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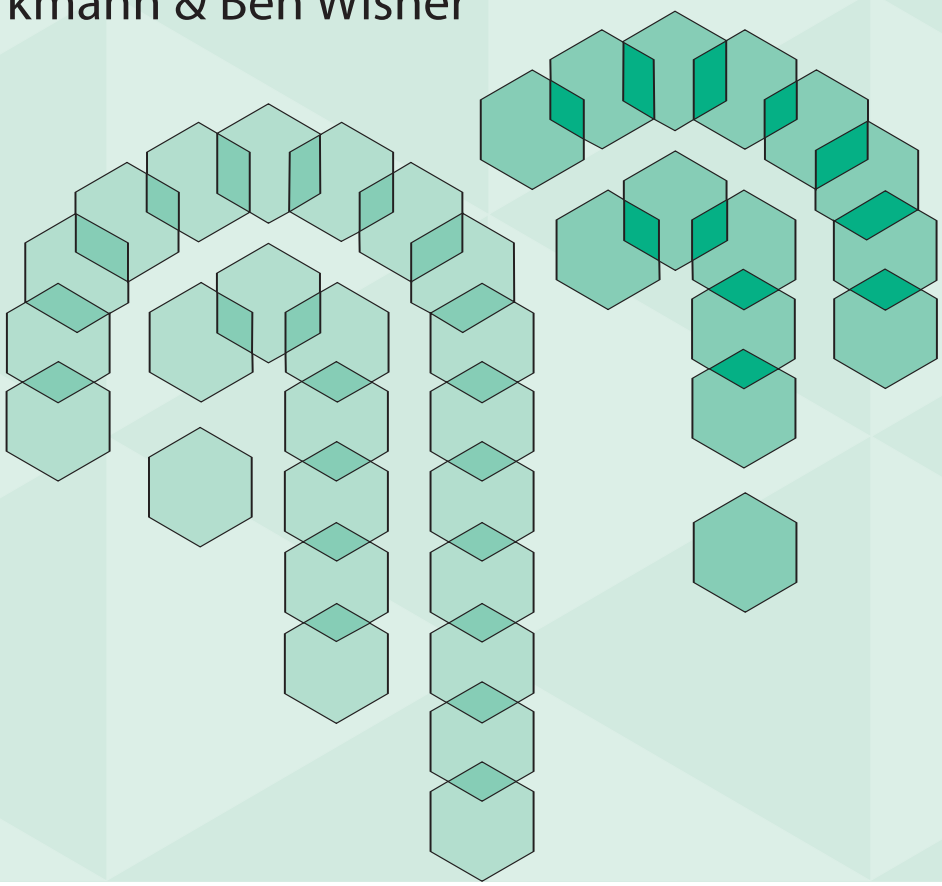
Measuring the Un-Measurable

The Challenge of Vulnerability

Jörn Birkmann & Ben Wisner



SOURCE

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About the Authors

Dr.-Ing. Jörn Birkmann is Academic Officer at the UNITED NATIONS UNIVERSITY Institute for Environment and Human Security. He holds a PhD in Spatial Planning from the Dortmund University as well as a license as urban planner. He has broad expertise in the field of vulnerability, sustainable development and environmental assessment. At UNU-EHS he is responsible for the area of vulnerability assessment. His research area encompasses the development of methodologies to identify and measure vulnerability and coping capacity of societies, economies and the environment to hazards of natural origin. His work experience also encompasses research activities and lectures around the globe, for example in London and Mexico.

Prof. Dr. Ben Wisner is a geographer (environmental social scientist) and philosopher/ethicist of world wide reputation in disaster reduction. He currently commutes between continents as visiting professor and researcher, working also as Senior Consultant for UNU-EHS since 2005. By virtue of his wealth of experience, B. Wisner's contributions include, but are not limited to, the provision of expert counsel to the Institute's Academic Officers on field-related research and publications. He holds honorary & visiting appointments in Development Studies, London School of Economics, Benfield Hazard Research Centre, University College London, Institute for Disaster and Public Security, Beijing Normal University, and Environmental Studies Program, Oberlin College. Among other activities, Wisner is a founding member of COGSS (Coalition for Global School Safety), advisor to Reuters AlertNet, and consultant to the ProVention Consortium.

Measuring the Un-Measurable

The Challenge of Vulnerability

Jörn Birkmann & Ben Wisner

Report of the Second Meeting of the UNU-EHS Expert Working Group on Measuring Vulnerability
12-14 October 2005, Bonn, Germany

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Of course, putting this publication together would not have been possible without the immense amount of behind-the-scenes work done. We are extremely grateful to N. Gebert, M. Garschagen and C. Ergler for their support in the transcription of the discussions and presentations, as well as for the notes taken by D. Alexander and others, which allowed us to focus and reflect on major points of the discourse.

Many thanks also to all the contributors from the 24 countries involved in the second Expert Working Group meeting. Furthermore, we would like to express our deep gratitude to the organizers and supporters of the UNU-EHS Expert Working Group, particularly U. Kastrup and J. Bogardi, C. Schneider, I. Roberts, V. Liaukonyte, and S. Zimmermann for their organizational and logistical support. Finally, we want to thank C. Schneider and I. Roberts for their copy editing work for this report.

Foreword

Measuring the Un-Measurable – is a short and succinct title as well as an indication of the challenges and difficulties in deriving appropriate methodologies, indicators and criteria to identify, measure and assess vulnerabilities of societies at risk. The most recent mega-events, the 2004 Indian Ocean tsunami and hurricane Katrina in 2005 certainly revealed the vulnerability of societies – in developing and developed countries – to the impact of natural hazards. Improving risk reduction and disaster preparedness requires first and foremost the identification and assessment of various vulnerabilities of societies, their economy, environmental resource base, and their institutional structures. Thus for effective preparedness strategies and sustainable recovery the development of tools to measure vulnerability is a prerequisite. It is important to note that this requirement formulated and agreed upon by professionals received strong political endorsement. Following the World Conference for Disaster Reduction in Kobe 2005, the intergovernmental, negotiated Hyogo Framework for Action (UN 2005) identifies the development of indicators to measure vulnerability and risk and their reduction as major challenges for the future. Thus being piece and parcel of the Hyogo Framework of Action vulnerability assessment became a major task for the UN System and consequently an obligation for UNU-EHS to concentrate its research activities in this area.

One of the contributions of the UNITED NATIONS UNIVERSITY Institute for Environment and Human Security (UNU-EHS) to the implementation of the Hyogo Framework of Action is to call upon the international community of scholars and professionals to form an international *Expert Working Group* on Measuring Vulnerability (EWG). The main focus of the international EWG is to provide a platform for exchange of different concepts on how to measure and assess vulnerability in its various dimensions and at different scales in different regions of the world. EWG serves as a think tank and forum for different schools of thought on the topic. EWG was literally launched with a first meeting in Kobe in January 2005, immediately after the *World Conference on Disaster Reduction* (WCDR). A second meeting of the EWG was held in Bonn within the framework of the IHDP Open meeting (International Human Dimensions Programme on Global Environmental Change) in October 2005. Papers discussed during the second meeting of EWG plus a number of invited contributions have been edited into a state-of-the-art book on "Measuring Vulnerability to Natural Hazards – Towards Disaster Resilient Societies" which was published by UNU-Press in October 2006. The present issue of SOURCE summarizes the main lines of the discussion and documents the second meeting of the EWG. While it refrains form becoming a traditional proceeding, it fully captures the quintessence of discussions and the spirit of the meeting experienced and shaped by 52 participants and over the 100 head strong audience of the open presentation part of the first day.

This SOURCE publication is an essential reading for those interested in vulnerability research and the assessment and measurement of it. The publication by J. Birkmann and B. Wisner leads us through the thematic areas which were discussed, outlines the different scales of the assessment approaches presented, and analyses the nature of vulnerability measurement. In this context the term "measuring vulnerability" does not solely encompass quantitative approaches. It also seeks to discuss and develop all types of methods able to translate the abstract concept of vulnerability into practical tools, classifications and comparative judgments to be applied in the field. Therefore, the publication is well balanced in this discussion of quantitative and qualitative approaches. Case studies gave particular emphasis to current disasters and the respective vulnerabilities, such as the vulnerabilities disclosed in tsunami devastated in Sri Lanka, the vulnerability of coastal communities in the US Gulf Coast revealed through the passage of hurricane Katrina, the recent floods in Russia in the Volga region, and the vulnerability assessment undertaken in Tanzania covering multiple hazards. Vivid discussions emerged – and reported – around the novel topics like how to capture institutional and environmental vulnerability – issues which have not been investigated in depth in the past. Conclusions summarize urgent

research needs. The recommendations provide a valuable source of ideas for future research projects and particular aspects to be considered when aiming to measure the un-measurable.

I am particularly indebted to the authors of this volume. Dr. Jörn Birkmann, Academic Officer of UNU-EHS does not only serve as the able "secretary general" of the EWG since its conception but has repeatedly proven his ability to address major research challenges, to capture debates, summarize findings, and to document workshops, thus making the experience of a privileged few to the information and knowledge of many. Prof. Ben Wisner is both a well-known scholar and practitioner in the subject areas addressed in this publication. He is a member of the UNU-EHS *College of Associated Scientists and Advisors* (CASA), thus helping our young Institute in its efforts in vulnerability research. His trademark enthusiasm, analysing and debating spirit, and dedication to bring vulnerability science forward gave a great deal of authenticity to this unique issue of SOURCE. Without his contributions the text might have reflected but not tell the story of the second meeting of the EWG in October 2005.

Janos J. Bogardi
Director UNU-EHS

Summary

This publication covers the main findings and discussions from the second UNU-EHS *Expert Working Group* (EWG II) meeting on Measuring Vulnerability. It provides an overview of concepts, methods, and debates. Discussion of the term vulnerability and its meaning from social, economic, environmental and institutional points of view was a major part of the scientific debate.

To paraphrase Charles Dickens, "this is the best of times and the worse of times" for interdisciplinary, policy relevant research on vulnerability. On the one hand, the term "vulnerability" appears frequently in applied research on areas as diverse as development and poverty studies (academically in anthropology and sociology), public health, climate studies, engineering, geography, political ecology, and, of course, among disaster researchers. The bad news is that researchers from such diverse backgrounds seldom sit together and share working definitions of "vulnerability," what methods they use to measure or assess it, and their successes and failures in communicating their research to decision makers. Such diverse researchers come from very different backgrounds and field experiences. They may hold different assumptions about fundamental things like the nature of science and what constitutes an explanation. While these differences can – as in the case of this EWG II meeting – lead to creative tensions and new insights, the resulting debate might appear to outsiders – especially practical people in decision making positions – to be, at best, a wasteful circus of ideas or, at worst, an unruly bar room brawl. The gentle reader should be reassured that the meeting reported herein was quite civilized and productive. In part, this is because it was the second in a series. It is also because in preparing the second meeting, everyone was aware of the very broad range of methods and views we were intentionally inviting – hence the somewhat ironic title: "Measuring the Un-Measurable."

The term "measuring vulnerability" does not solely encompass quantitative approaches, which is what first comes to mind. It also seeks to discuss and develop all types of methods able to translate the abstract concept of vulnerability into practical tools to be applied in the field. If one takes the *bare bones,* simple definition as "subject to harm", then the question rapidly proliferates and become concrete and situational: "what kind of harm?","harm from what?","how often?","recoverable or treatable harm?","avoidable harm?", and above all, "under what economic, social, and political conditions?"

There are many different ways to answer such questions at different scales (from household and local community to the national and supra-national to global levels) using a variety of methods including quantitative indicators, qualitative criteria as well as broader assessment approaches. Ordinal and cardinal numbers, models, proxies, narratives, maps, chronologies, and profiles all have their place depending on the purpose of vulnerability assessment / measurement.

Key questions that help to clarify the choice of methods are:

- Who and what is vulnerable?
- Vulnerable to what?
- Who wants to know and why?
- What circumstances and context shape the daily life of the affected?

This report also gives an overview of case studies in which vulnerability assessment was applied. These case studies were another reason why the EWG II avoided becoming yet another non-stop philosophical seminar with tea breaks. Case studies from Sri Lanka (tsunami), Russia (Volga River flooding), Tanzania (multiple hazards including drought), and the U.S. (hurricane Katrina) – as well as occasional references to other ongoing work in Central America, Southern Africa, and elsewhere – enlivened the discussion by making it concrete. The case studies showed that MEASURING VULNERABILITY requires different approaches depending on the hazard in question and the socio-economic and cultural context.

Participants of the EWG II came from 24 different countries, thus representing a variety of different socio-economic and cultural areas. Based on the diverse and rich discussion major poles of the scientific debate as well as challenges for future vulnerability research emerged and will be presented below. Among other subjects the discussion focused on the issues of "Complexity versus simplicity", "Understanding versus action/implementation" and "Natural science versus social science epistemology". Thus this report underlines the different standpoints and methodological, as well as practical decisions that need to be taken into consideration when dealing with the set up of tools to measure the multifaceted nature of vulnerability.

Table of Contents

I. Introduction

The term "vulnerability" has different meanings and interpretations for different people. On the one hand, the various definitions and meanings of vulnerability hamper a common understanding of how to measure vulnerability. On the other hand, perhaps it is not a bad thing if vulnerability has many meanings, each useful within specialized applications. Also, it is possible that some social aspects of vulnerability in particular are beyond quantification. But even if they are, this does not mean they escape measurement, or at least assessment and systematization altogether.

