-vulnerability-risk chain. It argues that vulnerability should be seen as a process and advocates proactive actions before risk manifests itself.

S. Schneiderbauer and D. Ehrlich introduce the idea of social levels of vulnerability. They say that "individual vulnerability" is not only determined by the individual alone, but is made

'We are dealing with a paradox: we aim to measure vulnerability but we cannot define it precisely'

In other words, vulnerability is much more than the likelihood of buildings collapsing and infrastructure being damaged. The concept of social vulnerability includes various themes, such as social inequalities regarding income, age or gender, as well as characteristics of communities and the built environment, such as level of urbanisation, growth rates, economic vitality, and so on (Cutter/Boruff/Shirley 2003).

The various concepts of vulnerability can be systematised as shown in Figure 1. There is a clear tendency for broadening the scope of the term's concept.

Before trying to work out how to measure vulnerability, scientific research should concentrate on the various existing conceptual frameworks and visions of vulnerability. The book examines these frameworks, introducing different schools of thought, such as the double structure of vulnerability by Bohle (Bohle 2001) and the vulnerability framework by Turner et al (2003). Vulnerability is seen both

up of a set of vulnerabilities linked to the different social levels an individual belongs to, such as household, country, cultural community. This important aspect of the debate needs to be developed.

Other theoretical aspects needing closer attention relate to the definition of indicators and criteria. Here the main point of interest lies in the "indicandum"—the characteristics of interest. In this context, indicators and criteria can be understood as signs, implying that they have to be based on or linked to goals. The lack of precise goals in the area of vulnerability reduction makes it difficult to develop tools to measure progress towards disaster-resilient societies.

Another important research task is to examine the practical application of tools to measure vulnerability. Approaches to measuring vulnerability should be relatively simple, under-standable and applicable to decision-making processes. They should fit into existing planning and decision-making

processes, such as emergency planning and risk-reduction strategies. This is still more the exception than the rule.

Global environmental change is also an issue to consider. Here, different conceptual approaches are discussed in the book. M. Kok, V. Narain, S. Wonink and J. Jaeger present an overview of different approaches to assessing human well-being from an environmental perspective, such as the vulnerability framework developed by Turner et al (2003) and the Millennium Ecosystem Assessment (2005). They outline the idea of archetypes of vulnerability, which will be used to illustrate ways and scenarios in which human well-being can be affected by environmental change.

Switch on your risk indicators and hazard lights

It would be impossible to include every approach to the measurement of vulnerability (there are over four million entries in Google). So it is best to examine selected representative approaches, and show their differences and similarities in order to understand the advantages and limitations of measuring vulnerability. The proposed book includes contributions from around 40 authors, and focuses on selected approaches on different scales: global, national, and local. Different conceptual frameworks and measuring structures are outlined. M. Pelling presents an overview of the three global risk-index projects: the Disaster Risk Index (DRI) of UNDP; the Americas Indexing Programme; and the Hotspots project. These show different methodologies and indicators to assess risk at a global level, and subsequent conclusions are drawn for sub-national and local vulnerability and risk assessment. Pelling emphasises that risk and vulnerability assessment at the sub-national and local level could help to identify causality. Local and sub-national approaches could provide a detailed characterisation of vulnerability and capacity in high-risk locations.

From the perspective of the developers of the three global index approaches, scientists involved also provide a contribution on specific aspects: P. Peduzzi on the DRI; O.D. Cardona on the System of Indicators developed for Americas; and M. Dilly on the Hotspots project. S. Greiving presents another international approach to measuring vulnerability, which aims to compare vulnerability and risk between countries at the sub-national level, especially relating to the European Union. He shows a multi-risk assessment approach and argues for assessing vulnerability using hazard-independent indicators. By contrast, J.C. Villagrán argues that vulnerability to natural disasters depends on the type of hazard. His approach measured the vulnerability of specific sectors, such as housing, industry, tourism, and