Such were the issues tackled by a series of *Expert Working Group* (EWG) meetings convened by the UNITED NATIONS UNIVERSITY Institute for Environment and Human Security (UNU-EHS). The first was in Kobe, Japan, in January 2005, just following the *World Conference on Disaster Reduction* (WCDR) and was supported by the *Asian Disaster Reduction Centre* (ADRC) (see in detail Birkmann 2005).

BOX 1: Working Definitions of Vulnerability

"Susceptibility to harm from external shocks"

"Degree of loss or harm likely if and when an extreme event occurs"

"Disruption of normal functioning likely due to hazard event."

"Characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard"

(EWG II 2005)

The purpose of both meetings, and, indeed, a third in the series scheduled for October 2006, is to promote research and the exchange of scientific concepts and approaches dealing with the measurement and assessment of vulnerability of people and social groups (at many scales), of economic sectors and of environmental services at risk to natural hazards. The broader context of the meeting was "human security"; the EWG dealt with violence and war as well as technological hazards only as boundary processes (see for example, the case study from Sri Lanka; Chapter III).

As suggested by the questions in the summary, the term measuring vulnerability does not solely encompass quantitative approaches, but also seeks to discuss and develop *all types of methods able to translate the abstract concept of vulnerability into practical tools to be applied in the field.*

The need to develop indicators and measures to identify and assess vulnerability has been emphasized in various international declarations, particularly in the Hyogo Framework for Action, the final outcome of the WCDR mentioned above, which points out that:

> *The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and of the ways in which hazards and vulnerabilities are changing in the short and long term, followed by action taken on the basis of that knowledge.* (United Nations 2005)

In this context the UNU-EHS *Expert Working Group* on Measuring Vulnerability sees itself as a group contributing to the implementation of the Hyogo Framework by enhancing the knowledge regarding vulnerability.

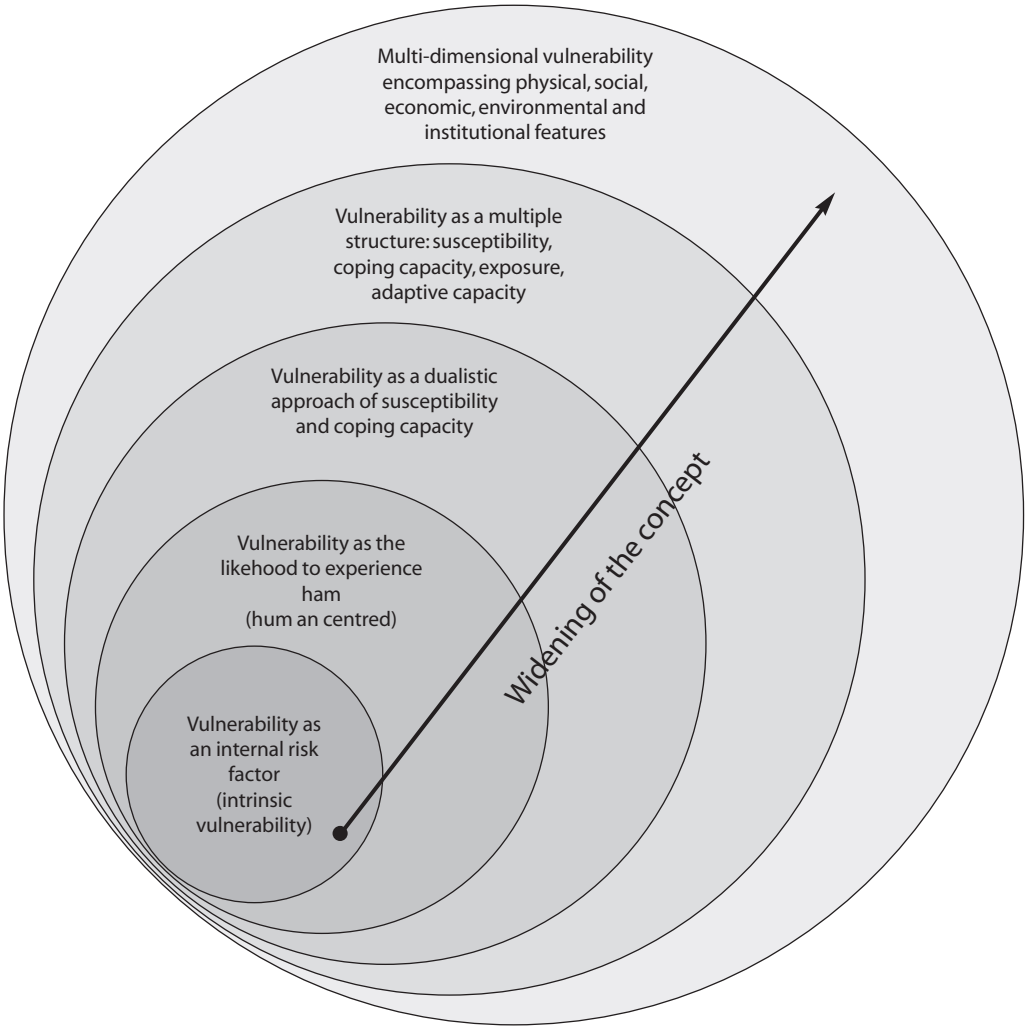
Measuring vulnerability requires as a starting point a shared minimum agreement concerning what vulnerability is. Although there are different schools of vulnerability research, such as the disaster risk community, the food security research or global environmental change research communities, a consensus can be seen in the fact that nearly everyone views vulnerability as an "internal side of risk" (UN/ISDR 2004). In this context vulnerability is an intrinsic characteristic of a system. That means the conditions of the exposed element or community at risk are seen as core characteristics of vulnerability (UN/ISDR 2004; Cardona 2004: 37; Wisner 2002: 12/7; Thywissen 2006). These intrinsic (though not

necessarily permanent or unchanging) characteristics or conditions of the exposed element or system is often called its "susceptibility." Thus in this broader context vulnerability is composed of "exposure" and "susceptibility." However, this is only the first inner sphere and various extensions of the concepts can be observed depending on the scale, theme and disciplinary focus, and purpose of the definition.

This range is shown in figure 1 as spheres of vulnerability. In this context an extension of this definition can be seen in definitions such as Wisner's (2002; also Wisner et al., 2004: 11), which defines vulnerability as the *likelihood of injury, death, loss and disruption of livelihood in an extreme event, and/or unusual difficulties in recovering from negative impacts* of hazardous events – primarily related to people (Wisner 2002: pp. 12/7) (second sphere).

Moreover, this definition is widened by viewing vulnerability as a dualistic approach of susceptibility on the one hand and the unusual difficulties in coping and recovery on the other (third sphere), which can be observed in the definitions by Wisner (2002) and also partially by Bohle (2001). Bohle´s double structure of vulnerability refers to vulnerability features which are external to an exposed element or unit at risk and those factors that are internal.

Figure 1: Key Spheres of the Concept of Vulnerability (Birkmann 2006)



Furthermore, the capacity to cope is the other side of vulnerability (positive definition/ capacities). An additional extension of the concept of vulnerability can be seen in the shift from a double structure to a multi-structure, encompassing not only susceptibility (negative definition of vulnerability) and coping capacity, but also adaptive capacity, exposure, and the interaction with perturbations and

stresses (see e.g. Turner et al. 2003). This implies a fourth sphere, by widening further the concept of vulnerability. Lastly, also the thematic dimensions can be broadened within the discourse of vulnerability. While formerly – mainly engineering based approaches and earthquake research – vulnerability was primarily associated with physical aspects (likelihood of a building to collapse), the current debate clearly shows that vulnerability captures various thematic dimensions, such as physical, economic, social, environmental and institutional aspects (fifth sphere, see Figure 1). A more in-depth analysis of this discussion can be found in Birkmann (2006). Overall, it is evident that vulnerability – including coping capacity – depends not only on the natural hazard in question – such as floods, droughts, hurricanes, tsunamis, etc. Schematically, risk (R) is a function of vulnerability (V) and hazard (H), that means [R = ?(V, H)]. This inseparable pair of concepts – vulnerability and hazard – is also shaped by the socio-economic development context as well as the cultural and institutional aspects of daily life.

BOX 2: Main Goals of the UNU-EHS Expert Working Group are:

- Strengthening the interdisciplinary dialogue and exchange on vulnerability research;
- Identification of different theories and frameworks used to conceptualize vulnerability;
- Discussion of different dimensions of vulnerability (like social, economic, environmental and institutional vulnerability);
- Review of current approaches used to measure vulnerability at different scales and for different dimensions;
- Identification of coping capacities (coping strategies) and potential intervention tools to reduce vulnerability;
- Testing of indicators and analysis of their applicability in selected planning and decision making processes;
- Compilation of the different approaches and publishing innovative research results

Primarily, the *Expert Working Group* aims at examining current ideas, methods and concepts for measuring vulnerability and coping capacity with regard to hazards of natural origin. Some attempt is also being made to learn parallel methodological lessons from research into violence (e.g. civil war situations) as an additional hazard in regions at risk of natural hazards, such as Sri Lanka. Additionally, some valuable lessons have been drawn from analyses of vulnerability to environmental hazards such as air, water pollution and land degradation. This analysis and the comparison of different approaches aim to determine to what extent current indicator and assessment concepts contribute to enhanced human security as well as to policy relevant information.

An unique feature of UNU-EHS is to conceptualize vulnerability to natural hazards in the broader context of human security and sustainable human development. Few, if any, programs of disaster or hazards research attempt to bridge between work on civil war, displacement and violence, climate change, chronic and acute anthropogenic environmental threats, and natural hazards, such as sudden-onset hazards (tsunami, floods, hurricanes) and creeping hazards (drought, landdegradation, changing socio-physical conditions like climate variability). In this context Bogardi and Brauch (2005) suggested extending the human security concept by introducing a third "dimension" – "freedom from hazard impacts" – to the two existing ones: "freedom from fear" and "freedom from want".

More information about the Expert Working Group on MEASURING VULNERABILITY can be found at: www.ehs.unu.edu; or directly by contacting the responsible Academic Officer Dr. Joern Birkmann, E-Mail: birkmann@ehs.unu.edu

II. Constituencies

2.1 The Participants

The participants represented natural and social sciences, engineering and came from 24 countries. There were policy makers and NGO practitioners present at EWG II, together with researchers and university lecturers. In other words, there was a span of disciplinary background reaching from systems and civil engineering and soil science and hydrology to economics, political science, and anthropology. The work situations and locations in relation to institutions and points of leverage also varied considerably. Some had experience in national level governmental institutions (e.g. Tanzania, South Africa, Guatemala, Germany), others in universities, quasi-governmental or regional research institutions, while yet others were active in NGOs. Each of these "locations" carries with it power of one kind or another, and/or access to other levels of power.

Box 3: Nationalities Represented at EWGII

Fortunate timing meant that the EWG could meet immediately after a large conference on "Global Environmental Change, Globalization and International Security: New Challenges for the 21st Century" of the *International Human Dimensions Programme on Global Environmental Change* (IHDP) at the *University of Bonn* (IHDP 2005). This meant that a number of researchers whose work centres on climate change, global environmental change, and development – not in the first instance directly focused on disaster risk reduction or natural hazards – were able to attend. This circumstance enriched the debate. Young scientists from UNU-EHS, ZEF and the University of Bonn also attended the second meeting of EWG. As well as the young scientists awarded by the so called Young Scientists Award of UNU-EHS.

BOX 4: UNU-EHS Young Scientists Award & Programme

The young scientist programme of UNU-EHS targets individuals from developing countries who, it is hoped, will use their newly acquired knowledge and skills either back home or in institutions devoted to disaster risk reduction or sustainable development. It is also open to individuals from developed countries who are interested in working on global issues professionally.

Depending on the disciplinary background of each participant and the kind of problems they confronted in their work situations and institutional locations, they brought with them different notions of measurement and of vulnerability.

2.2 Scale

One of the big challenges of the EWG meeting were the different scales in regard to measuring/assessing vulnerability. Some participants mentioned the household level or community scale they work at, sometimes in collaboration with local government (towns, cities); others pointed out the national, regional or even international scale including work dealing with issues like risk mitigation,

Figure 2: Tsunami Affected Squatters in Galle, Sri Lanka (Birkmann et al. 2006)

response, recovery, or preparedness. They all pointed out their typical need for measurement or assessment of vulnerability which varied considerably depending on the scale at which they work.

2.3 Creative Tension and Debates

Given the different professional situations and scientific formations of the EWG II participants, it is not surprising that there was creative tension and debate in the meeting. One might summarize this dynamic as follows:

BOX 5: Creative Tensions and Debates over Vulnerability

Complexity versus simplicity:
- Cultural, livelihood, situational, institutional/ political complexity vs. desire for mathematical parsimony
- Complex, dynamic, even chaotic process vs. product

Understanding versus implementation:
- Utility/ necessity of basic starting points: e.g. exposure maps in Sri Lanka; e.g. district/ village surveys in Tanzania;
- But how does one get from basic description to understanding?

Natural science versus social science epistemology:
- Are controlled experiments possible when groups of people are involved?
- When local people themselves are researching their own hazards and vulnerabilities/ capacities and implementing action plans, does this constitute an experiment?