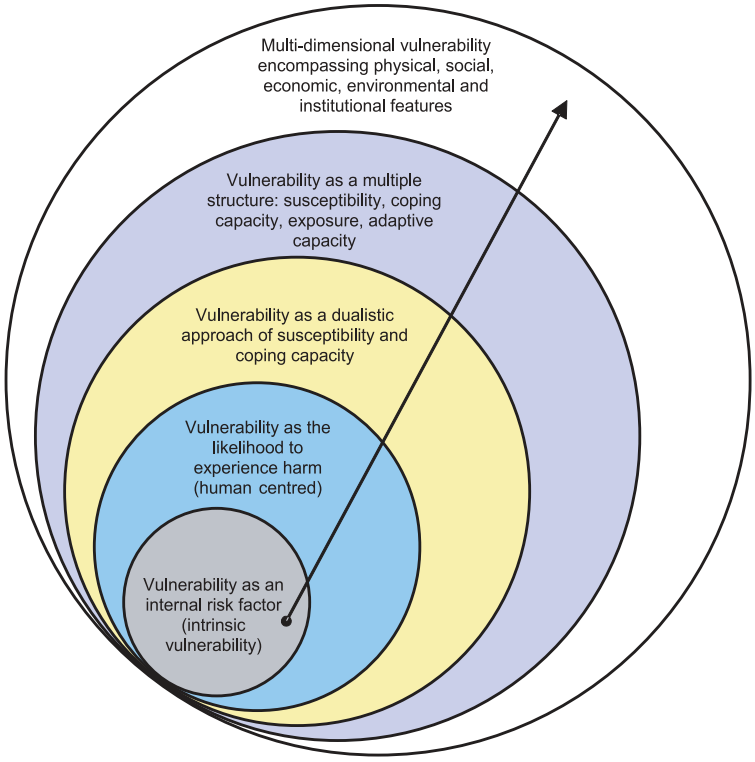

Figure 1: Key spheres of the concept of vulnerability
Source: author's figure

agriculture at the local level. R. Kiunsi and M. V. Minoris give an insight into a method of calculating a vulnerability index for different administrative levels in Tanzania. C. Bollin and R. Hidajat present a community-based risk index, tested in Indonesia. Although it is very difficult to use the same indicators for estimating the vulnerability of an individual, a local community or a population at the national level, E. Plate proposes a Human Security Index which would allow up-scaling and down-scaling. The Human Security Index idea is illustrated by the example of household income and living conditions. Plate argues that when an event strikes a household, its potential to recover depends on the proportion of the income above the minimum necessary to cover the family's subsistence. But if the damage and implied economic losses exceed this surplus, the household will face disaster.

'Approaches to measuring vulnerability should be simple, understandable and applicable to decision-making processes, such as emergency planning and risk-reduction strategies'

In contrast to purely quantitative approaches, B. Wisner examines the potential of qualitative and self-assessment-oriented measurement. He outlines the limitations of the "taxonomic approach" to assessing vulnerability, and shows that self-assessment to measure coping capacity and vulnerability is both participatory and provides proactive information. P. Billing and U. Madengruber, on the other hand, introduce an approach for measuring coping capacity in a quantitative fashion.

Awareness-raising and lesson-learning should be goals in themselves. If vulnerability assessment focuses purely on retrospective losses—such as fatalities and economic losses—it is hard to estimate whether the group, community or nation was able to learn lessons, and implement coping capacities and intervention tools to lessen the impact of similar events in the future. In this context, E. Krausmann and F. Mushtaq outline a lesson-learning methodology developed and tested by the Joint Research Center of the European Commission. They also highlight the pitfalls of having targets to assess and measure lessons learned, such as the subjectivity of actors involved and the difficulty of standardising practices. This research, based on experiences in western Europe, points to similar problems as those described by L. Lebel, E. Nikitina, V. Kotov and J. Manuta in their assessment of institutionalised capacities and practices as risk-reduction tools. Based on research in Vietnam, Thailand, Japan and Russia concerning institutionalised vulnerability, they conclude that plans and structures on paper might differ from action on the ground when a disaster occurs. R. Mechler, S. Hochheimer, J. Linnerooth-Bayer and G. Pflug developed a model to measure the financial vulnerability of the public sector with regard to hazards of natural origin.