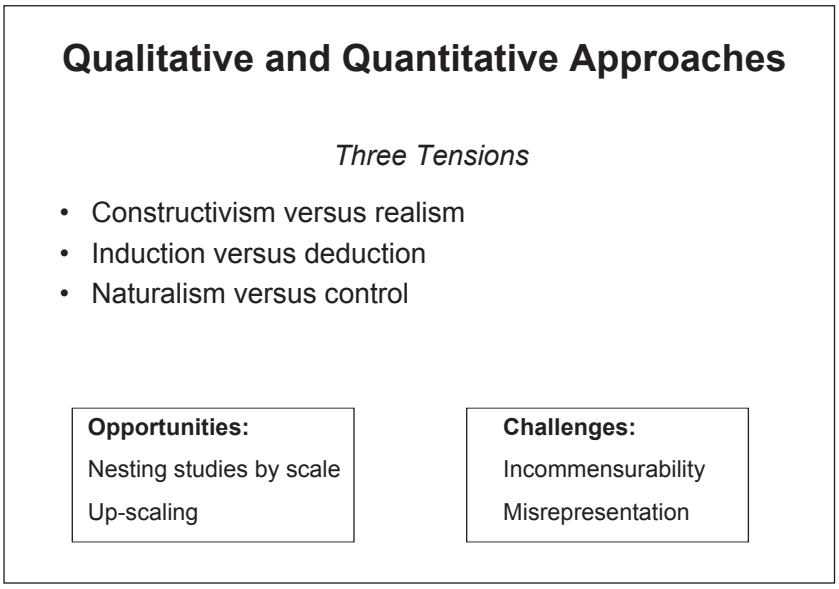
Nomothetic versus ideographic goals:
- Are we trying to establish law-like statements and the ability to predict outcomes or are we providing narratives and descriptions of situations that raise consciousness of risks and mobilize local and outside action, vigilance, and preparedness?

Ethical issues:
- Are people research objects or subjects?
- Are there not winners and losers in any intervention into the risk-scape of a locality?

Cacophony versus polyphony:
- Full understanding of vulnerability may involve a large team, but can they speak with one voice when a common language or metric of vulnerability may not exist?
- Decision makers want clear options, not nuanced understandings.

Complexity vs. simplicity emerged as two principal poles of attraction. Participants were aware that vulnerability is influenced by many things, some of which may have their origins decades or even centuries ago in distant, non-local places (thinking about patterns of access to resources, for instance). Also, the many components or aspects of vulnerability – social, economic, environmental, institutional – are hard to separate in a tidy manner. They interact and overlap. Despite the resulting complexity in understanding vulnerability, most participants agreed that decision makers want simple explanations and clear cut categories. Most of the other poles of creative tension listed above derive from this principal antinomy. Pelling introduced the subject well during the initial debate, using a single, elegantly simple power point slide (Figure 3).

Figure 3: Three Tensions Between Qualitative and Quantitative Approaches (Pelling 2005)



Pelling, Bohle, Oliver-Smith and others argued that vulnerability is not an object or phenomenon that is given independently of web of perception, discourse, and power that constructs (and over time re-constructs) it. [1]

Concerning the tension between induction and deduction, most participants, if not all, utilized methods that depend on induction as cases are analysed. Some economists and engineers would rely to some degree on the formal logic of their specialities to reveal underlying structure (through mathematics and modelling). Finally, as regards the usefulness of modelling and the feasibility of top down planning, the tension between naturalism versus control was seen to be relevant. Returning to the fundamental notion of complexity, some participants believed that society-environment systems are dynamic and chaotic, and that notions of equilibrium and normality simply do not apply.

BOX 6: EWG's Knee-Jerk Definitions

On the last day, participants were asked to write down on a slip of paper a single word that the notion of vulnerability evoked and to do it quickly without much thought.
The results break down into four groups (N=36):

Definitions (11)
(Index, part of risk, unsafe, resilience, disturbance, etc.)

Lamentations (11)
(Confusion, keep it simple! jargon, never ending story, etc.)

Qualitative/ Humanistic Reflections (8)
(People, diversity, poverty, structural, social)

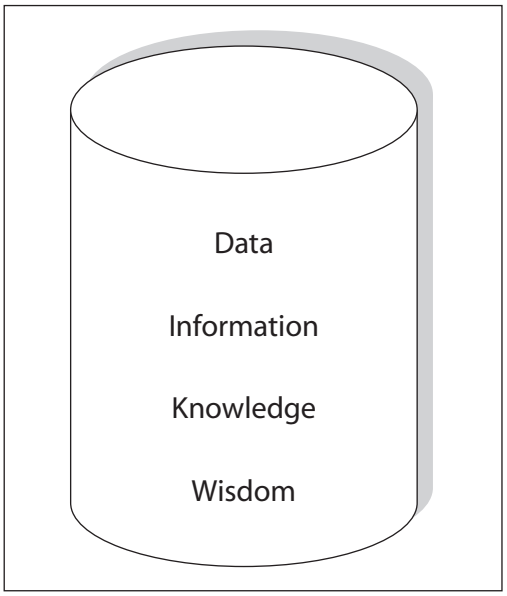
Action-oriented Invocations (6)
(Communication, empowerment, response, action)

1 In fact, some forms of constructivism have been applied as well to the natural sciences, and argue – against conventional realism – that no object of scientific study is independent of its observer. While this is certainly true at sub-atomic, quantum scales, it is harder to believe of rocks and geologists.

2.4 Nature of Measurement

Common agreement can be reached concerning a hierarchy of knowing. Data (such as signals from a land resources satellite or tallies of age and gender in a household) are not yet information. Data becomes information when interpreted according to definitions, taxonomies, and scales. Data must be processed and interpreted to become information. Information becomes knowledge when it is systematically organized in relation to questions. Knowledge becomes wisdom when it is set along-side prior knowledge and the results of application of knowledge are critically appreciated (IFRC, 2005: 13).

Figure 4: Hierarchy of Knowing
(IFRC, 2005: 13)



If the aim of common efforts in disaster risk reduction is human security and sustainable human development, then wisdom would result from the critical assessment of outcomes when one tries to implement policy at international, national, or local scale or when people in a locality attempt to act on behalf of their own to improve self protection. The last mentioned assessments are simple because they are place and situation specific, like this village in relation to that flood hazard or landslide hazard, etc.

Assessments can be narrative, qualitative and quantitative. Data and information are automatically given in the form of local experience and the elicitation of local knowledge. However, local, national and international assessments can require one to step back from such rich detail and to simplify. One needs indicators or even more distant proxies. Indicators are nominally-countable or ordinally-scaleable characteristics or properties that bear a functional relationship to the hazard, exposure of people or property or livelihoods, or the impacts of exposure. Thus numbers of livestock lost in past floods might be an indicator of possible future vulnerability to flood. A proxy is likewise countable or scaleable, but does not bear a functional relationship to hazard, exposure or impact. Thus income per capita or infant mortality rate might turn out to be a good proxy for vulnerability to a range of extreme events.

2.5 Thematic Areas

In the course of panel debates, presentations of various methods, and case studies from a number of countries, four thematic areas emerged:

- Social;
- Economic;
- Environmental;
- Institutional.

SOCIAL

Social relations and the historically rooted patterns of discrimination, inequity in access to resources, and power are important determinants of vulnerability. In the discussion of hurricane Katrina and New Orleans, Oliver-Smith touched on social relations, as did Bohle and Brauch, in the context of violent conflict. Social capital (networks) were seen to change under the influence of daily violence in Bohle's research sites in Sri Lanka. This, in turn, changed the coping options people had in the face of extreme events.

Figure 5: Displaced People After Hurricane Katrina (Oliver-Smith, Button 2005)

Gregory Button, University of Michigan

History and the layers of identity that people carry (gender, race, age, ethnicity, and religion) need to be analysed and assessed (e.g. work of Oswald Spring). Is it possible to do this in a rapid, standardized manner? This may or may not be possible. Wisner mentioned techniques of *Community Based Risk Assessment* (CRA) that have been collected by the ProVention Consortium on their website as a "tool box" (ProVention Consortium 2006). To some extent groups of people can be guided to assess such differences and their impacts on exposure and possible losses (vulnerability) in relation to specific hazards in situ as part of focus groups. Nevertheless, as Handmer emphasized, economic and social vulnerability are often hard to distinguish, and some aspects of vulnerability are likely to remain hidden and only understandable more deeply "from within" as, for example, through participant observation on the long run. Where a large proportion of economic activity is informal and hidden from official view, it is hard to quantify and less likely to be mentioned even in focus groups. Complications are even greater when some of the social relations and economic activity are linked to criminality and chronic violence.

More optimistic were Bohle and Bilia who suggested, respectively, that the livelihood approach (see e.g. DFID 1999; Wisner et al., 2004: Chapter 3) bridges the social and economic and gives one considerable insight into vulnerability. They also expressed the view that social vulnerability can be addressed on a large scale by tying assessment and action planning to a decentralized national planning system. Hettige, Fernando, and Amarasinghe reported on work in Sri Lanka after the Asian tsunami that conducted vulnerability assessment on the basis of a series of demographic characteristics (household size, occupation, etc.) and that also dealt with the question of how to measure coping capacities and the recovery potential of different households to the primary and secondary impacts of the tsunami. In the case of Tanzania, nationwide surveys at district level provided planners with an overview of hazards and available social infrastructure for preparedness and mitigation. As a starting point, it is very useful to know, for example, that 41% of district teams reported having some first aid training and 26% having search and rescue capacity, or that 80% of the population listens to *Radio Tanzania*.

ECONOMIC

There was considerable overlap between social and economic vulnerability issues. More focused technical accounts of economic vulnerability were also presented to the EWG, differentiated by scale. Dutta from WIDER, a sister UNU center, shared econometric analysis based in micro economics that he believes can isolate determinants of vulnerability in the economic behavior of individuals. From this point of view one can define and measure vulnerability as the likelihood of falling below the poverty line at a time of stress such as a tsunami or drought and the depth of that poverty. Indeed, Dutta said that 200,000 people fell below the poverty line in El Salvador after the 2001 earthquake and that unemployment in Sri Lanka increased from 14 to 21% after the Indian Ocean tsunami. A corollary of Dutta's definition of vulnerability is that capacity benefits from building up diversity of income sources, family health status, savings, and social networks (available loans, etc.).

> *"200,000 people fell below the poverty line in El Salvador after the 2001 earthquake and unemployment in Sri Lanka increased from 14 to 21% after the Indian Ocean tsunami."*
>
> Dutta (EWG II 2005)

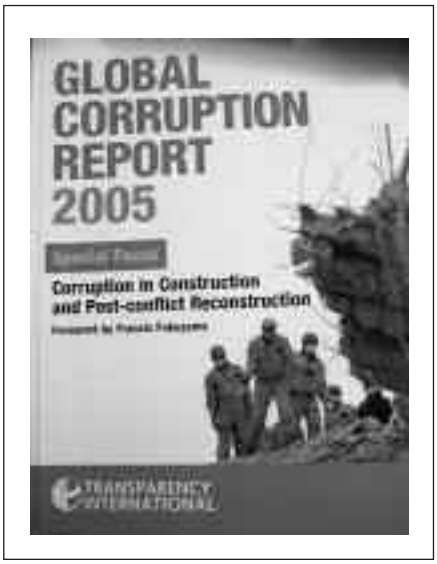
At the macro scale, indicators of the fragility of whole economic systems have been suggested (e.g. Linnerooth-Bayer and Mechler EWG II 2005); while others commented on measurement at both micro and macro scale (Mechler and Schneiderbauer EWG II 2005). As a tool for decisions about making investments in reducing vulnerability to natural hazards, Hidajat and Jaeger suggested a time-tested (though controversial) tool: cost-benefit analysis.

Losses incurred by municipal, sub-national and national governments when hazards events destroy infrastructure and housing can be enormous (e.g. $1 billion for the Bam earthquake; $4.5 billion for hurricane Mitch in Honduras and Nicaragua combined; $12 billion for the Asian tsunami). In many countries roads, bridges, port facilities, schools and hospitals, water and sewage plants, and energy facilities are uninsured. Cardona and colleagues have developed a measure of the financial exposure, governments face in relation to a variety of extreme events in Latin America (National University of Colombia 2006). The *Disaster Deficit Index* (DDI) outlines the percentage of loss that would not be able to be covered by national sources in such an event. Linnerooth-Bayer and Mechler are working on ways to buffer such impacts at the national scale and reduce the knock on effects on economic growth and its volatility.

INSTITUTIONAL

Institutions play an important role regarding vulnerability. Firstly, institutions like governments, businesses, markets, health systems, etc. – may have more or less capacity to cope with extreme events and shocks and ability to carry on with their normal functions or at least to re-establish them quickly (Nikitina; Greiving; Ivanov EWG II 2005). Also one can develop ways of characterizing the approach of a national or other scale governmental or non-governmental institution towards risk reduction and disaster management. Thus Ivanov has developed a method of scaling institutions in Russia along several dimensions: e.g. education and training, structural mitigation, non-structural mitigation, emergency response, etc. Using this approach he reported that Russia's flag-ship national disaster management institution, EMERCOM, does little strategic planning or non-structural mitigation but concentrates on structures and emergency response. Pelling described a new research looking at institutions as sets of rules and relationships and attempting to map the impact of such rules and relations on flow of information and decision making about risk in UK based institutions. It uses key interviews about climate change with decision makers in institutions at various scales: DEFRA & *Environmental Agency* (national scale); *Welsh Association* (regional scale); dairy cooperative (local scale).