In addition to the above, the book includes a reviewed glossary compiled by K. Thywissen which provides an in-depth overview of key terms in disaster-risk reduction. The following recommendations for future research are based on the various approaches to measuring vulnerability presented in the book:

Quantitative or qualitative?

- The decision whether to use qualitative or quantitative assessment tools depends both on the level of approach (global, national, sub-national or local) and on its focus (macro-economic, nation-state or individual groups at local level).
- Quantitative approaches based on global data are useful for measuring vulnerability with regard to experienced losses—such as mortality and economic loss (e.g. DRI, Hotspots)—but they are limited when it comes to measuring context-dependent and spatially specific characteristics.
- Qualitative approaches are limited in that they tend to lack continuous assessment; they are often used on a one-off basis.
- Research is needed into balancing qualitative and quantitative methods of measuring vulnerability and coping capacity. As B. Wisner says, it will be important that quantitative and qualitative, as well as reflective and action-oriented methodologies, are transferred into continuous monitoring and correction measures.
- A key issue for future research is to explore methods of improving the application of vulnerability and risk indicators into traditional planning and decision-making processes, such as emergency and disaster-mitigation plans, land-use plans and community-development strategies.

Can Katrina teach us anything?

- Future research should explore more precisely how to combine hazard-dependent and hazard-independent indicators in order to cover both these aspects of vulnerability. Hazard-independent approaches tend to focus on general and indirect aspects of vulnerability, such as income. Hazard-dependent indicators generally focus on potential direct hazard impacts, such as the possibility of a building being flooded, based on the assessment of the height of a building related to the hazard type floods.
- Future research also needs to focus on the hazard-nesting problem that M. Pelling addresses. For example, a hurricane that leads to water pressure causing a break in a levee may lead to the flooding of a city, as in New Orleans. We need to develop relevant methodologies to assess primary and secondary effects of hazards of natural origin, without simply measuring the same effect twice.

> 'If assessment focuses purely on losses—such as fatalities—it is hard to estimate whether the group, community or nation was able to learn lessons'

Linking global to local

- We have a limited understanding of how changing socio-economic and environmental conditions affect vulnerability. Global indexing projects and national vulnerability and risk profiling are often too general to explore these issues. Research is needed to give a more precise idea of how to integrate the "time" and the "spatial" dependency of vulnerability into measurement tools, especially with regard to coping capacity and adaptation.
- Global indexing projects are useful in identifying countries with a high level of risk and vulnerability. These approaches could serve as a first

screening for hotspots, while local and sub-national approaches should also consider spatially specific aspects of vulnerability. This requires more research on how to combine and link global indexing methodologies with local and sub-national indicators.

- We need to focus on the question of how we can use approaches to measuring vulnerability to prompt future action to reduce vulnerability.

Counting the losses?

- The review of current approaches showed the divergence between reliable loss data (implying a retrospective focus) and forward-looking assessment, based on broader development and context indicators, such as population growth, poverty level, literacy rate.
- Vulnerability assessment must go beyond retrospective loss estimation, even though losses reliably indicate the vulnerability of people in the past. That said, L. Lebel et al. and E. Krausmann/F. Mushatq point out that exploring specific cases of severely hazardous recent events is often crucial for understanding the difference between theories and context situations in general, and the reality of revealed vulnerabilities and actions taken when an extreme event hits the society, economy and environment.