Figure 6: Global Corruption Report 2005 (Transparency International 2005)



Trust and informality emerged as major themes in presentations on institutional vulnerability and the discussions that followed. Organizations structured along military lines have great difficulty communicating with marginal groups of people in society. The culture of different kinds of institutions can make inter-organizational flows of information more difficult or easier, as Greiving suggested. Mistrust is often well-founded in what is now documented internationally as corruption at many levels of most societies (Transparency International 2005).

Secondly, the way that various institutions impact people's lives may make them more or less vulnerable. For example, a market that systematically exploits poor farmers through unequal exchange or pays migrants below the cost of reproduction (because it counts on an ability of women remaining in the countryside to feed the next generation of the workforce) may be seen as creating and reproducing vulnerability. A corrupt and inatten-

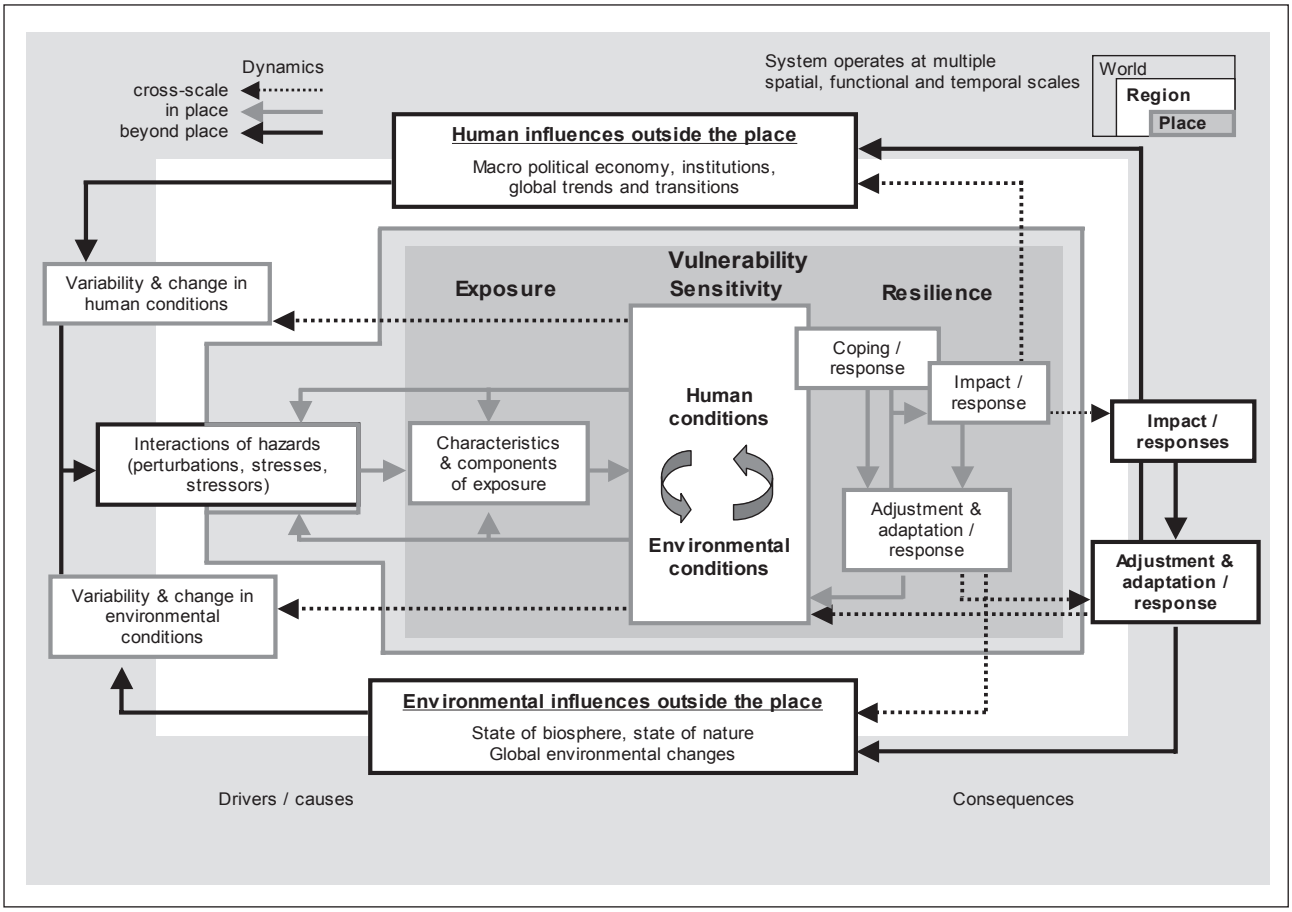
tive government is not simply neutral as regards social protection but may do things through taxation or arbitrary land seizure that increases the vulnerability of the poor. By contrast, good governance may strengthen both the self protection and coping ability of its citizens and also provide social protection (Pelling; Oliver-Smith; Alexander EWG II 2005).

ENVIRONMENTAL

Several presentations touched on environmental issues. There were some presentations of vulnerability assessment applied to pollution hazards such as those produced by release of dioxin and petroleum into the air or water. In a more systemic and conceptual manner, several presenters mentioned the necessity of linking up with those who study climate change and also use the term vulnerability (e.g. Downing and Renaud). Slow onset, or pervasive hazards such as soil erosion, desertification, decline in biodiversity, and other environmental changes commonly play a role in vulnerability unlike the contribution of baseline nutritional status and health do in the case of individuals and households (Jayasingam). Finally, Billing from the European Commission emphasized the need for strengthening the cooperation between disaster management and environmental management.

Kok provided an overarching view of how disaster risk reduction could be seen in the context of efforts to bridge between development and environment such as the Millennium Ecosystem Assessment (2006) and one of its underlying conceptual models of vulnerability put forward a few years ago by Turner and colleagues (Turner et al. 2003).

Figure 7: Vulnerability Framework (Turner et al. 2003)



It is one thing to provide cases and examples of how, for example, healthy mangroves protected some Sri Lanka fishing villages from the full impact of the Asian tsunami (e.g. Bohle's comment), but it is quite another to pursue policy that fully integrates environmental sustainability and human well being with

disaster risk reduction in a systematic way. The latter remains a challenge, and would also imply measurements or assessments of vulnerability that would contain local environmental quality variables.

An aspect of the challenge is the difficulty of spelling out in detail exactly how social and ecological systems are coupled and how they interact (Bohle EWG II 2005). In a later review of the concept of resilience in ecology and social science, Oliver-Smith (2006) returned to these concerns. The danger, both Bohle and Oliver-Smith see, is taking uncritically on board concepts such as equilibrium and resilience as the ability to bounce back to former function. It may well be that human-environment systems are chaotic and non-equilibrating (Handmer et al. 2001).

III. Case Studies

3.1 Sri Lanka: Tsunami Vulnerability

Hettige, Fernando, Amarasinghe and Jayasingam presented first research results regarding the identification and measurement of pre-existing and emergent vulnerabilities to tsunami in Sri Lanka, piloting vulnerability assessment methods at the local level during a period of eight months. The study, funded by UN/ISDR-PPEW, is ongoing and conducted jointly with the *University of Colombo, University of Ruhuna, Eastern University* and UNU-EHS.

The assessment approach that was developed and tested in this project aimed to explore various characteristics of vulnerability of different social groups, critical infrastructure and economic sectors to tsunamis and other coastal hazards. As a conceptual basis of vulnerability, the approach is based on the BBC framework (see Figure 8), which stresses the fact that vulnerability is defined through exposed and susceptible elements on one hand, and the coping capacities of the affected entities (for example social groups) on the other.

BOX 7: Pre-existing, Baseline and Emergent Vulnerability

The terms pre-existing and baseline vulnerability are understood as those vulnerabilities which exist before a disaster and are revealed within disaster situations. Some of these vulnerability characteristics are chronic (though dynamic and changing) such as malnutrition and poor access to clean water.

In contrast the term emergent vulnerability emphasizes that new vulnerabilities, for example within the dynamics of the recovery process, are formed and created. These emergent vulnerabilities are often solely visible within a disaster or the recovery process.

Birkmann underlined that in terms of the Sri Lankan case study "emergent vulnerabilities" were particularly generated by the procedures and rules of the recovery and reconstruction process, for example the fact that squatter households did not receive any financial support for the reconstruction of their houses which were heavily impacted.

The BBC-conceptual framework shows that it is also important to address the potential intervention tools that could help to reduce vulnerability in the social, economic and environmental spheres (Birkmann 2006). The framework integrates social, economic and environmental aspects into the vulnerability assessment, thus reflecting the "three pillars" of sustainable development.

Another example for emerging insecurity:

"More than half of the population in developing countries consists of highly vulnerable children. There is a need to re-think how can we assist this highly vulnerable group."

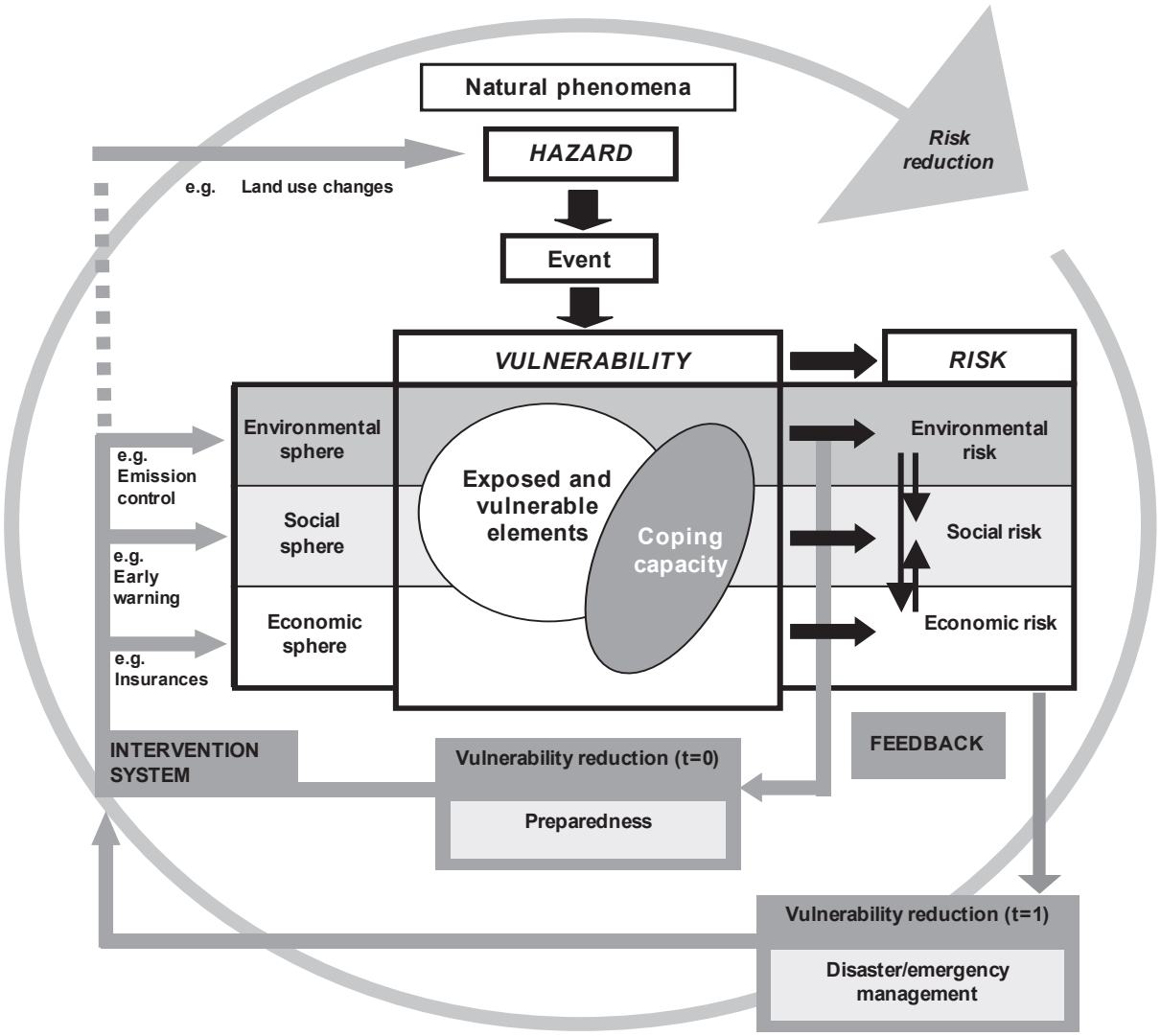
Oswald Spring (EWG II 2005)

The BBC-framework was used especially to design the assessment of the vulnerability of different social groups to tsunamis using questionnaires as a data-gathering tool. Altogether, the research encompassed four main techniques to identify and measure vulnerabilities, coping capacities and appropriate intervention tools, focusing on different data sources and different characteristics of vulnerability (see Box 8).