Conclusion

Quantitative and qualitative ways of measuring vulnerability are a precondition of the effective and systematic integration of vulnerability and risk reduction into day-to-day decision-making processes. Politicians, the media and the public often focus on the disaster itself, the initial relief actions and perhaps on the first days and weeks of reconstruction. However, disasters reveal the lack of proactive actions beforehand. To develop appropriate actions before disasters and risks occur, vulnerability reduction and hazard mitigation are essential. In this context, measuring vulnerability must be understood as a continuous and long-term task (monitoring) in order to identify potential areas for priority proactive policy interventions. We have to see vulnerability estimation and reduction as vital for early warning and effective risk reduction. Choosing the right coping capacities should also be based on vulnerability assessment. Although major decisions have to be taken at the political level, scientific research and contributions from the scientific community worldwide are essential to examine the opportunities and provide the tools to assess progress towards disaster-resilient societies. The forthcoming book examines important approaches to measuring vulnerability and coping capacity at various levels.

This research is extracted from a book proposed for publication by United Nations University Press in 2006

"MEASURING VULNERABILITY TO HAZARDS OF NATURAL ORIGIN"

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Includes:

Bogardi J.J. */ UNU-EHS*
Introduction

Pelling M. */ King's College London*
Review of Global Risk Index Projects – Conclusions for Local Approaches

Cardona O.D. */ IDEA, Universidad Nacional de Colombia, Manizales*
System of Indicators for Disaster Risk Management in Americas

Wisner B. */ London School of Economics*
Self-assessment methods: Participatory, Proactive, and Qualitative

Plate E. */ University of Karlsruhe*
A Human Security Index

Lebel L., Nikitina E., Kotov V., Manuta J. */ Chiang Mai University, Thailand; Eco-Policy Research and Consulting, Moscow, Russia*
Assessing institutionalized capacities to reducing the risk of flood disasters

Greiving S. */ University of Dortmund*
Multi-Risk Assessment – with a special focus on vulnerability

Kiunsi R.B. and Minoris M.V. */ Disaster Management Training Center, University College of Lands and Architectural Studies (UCLAS), Tanzania*
Disaster Vulnerability Assessment: Tanzania Experience

Birkmann J. */ UNU-EHS*
Measuring Vulnerability – Conceptual Frameworks and Basic Fundamentals

Bollin C. and Hidajat R. */ GTZ*
Community Based Disaster Risk Index – Pilot Implementation in Indonesia

Krausmann E., Mushtaq F. */ Joint Research Center of the EU*
Methodology for Lessons Learning – Experiences at the European Level

Arakida M. */ Asian Disaster Reduction Center, Kobe, Japan*
Measuring Vulnerability – The perspective of ADRC

Villagrán J.C. */ UNU-EHS*
The sector approach

Mechler R., Hochrainer S., Linnerooth-Bayer J., Pflug G. */ IIASA, Laxenburg*
Public Sector Financial Vulnerability to Disasters

Billing P., Madengruber U. */ European Commission, DG Environment*
Coping Capacity – towards overcoming the black hole

Birkmann J. */ UNU-EHS*
Recommendations for future research

Thywissen K. */ UNU-EHS*
Glossary of core terms of disaster risk management

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Within UNU's overall mission of "Advancing Knowledge for Human Security and Development", UNU-EHS explores threats to human security arising from natural and human-induced hazards. The Institute spearheads UNU's research and capacity building activities relating to the broad interdisciplinary field of 'risk and vulnerability'.

Knowledge generation and capacity development efforts aim to address decision makers and scientists worldwide, notably in the following areas:

- development and testing of vulnerability indicators, investigating the relationships between risks, vulnerability, and coping capacity;
- fostering a better understanding of the links between different hazards and creeping processes such as climate change and environmental degradation and their influence on hazard magnitude and frequency.

INSIDE:

Research Brief

"Danger need not spell disaster"

Were Hurricane Katrina and the Asian Tsunami unavoidable disasters, or could we limit the impact of such events by addressing our vulnerabilities in advance?

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