BOX 8: Overview of the Four Main Methods Used to Assess Vulnerabilities

1) *Assessment of the built environment with remote sensing*
   Estimation of vulnerability of different urban areas
2) *Critical infrastructure and sector vulnerability*
   Ground survey of the exposure and susceptibility of basic infrastructure services and their facilities, e.g. hospitals and schools
3) *Vulnerability of different social groups – questionnaire-based*
   Interviews with households in selected locations to identify and assess the different vulnerabilities of various social groups to tsunami risk. Focus group discussions, in-depth interviews with selected families and key informant interviews were also conducted
4) *Vulnerability of social groups and local communities*
   Census data-based assessment of vulnerability using general indicators

Figure 8: The BBC-conceptual Framework



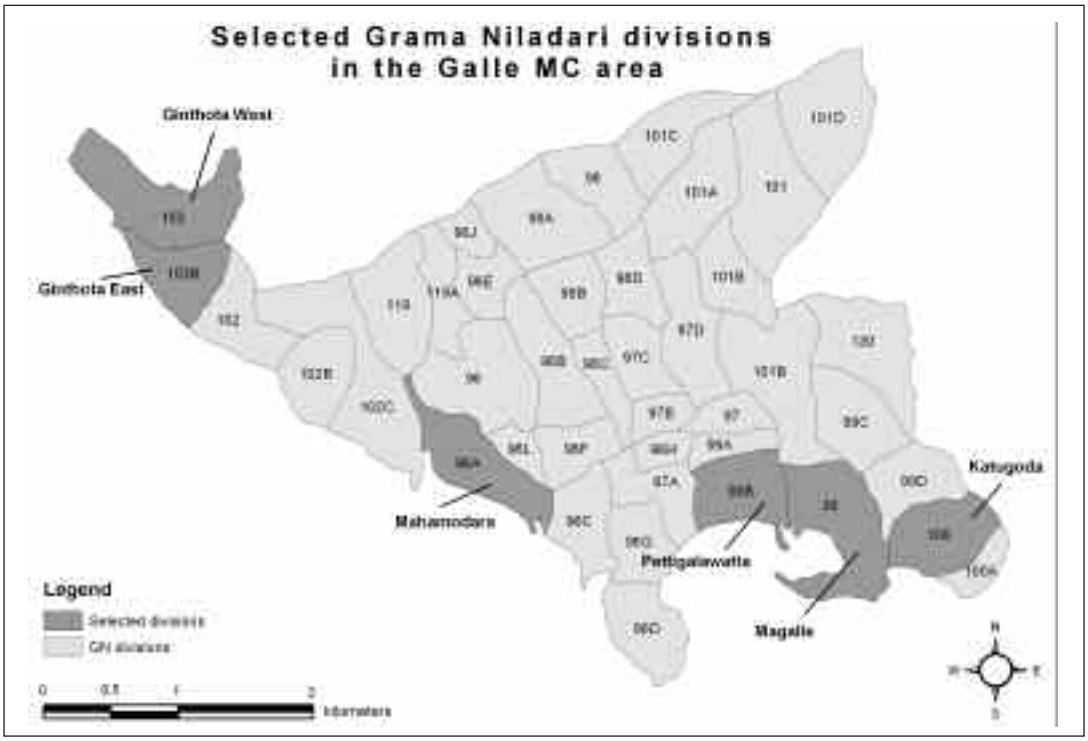
(Birkmann 2006, based on Bogardi/Birkmann (2004) and Cardona (1999/2001))

This research was primarily conducted in Galle and an additional assessment was also carried out in Batticaloa. While Galle in the southern coastal belt of Sri Lanka is primarily inhabited by Singhalese population, Batticaloa in the east coast is home to a primarily Tamil population (and some Muslims). It is

constantly facing civil and military strife between the Government of Sri Lanka and the LTTE *(Liberation Tigers of Tamil Eelam)*.

The presentation of Hettige, Fernando, Amarasinghe and Jayasingam encompassed first results of the study based on six sample communities in Galle (see Figure 9). A representative sample of 502 families within these six GN Divisions (Grama Niladari divisions, the smallest statistical unit in Sri Lanka) was selected.

Figure 9: Overview of Selected Sites in Galle for Questionnaire-based Research
(Birkmann et al., 2006)



The structure and content of the questionnaire take into account both the "BBC-framework" (see Figure 9) as well as aspects of the sustainable livelihood framework (DFID, 1999; Wisner et al., 2004, chapter 3), thus measuring susceptibility, the degree of exposure, coping capacities and intervention measures to reduce vulnerability (Figure 9).

Regarding the intervention tools – emphasis was given to the politically defined 100 metre buffer zone from the sea and the establishment of an early warning system.

Within the discussion ensuing the EWG meeting the usefulness of the buffer zone was questioned. However, without neglecting the conflict and confusion the establishment and amendment of the 100 metre

BOX 9: Structure of the Questionnaire

Vulnerability

Susceptibility and degree of exposure

1) Impact of the tsunami on household members and their assets;
2) Structure of household;
3) Housing conditions and impact of the tsunami;
4) Direct loss of possessions;
5) Activity and occupation of household members.

Coping capacities

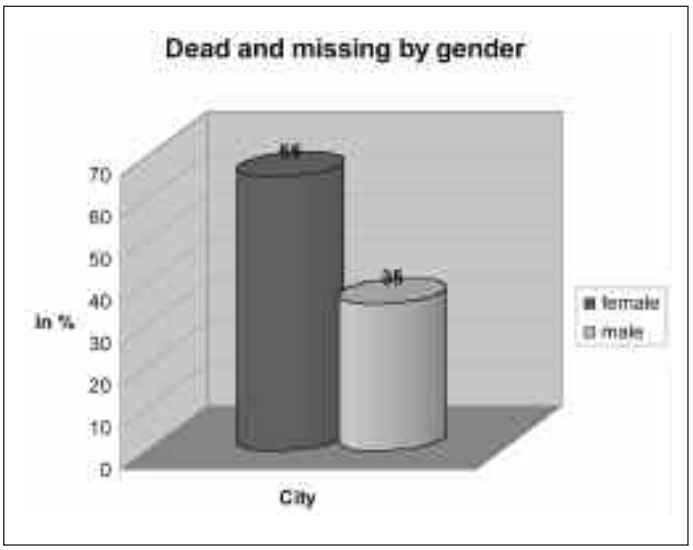
6) Social networks;
7) Knowledge of coastal hazards and tsunami;
8) Financial support from formal and informal organisations;
9) Access to information, e.g. radio.

Intervention tools

10) Relocation of housing and infrastructure to inland;
11) Early-warning system;
12) 100m 'buffer zone' (implemented by Government).

zone generated, the study shows that the likelihood of being killed by the tsunami in the 100m zone was twice as high as in the 200m and 300m zones away from the sea in Galle. In addition, data on demographic characteristics of dead and missing people showed that the youngest age group, 0-9 years (25 percent), and the age groups over 40 years (44 percent), elderly people in particular, were highly vulnerable to the tsunami. Additionally, gender played an important role with regard to the likelihood of being killed by the tsunami: nearly twice as many females (65 percent) as males (35 percent) were dead or missing in Galle (see Figure 10), a result also observed by Nishikiori et al. (2006) for the Ampara district in Sri Lanka in Tamil Nadu India by Guha-Sapir et al. (2006)

Figure 10: Dead and Missing According to Gender in Galle (Birkmann et al. 2006)



Besides vulnerability, also coping and recovery were studied. This was undertaken by analyzing changes in activities and unemployment, as well as the capacity of different households to recover (Birkmann, Fernando 2007). According to Fernando´s report it turned out that households living in the 100 metre zone who did not own their land were particularly ill-prepared to recover from the tsunami's impact. Based on a simulation model developed by UNU-EHS, households who owned land would theoretically need around seven months to replace their housing losses, while in contrast the group of squatters (or "encroachers") who had no legal title to land would need on average around 44 months to replace housing losses. The difference is due to a number of factors including higher income and different occupational patterns among land owning households and their access to loans. Moreover, landless households are not allowed to rebuild their houses in the same place; nor do they get financial support from the government for rebuilding inside the buffer zone. The problem of reducing vulnerability by decreasing the exposure of people (buffer zone), whilst creating at the same time confusion and conflicts for those who were living there and are now displaced is also addressed by Madhavi Ariyabandu in the South Asian Disaster Report (Duryog Nivaran 2006).

Lastly, the study showed that when looking at how tsunami-affected people cope, assets such as access to social networks, memberships in community-based organizations, mutual trust and reciprocity in society play an important role. Interestingly, a significant proportion of household members interviewed were not members of local organizations. As a result, only 6 percent of community members received financial assistance from local organizations to recover from the tsunami. In contrast, nearly 98 percent of respondents received different types of aid in cash and kind from various UN agencies such as UNDP, UN-Habitat and other government and non-governmental organisations to recover from the tsunami. This underlines the important role of international support. On the other hand the study shows that when the tsunami first hit it was neighbours (55 percent), friends (10 percent), other family members and relatives (18 percent) who first came to help the affected people before other authorities – which shows the close relationship with social and family networks.

During discussion, Bohle and Wisner underlined that the study undertaken in Sri Lanka is an excellent example of linking a conceptual framework – the BBC-framework – with empirical work conducted in the field based on questionnaires. However, they questioned whether the study should also focus on the broader

> *"In some cases the crisis after the tsunami can also be an engine of development and transformation – if properly managed (window of opportunity)."*
>
> Bohle (EWG II 2005)

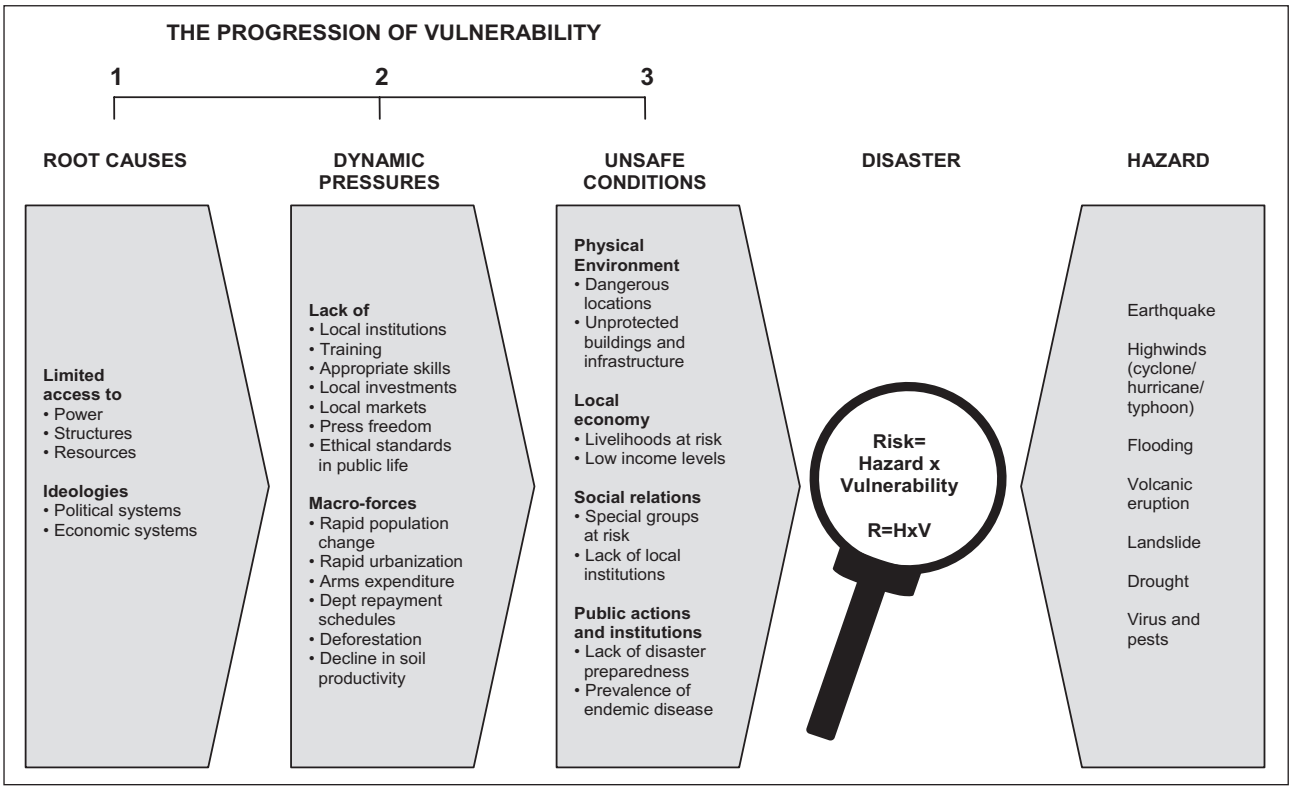
picture, for example, on how the conflict influenced the vulnerability of people before the tsunami. The discussion of base-line vulnerability emerged. That means the crisis might turn out to offer new windows of opportunity. In this context Wisner suggested that one should integrate the conflict dimension (civil war in Sri Lanka) and examine the root causes of vulnerability, e.g. based on the history of development and on theoretical approaches, such as the political economy. The South Asian Disaster Report 2005 (Duryog Nivaran 2006) outlined important developments in the past that contributed to the high vulnerability of coastal communities in Sri Lanka such as the construction of critical infrastructure along the coast and also economic activities such as illegal coral and sand mining as well as encroachment of highly exposed areas. In addition, protective mangroves had been removed for strategic reasons by the Sri Lankan military (to deny the *Liberation Tigers of Tamil Eelam (*LTTE) places to hide). Furthermore, Bohle pointed out that disasters are a tragedy and mega disasters even more so, however, in some cases, the crisis after the tsunami can be also an engine of development and transformation – if properly managed.

The final report of the "Rapid and Multidimensional Vulnerability Assessment in Sri Lanka – Case Studies Galle and Batticaloa" can be obtained soon from UNU-EHS and the University of Colombo and Eastern University.

3.2 US Gulf Coast: Hurricane Katrina

Oliver-Smith, from the University of Florida, reviewed the hurricane Katrina disaster. He emphasized that understanding forced migration and vulnerability requires seeing the totality of relationships in the social situation that produced a disaster in combination with the atmospheric trigger event. He used the *Pressure and Release Model* by Wisner and his co-authors (2004) in which a disaster is understood as the product of vulnerability (composed of root causes, dynamic pressures and unsafe conditions) and natural hazards (Figure 11).

Figure 11: The Pressure and Release (PAR) Model: the Progression of Vulnerability
(Wisner et al. 2004: 51)



Against the background of this multifaceted understanding of vulnerability and disaster, the connections between disaster and forced migration involve a complex chain of causes and effects. That means disaster outcomes are rarely the result of a single agent (e.g. a hurricane), but by multiple and intersecting forces acting together in a specific social context that is complex in its own right, as it becomes very clear in the case of hurricane Katrina. In this regard Oliver-Smith explained the potential continuum of migration types. It can range from

- voluntary to forced;
- permanent to temporary;
- proactive to reactive;
- administrated to non-administrated.

In New Orleans the lack of appropriate and prompt support from official agencies became obvious. Oliver-Smith pointed out that many hurricanes in the last 150 years passed near or even hit the New Orleans region (as in 1965). Hence, hurricane Katrina did not appear from nowhere and coping measures could (and should) have been in place. In the terms used in the Pressure and Release Model (Figure 11), public actions and institutions as well as social relations were insufficient to meet the demands of social protection under the stress of this hurricane hazard. Some 120,000 people without access to transportation could not evacuate before the storm.

Oliver-Smith paid special attention to the spatial correlation of those areas of New Orleans highly exposed (i.e. lying below the sea-level; Figure 12) and those areas whose inhabitants suffered chronic socio-economic deprivation (i.e. areas with a high proportion of people living beneath twice the poverty threshold; compare Figure 13).

Figure 12: New Orleans Elevation Map

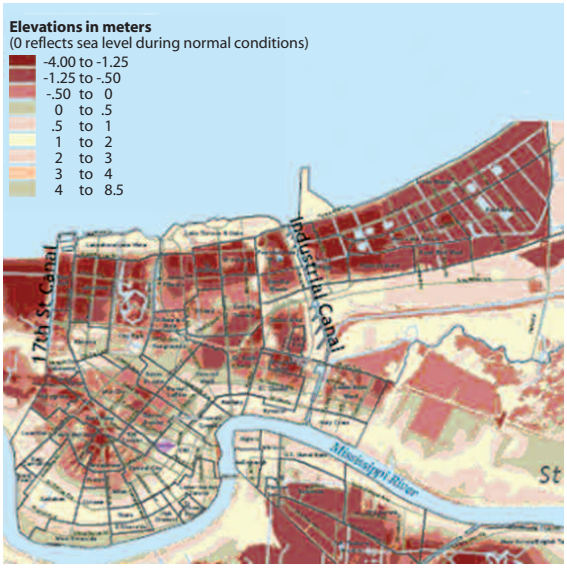
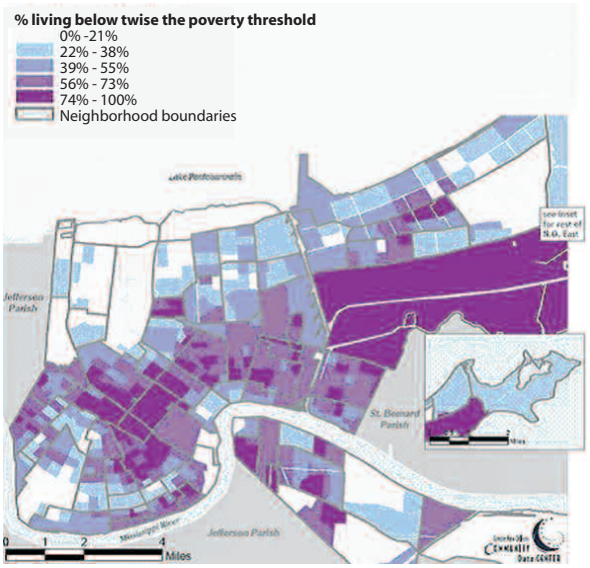


Figure 13: New Orleans Poverty Map



(Greater New Orleans Nonprofit Knowledge Works 2006)

Here the linkage between unsafe conditions and impoverished socio-economic conditions becomes evident and led to high vulnerability and impact on life safety and livelihoods in the Katrina event.

Finally, Oliver-Smith outlined the particular impact of hurricane Katrina with regard to forced migration, in the course of which migrants were spread out to many of the 50 states in the U.S.A. year later there are still 160,000 people who have not returned, many of them from low income groups who had lived in low lying, highly impacted areas such as the 9th Ward.

> *"For the vast majority of the inhabitants in the affected areas forced migration hence became the bitter reality."*
>
> Oliver-Smith (EWG II 2005)

3.3 Russia: Flood Vulnerability

Ivanov, researcher at the *Nizhny Novgorod State University of Architecture and Civil Engineering,* Russia, outlined research on vulnerability to flood of cities and villages in the Volga region experiencing economic, social and institutional transformation in Russia. An important goal of the study is to support the effort of the *Civil Protection, Emergency Response and Disaster Management Agency* (EMERCOM) to develop vulnerability reduction policies for communities and settlements being affected by floods in the Volga Basin in the Province of Nizhny Novgorod. Ivanov believes Russia has an urgent need to develop tools that enable policy makers and disaster managers to evaluate short and long term disaster management approaches and interventions (including, but not exclusively, cost-benefit of the different strategies).

In this context Ivanov outlined the differences between short and long-term strategies to mitigate flood losses. In a first phase the research focused on the development and testing of indicators to measure vulnerability to floods in the Volga Basin. The goal was to develop indicators that are useful for decision makers, particularly EMERCOM. Financial and conceptual support has been provided by UNU-EHS.

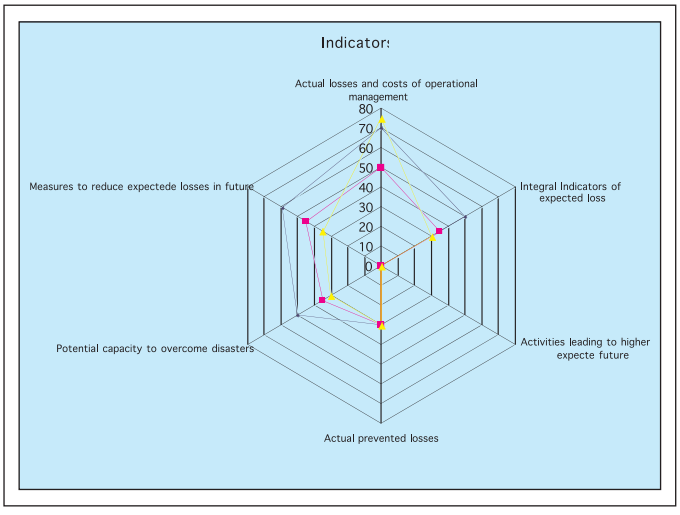
The case study comprises seven settlements in the Volga Basin, where overall 300 to 1000 households are regularly affected by the spring floods, yielding a flood frequency of 0.2 events per year. The analysis in the Volga basin deals with small and medium size floods leading to small and medium size damages of property, infrastructure and agricultural assets usually without human losses. This contrasts with the case study discussed earlier of the tsunami in Sri Lanka as a mega-disaster. Those people exposed to floods in the Volga River area are chronically stressed through their daily struggle to maintain their livelihoods in the post-Soviet economic and political environment as well as due to exposure to flood risk over the past ten years. Many live below the poverty line. These communities are often characterized by subsistence farming based mainly on growing potatoes (the cheapest staple food in the region).

Due to their chronic poverty and daily struggles, most people in these villages do not invest income in flood protection or insurance.[2] They also manifest a deep mistrust in government institutions.

> *"People´s mentality in these rural flood affected villages is characterized also by the deep mistrust in government institutions."*
>
> Ivanov (EWG II 2005)

Conceptual Framework

Figure 14: States and Scenarios for Transition
(Ivanov 2005)



The first phase developed three sets of quantitative vulnerability indicators. The first investigates experienced losses (financial, human, natural resources) and calculates actual costs of preparedness (e.g. actions and projects to reduce losses) as well as costs and losses prevented during disasters. The reference time period of the indicator is one year.

The second set comprises integral indicators, such as modelled expected losses and potential capacity to overcome disasters within a 100 year period. Looking at expected losses to flood hazards, vulnerability will be measured according to the classification of economic, social and environmental vulnerability. Potential capacity to overcome disasters is mea-

2 On the use of insurance as a tool for reducing the vulnerability of the poor, see Mechler et al. (2006).

sured through focusing on institutional activity, such as long-term civil, legislative, and administrative decisions to reduce potential losses as well as on facilities and structures that contribute to vulnerability reduction. This aspect of the study compliments the work of Nikitina, Greiving, and Pelling discussed later in this report.

The nature of the third set of indicators is differential, meaning the calculation of annual changes of potential losses per year on the one side and the growth rate of strategic prevention measures on the other. Sub-indicators related to potential losses include those caused by climate change, by the growth of external threats (socio-economic development), and the annual growth rate of prevention costs. Strategic prevention growth rates are to be estimated by calculating the cost of relocation of assets from hazardous areas to safe areas and construction of dykes and dams measured as a percentage of the value of saved assets.

Overall, Ivanov concluded that the study is still in its first phase and that it is much more difficult than expected to obtain the data needed.

First findings underline the fact that governmental institutions such as EMERCOM have no long term strategy for disaster mitigation. Instead, priority is given to operational disaster management (e.g. evacuation plans).

> *"Also, the socio-economic and institutional transformation in Russia hampers data monitoring in many governmental institutions, thus the official census and ministry data is often of poor quality."*
>
> Ivanov (EWG II 2005)

Next steps in the assessment will be the testing of the indicators for urban agglomerations and the development of sub-indicators to measure social, economic, and environmental dimensions. This will be done in close cooperation with relevant decision makers.

3.4 Tanzania: Vulnerability Assessment at Sub-national Level

In recognition of the various threats that Tanzania faces (flood, drought, pests, famine, cyclones, fire), the government has made various efforts to strengthen its capacity for disaster management by introducing policies, legislation, and operational guidelines. However, these efforts confront obstacles due to lack of reliable data on vulnerability in communities that are exposed to hazards. Therefore, as stated by Bilia, a national and sub-national vulnerability assessment was considered a precondition for taking evidence based decisions in disaster management. Thus a study of sub-national vulnerability assessment was conducted jointly by the *Tanzanian Disaster Management Department* in the Prime Minister's office and the *University College of Lands and Architectural Studies* (UCLASS).

Specific objectives of the study were to:

- determine the type, location and frequency of the disasters at the household, village, district and national level;
- identify the current capacity and coping systems (organizational arrangement) at household, village, district and national level;
- identify causes of vulnerability of major hazards in Tanzania;
- develop a national vulnerability index;
- map vulnerability specific hazards at national level;
- develop a national vulnerability analysis report.

Four main parameters were used to calculate vulnerability indexes at various scales for Tanzania prone to a series of hazards. These parameters were hazard occurrence, effects of the last disaster occurred, hazard manageability and coping strategies. Following UNDP (1992), the following formula was used:

$$\text{Vulnerability} = (\text{Hazard} * \text{Risk}) / (\text{Manageability})$$

The analysis was based on agro-ecological zones as a spatial division of the country. These zones directly reflect the physical and sometimes also indirectly the socio-economic conditions of the different communities in the country. This is because more than 75% of the population in Tanzania live in rural areas and depend heavily on farming to sustain their livelihoods.[3] Areas with reliable rainfall and good soils are likely to be economically and socially better off than areas exposed to drought and with poor soils. The scale of the study was set up to yield a country-wide vulnerability index. By using a multistage sampling method, the sample size was determined to be 2,040 households living in 84 villages to be found in 42 out of 113 Tanzanian districts. The main tools used for this study include questionnaire-based interviews at household, village, and district level, checklists, GIS *(Geographical Information Systems),* and statistical analysis. For each level specific questions were used to capture vulnerability and manageability. For example, at the household level, the question on manageability was meant to determine levels of awareness, while at the village and district level it was meant to determine the level of preparedness.

Results

Hazard Occurrence

The results of the interview and household data were used to aggregate hazard and disaster occurrence for the whole country according to agro-ecological zones. The study revealed that among the most occurring hazards are pests, drought and disease outbreaks.

Coping Strategies

Coping strategies for the three most frequently-mentioned hazards were generated for each zone by matching and summarizing the captured coping strategies at all levels. With respect to coping capacity, the three main methods identified to cope with drought are selling of assets (33%), seeking employment elsewhere (29%), and growing drought resistant crops (22%). Also here, comparable values for the three most common hazards according to agro-ecological zones were calculated.

Risk Levels

Moreover, a risk index was calculated for specific disasters by fitting the response variables of the household questionnaire linked to the impacts of the last disaster (e.g. loss of life, property and loss of income) into a statistical model that meets the Hosmer and Lemeshow criteria (Neter et al., 1996: 347) (i.e. all variables with a p-value of at least 0.25 in a univariate logistic regression analysis were considered for further analysis). In the case of the impact variable "loss of income", hazards with significant impact were drought and floods. Also a single estimate encompassing all effects (see above) for each agro-ecological zone has been calculated.

Vulnerability Index

Finally, a series of vulnerability indices were developed by using the UNDP formula. Consequently, the vulnerability index was calculated by multiplying the value for hazard occurrence by the value for risk, divided by manageability. A vulnerability index for each zone for each hazard was produced, as well as an aggregate vulnerability index for each agro-ecological zone (Table 1).

3 Recalling discussion of economic and social thematic areas earlier, one will not be surprised that throughout rural Tanzania to varying degrees of informal income and activities also make up a part of people's livelihood strategies (see Bryceson et al, 2000).

Table 1: Vulnerability Index Parameters for Drought by Agro-ecological Zone
(Kiunsi and Meshack 2006)

Parameters	Zones						
	1	2	3	4	5	6	7
Manageability	67.78	76.47	75.99	74.72	68.57	76.80	71.02
Hazard occurrence (drought)	31.06	38.94	30.00	78.91	57.69	43.04	40.21
Risk	0.16	0.31	0.38	0.31	0.42	0.53	0.15
Vulnerability Index	0.06	0.16	0.15	0.33	0.35	0.30	0.08

Legend: Zones 1 = Coastal; 2 = Eastern plateau and mountain blocks; 3 = Southern highlands; 4= Northern rift valley and volcanic highlands; 5 = Central plateau; 6 = Rukwa-Ruaha rift zone; 7 = Inland sedimentary, Ufipa plateau and western highlands.

Using drought as an explanatory example, the central plateau (Zone 5) is the most vulnerable (0.35), closely followed by the northern rift and volcanic highlands (Zone 4) (0.33) and the Rukwa-Ruaha rift zone (Zone 6). Even though drought occurrence is highest in the northern rift and volcanic highlands (Zone 4), its vulnerability is the second highest because this zone has a relatively low risk factor compared to the central plateau (Zone 5), due to higher drought manageability capacities. The Rukwa-Ruhaha rift zone (Zone 6), which is the third most vulnerable area, has the highest risk factor compared to the other zones, but has relatively low drought occurrence and the highest manageability capacities. The other zones have essentially low drought vulnerability because they have low drought occurrence and high manageability capacities.

During the discussion Wisner made a point that relates to the way infrastructure was conceptualized. Hospitals, dispensaries and open spaces were addressed in the study, but not schools. Wisner recommended future research that also considers the exposure of other community infrastructure, especially schools. School children in Tanzania may be exposed to such hazards as earthquake, lightning strikes, high wind, fires, and landslides. In addition, schools are often used as community shelters and rallying points following disasters, so they should be resilient and safely located. As disaster management departments may often be relatively weak in the many countries, Wisner recommended trying to establish an intensive cooperation with the *Ministry of Education* in order to be able to accomplish such a study – focusing on the exposure and vulnerability of schools and children.

IV. Specific Foci

Attention was paid to specific methods of vulnerability assessment that have been relatively neglected by most researchers. Those foci can be subsumed under four categories:

- vulnerability and spatial planning;
- vulnerability assessment using remote sensing;
- institutional vulnerability; and
- environmental vulnerability.

4.1 Vulnerability and Spatial Planning

Borchard, President of the *Academy of Spatial Research and Planning* in Germany, discussed the linkages between spatial planning and vulnerability assessment. The *Academy for Spatial Research and Planning* (ARL) is a research institute for the spatial sciences performing service functions in both fundamental and applied areas of research. The ARL was founded in 1946 and is a self-governing body and its performance is of supra-regional as well as national importance for Germany and beyond. The ARL's research interest is how to foster sustainable spatial development that includes social structures, private and public infrastructure as well as regional economies. Moreover, the ARL assists governments with spatial planning and is involved in European spatial development as well as in other cross-border planning ventures.

With regard to the necessity of risk assessment within spatial planning, Borchard stated that although natural and technological risks have long been subject of a great deal of attention within spatial planning in Germany, there is still a substantial lack of risk assessment capable of looking beyond natural hazards. In other words, there are shortcomings in the way spatial planning deals with natural and technological risks.

Furthermore, the integration of risk assessment results into cross-sectoral spatial planning being conducted in Germany at federal, provincial, regional, and municipal levels is less than satisfactory. There is an urgent need for integrating risk assessment into spatial planning, but so far there is no comprehensive risk-information system available to serve spatial planning. Hence, the spatial planning community has strong interests in fostering the development of sound risk and vulnerability assessment methods.

> *"There is an urgent need for integrating risk assessment into spatial planning; however, so far, there is no comprehensive risk information system available to serve the needs of spatial planning information on risk, hazard and vulnerability."*
>
> Borchard (EWG II 2005)

One of the biggest problems in bringing together risk management and spatial planning in Germany lies in the difficulty of drawing a clear distinction between the concepts of "hazard" and "risk". The main issues of concern in this area are the different administrative responsibilities resulting from this distinction. While technological risks fall under the responsibility of the users of these technological systems, hazards of natural origin cannot be accounted to anyone's responsibility in the original sense of the word.

In the discussion, some participants underlined, that also a landowner who cuts down the forest and in doing so causes increased rain water run off may exacerbate flood risk for downstream residents and will therefore surely be considered "responsible".

Again, according to Borchard, spatial planning in most cases has to deal with risks which cannot be clearly attributed to just one source – natural hazards and technological hazards sometimes with complex inter-relations (the so-called Natech hazards that combine natural and technological – as in the chemical and oil spills that followed hurricane Katrina in New Orleans; CDC 2006). Moreover, to allow for

sound spatial planning based on detailed consideration and weighing of (minimum) risk and (greatest) benefits, clear planning competences must be assigned to assure spatial planners have access to all the information they need.

For the development of spatially-oriented risk management, Borchard proposed a number of steps.

The first should be to identify the assets at risk from proposed developments or measures and to classify these assets within an assessment procedure using indicators. This step should be undertaken in collaboration with sectoral planning authorities, which is particularly important because of its preventive effect. Assets that are affected by hazard impacts may – through their destruction or malfunction – themselves become a source of new risk (e.g. loss of a water or electrical distribution system). Planning can help to prevent such loss or malfunction.

In the second step all data collected should be aggregated into an expression of a total "risk load" affecting a particular area.

The third step should then be to define specific "risk-area categories" based on the aggregated risk load examined in the second step. Those categories which then call for special attention are the ones that require a specific response on the part of spatial planning. The approach presented here could benefit from the methodology used within the framework of *European Spatial Planning Observation Network* (ESPON) hazard project.

Linking spatial planning to risk and vulnerability assessment is necessary for good spatial planning. The case of flood protection can serve as an example. In Germany there is a long tradition of settlement in floodplains of rivers, which by definition are areas at high risk of flooding. Furthermore, we see that public funds are primarily used for the construction of technical flood protection rather than making available the land which would be needed for retention areas. Even today, there is a certain resistance to measures aiming to secure such land for flood protection or at least to restrict development in those areas.

4.2 Remote Sensing and Vulnerability Assessment

Figure 15: Report on Rapid Vulnerability Assessment in Sri Lanka (Birkmann et al. 2006)

Recent projects have been trying to incorporate remote sensing into the field of vulnerability assessment. One of such projects was the testing of approaches for satellite based vulnerability mapping in Sri Lanka conducted in cooperation with the *German Aerospace Center* (DLR) and UNU-EHS. This work was financially supported by the UN-Flash Appeal and the *United Nations International Strategy for Disaster Reduction* (UN/ISDR). Voigt from the DLR explained that a major subcomponent of the project "Rapid and multi-dimensional vulnerability assessment in Sri Lanka" was a satellite based vulnerability mapping. The idea behind using remote sensing to estimate vulnerability was that vulnerability is linked to people who mostly live in houses and use certain infrastructure which can be assessed with satellite imagery.

Additionally, the proximity to the sea and to earthquake hotspots can be easily examined with the help of satellite imagery.

In a second step vulnerability proxies using remote sensing could be compared to ground truth data in order to check the reliability of the satellite data and to assist in interpreting data.

The analysis of vulnerability in this project used *Earth Observation* (EO) and GIS data structured according to the following steps (Nassel and Voigt 2006):

- thematic classification and zonation;
- analysis of settlement structure (settlement structure types);
- derivation of vulnerability indicators (estimation of physical vulnerability of specific buildings based on their roof, height, and density)
- scenario computation;
- derivation of vulnerability estimations based on EO and GIS.

The project showed that ex post comparisons, e.g. of the alteration of the coast line caused by the tsunami (see Figure 17), could be conducted quite accurately even though minor difficulties in defining the exact run of the coastline occurred, e.g. at places were overgrown parts alternate with open beaches or in areas of heavy tidal influence (see Figure 17).

Figure 16: Ex Post Tsunami Hazards and Impact Mapping Comparing the Coast Line Before and After the Event in Banda Aceh, Indonesia (Voigt 2005)

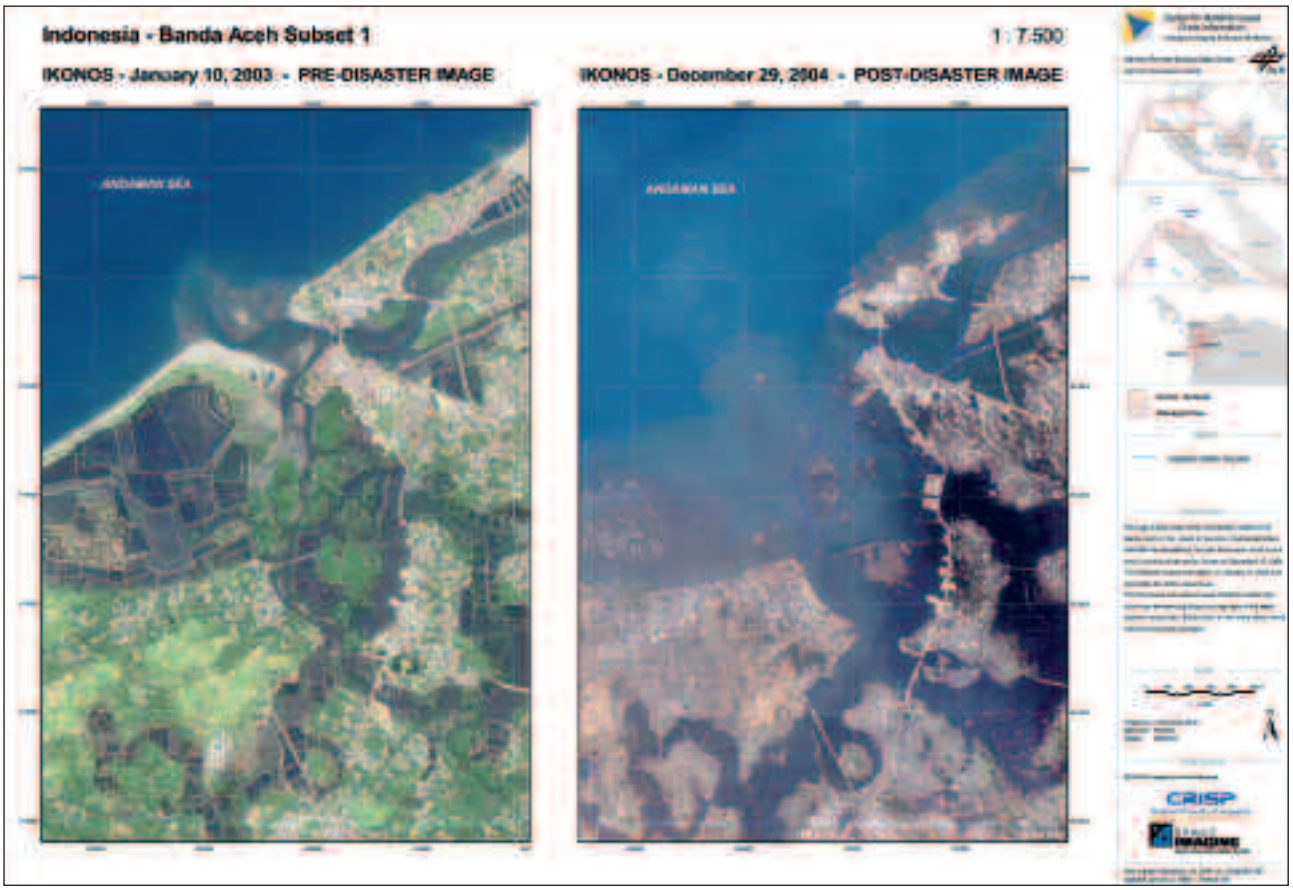
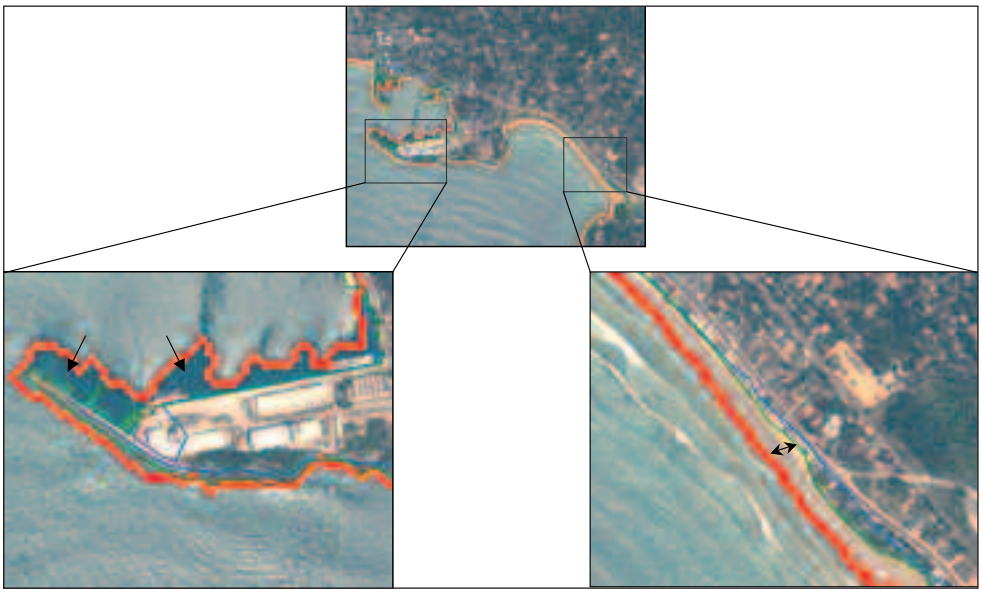


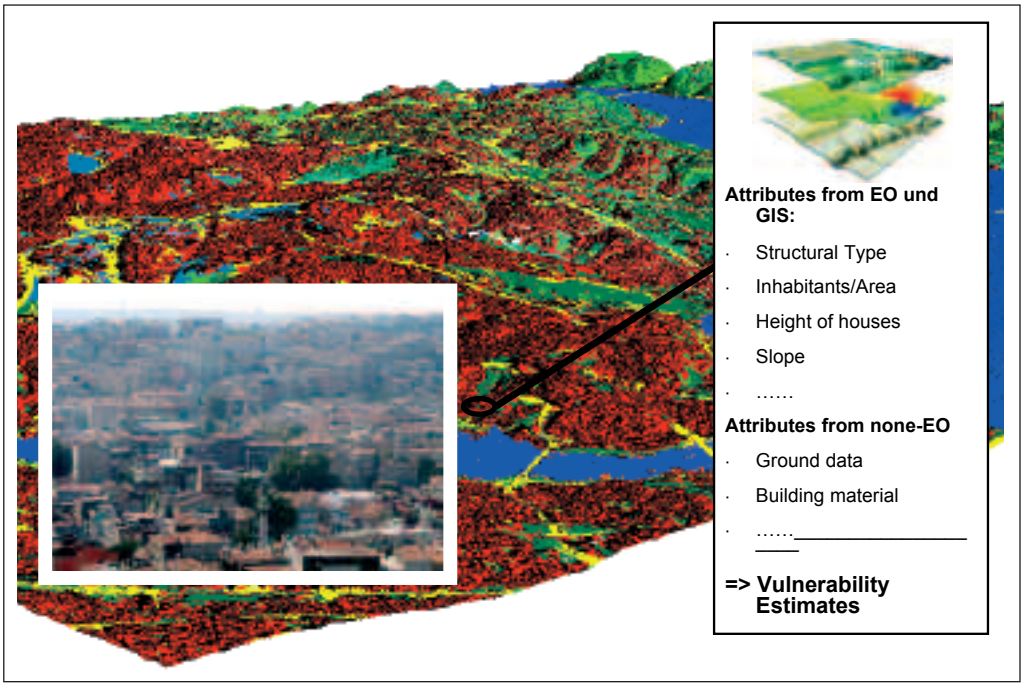
Figure 17: Difficulties in Defining the Exact Run of the Coast Line in Galle, Sri Lanka (Voigt 2005)



The analysis also showed that the computing and aggregation of features like vegetation density, homogeneous settlement types or settlement structures is much more complicated, and comparison with ground truth data revealed some substantial inaccuracies. However, the overall analysis showed that remote sensing can be a great help for impact and rapid vulnerability assessment particularly in terms of the physical dimension and the revealed losses.

Of course, EO and GIS data do not constitute assessment of vulnerability on their own because aggregated data derived from different remote sensing methods has to be checked against, and combined with, ground truth data. Such checking is evident in a project aimed at estimating vulnerability to earthquakes in Istanbul with the help of IKONOS imagery combined with ground data covering building material and structure, etc. – see Figure 18)

Figure 18: Zonation of Istanbul using IKONOS imagery (Taubenböck and Roth 2006)



4.3 Institutional Vulnerability

Many presentations touched on institutional vulnerability.

The presentation of Greiving from the *University of Dortmund,* Germany, approached the topic by defining institutional vulnerability as being determined by the arrangements which organize risk assessment, management and communication. The term "Institutions" was defined as all public agencies dealing with risks on a collective level.[4] For example, as seen in the Katrina case study, institutional arrangements from local through state to federal seem to have increased rather than decreased the vulnerability of most people to the hazards presented by the hurricane and its aftermath (flood, chemical spills, etc.). Hence, vulnerability assessment is first and above all meant for public institutions aiming at better decision making. In order to do so they need to enhance their understanding of how institutional systems at issue work – one fundamental component of vulnerability assessment.

> *"Measuring institutional vulnerability has to assess institutional settings (existing instruments, measures, procedures and responsibilities) as well as their performance in practice."*
>
> Greiving (EWG II 2005)

In Greiving's view, increased institutional vulnerability can arise in two ways. Firstly, there can be mismatches in the interplay among different institutions involved in risk assessment, communication, and management. Secondly, there can be mismatches between institutions and stakeholders. In order to capture both dimensions institutional vulnerability has to be assessed by measuring both, institutional settings (existing instruments, measures, procedures, responsibilities) as well as their performance in practice (decisionmaking in emergency situations at sub-national and local levels).

Coordination between institutions responsible for two basic social protection functions – preparedness and mitigation – is seldom optimal. Even considering just mitigation plans and programmes, these are carried out by different actors (spatial planning, water management, geological survey, etc.) each promoting different mitigation actions which are often not well coordinated. In other cases hazard and vulnerability related information is simply not available or does not satisfy the needs of different end-users (scale, content, etc).

In order to track potential mismatches, indicators could include whether shared risk assessment standards (e. g. hazard risk maps) have been established within a jurisdiction or whether there are working groups aiming to coordinate risk management activities. By the same token, possible improvements might include the development of guidelines for harmonized risk assessment (such as the forthcoming EU directives on flood risk management and hazard mapping; EU 2006). Additionally, funding policy could be readjusted, setting protection goals to be guaranteed on a comprehensive, regional basis (with representatives of all actors involved) instead of granting single projects.

Concerning emergency response, poor coordination is also observed. Greiving reported that actors frequently only have contact with people from their own organization but not with "external" actors. Moreover, in many cases substantial disagreement exists concerning the scale of event that should trigger response, and this leads to delay in response. Concerning indicators of this problem, Greiving suggested some possible criteria. Firstly, the existence of standard national organisational regulations for disasters (although care should be taken to differentiate between paper plans such as existed in the case of Ka-

> *"Hazard and vulnerability information is often not available or does not fulfil the needs of the different end-users. Thus one possible response could be the development of guidelines for harmonizing risk and vulnerability assessment."*
>
> Greiving (EWG II 2005)

4 M. Pelling (see below) defined institutions differently as sets of rules both within and among institutions, a concept that includes informal and tacit expectations in addition to formal "arrangements."

trina in the U.S. and actual implementation and execution of the plan). Secondly, one might investigate the existence of common overall goals for disaster protection and their implementation in practice. Thirdly, the existence of complementary equipment and qualifications should be checked ("inter-operability"). Fourthly, one can inquire whether or not simulations of emergency situations are conducted in order to test readiness for disaster preparedness and response.

In order to reduce mismatches, response actions can be improved and fostered. To do so, it is necessary to define common overall goals of disaster protection, e.g. by means of protection objectives for different protection goods (people, infrastructure, private property). Additionally, a clear definition is required and an investment policy that rules out overlapping tasks and distributes resources according to protection requirements. Moreover, the training in the so-called "soft" capabilities and skills (motivation, social and communicative competence, discipline, etc.) is essential, particularly for task forces and management staff. Finally, it is crucial to communicate the goals to the local stakeholders and, as some mentioned in discussion, intensive listening to what local stakeholders have to say in response.

Nikitina from the *EcoPolicy Research and Consulting* from Russia presented a study similar to the one by Ivanov. Institutional capacities and incapacities with regard to floods in Asia were assessed. This work arose because of the paradox that even though there are many institutions in place, the number of people affected by floods in Asia has doubled within the last decade. This paradox raises many questions. Which institutional failures occur and why? What possible measures are there to improve the situation? In order to answer these questions the researchers chose an approach that distinguishes between "design" and "action" (i.e. plan vs. implementation or invention vs. performance). This approach allows identification of success and failures in the performance of institutions and promises clarity concerning those shortcomings rooted in the institutional design or set up and those successes and failures that stem from insufficient implementation (action).

In order to allow for an even more specific analysis, the approach analysed management of flood events according to the stages of preparedness, emergency, response, and rehabilitation.

The study presented was carried out in cooperation with researchers from Japan, Russia, Thailand, and Vietnam. In all these countries floods are at the top of the national disaster reduction agendas with a particular focus of linking science and practice. Similarly to the study presented by Greiving, institutional capacities and incapacities were assessed in light of the complex of intertwining administrative arrangements, the appointment of vertical and horizontal responsibilities including overlapping and conflicting mandates and missions among national, provincial, and regional agencies. It also took into consideration the fabric of legislation, the existence of programmes, strategies, and action plans related to the allocation of financial resources as well as insurance and availability of policy tools.

The study revealed some positive trends taking place over the last few years. The last decade witnessed several attempts to modernize institutional settings coming along with an enhanced awareness for the necessity to combine emergency efforts with sound prevention and planning.

Moreover, there is a trend towards broader involvement of capacities at the local level as well fostering of community based participation. Concerning state participation, the study revealed that its role is formally very large. This is because the state in most systems of political theory is the provider of public goods including the performance of emergency actions and, to some extent, the improvement of societal and economic resilience (Wisner 2005)

However, the study also revealed problems. The external factors explaining shortcomings are relatively easy to identify since they have existed and been subject of study for a long time. Typical examples are the impoverishment of the population, financial shortages, corruption, and weak legislation or at least weak enforcement of legislation. Internal factors, how-

> *"Although an intensive coordination between stakeholders and authorities is envisioned by most of the institutional designs, implementation can not be observed widely."*
>
> Nikitina (EWG II 2005)

ever, are more complicated and cause to return to the question whether one is dealing with defects in design of risk reduction institutions or simply poor performance. For example, intensive consultation between stakeholders and authorities is envisioned by most of the institutional designs reviewed by this study; however, implementation was generally observed to be weak. By the same token, bureaucratic barriers of all kinds were found to be still very high and non-compliance with existing legislation, particularly in weak states, was widespread.

Plenary discussion achieved consensus that the management of risks has become increasingly politicized and contentious in recent years. Defining risk is an exercise in power. Who in society should decide what an "acceptable" or "real" risk is? Hence, trust, or better the lack of it, has to be understood as central for the question of how disparities between "real" and "perceived" risk might engender public discourse. Moreover, more public participation in both risk assessment and risk decisionmaking is needed for more legitimacy and public acceptance of the resulting decisions.

4.4 Environmental Vulnerability

Another area of vulnerability research discussed was the role of the environment in two ways – with respect to hazard impact (intensity), vulnerability, and human well-being as well as regarding human impact on natural systems. Presentations by Kok, Renaud and Jayasingam reviewed how researchers conceptualize environmental vulnerability and what methods and tools can be used to identify and assess environmental concerns in the context of hazards of natural origin.

Kok introduced the approach of archetypes of vulnerability that have been generalized from different parts of the world – for example, the semi-arid tropics or sub-tropical mountainous environments. Such modelling has been advanced as a way that planners can anticipate negative interactions between land use and livelihood and long run sustainability in the face of recurrent natural hazards. (UNEP 2007)

Renaud and Jayasingam presented examples of applied indicators to measure environmental vulnerability after the Indian Ocean Tsunami in Sri Lanka at the local level. In this context interesting and controversial questions emerged such as whether there is a unique "environmental vulnerability" separate from human activities and how far human vulnerability should encompass environmental vulnerability thus implying coupled human-environment systems. Therefore, the term "environmental vulnerability" brings about a two-fold perspective and created vivid debate.

The first point of view focuses on the susceptibility and fragility of ecosystems and environmental components themselves (implying philosophically a bio-centric vs. anthropocentric perspective).

Figure 19: Mangroves in Sri Lanka

Figure 20: Water Supply After the Tsunami

(UNU-EHS, Renaud)

This view was represented by Jayasingam, who underlined the importance of focusing on the impact of the tsunami wave on the coastal landscape as well as on how human induced threats increase the vulnerability of environmental systems, for example through civil war, mining and fish-farming as observable in Sri Lanka. Thus according to this first view "environmental vulnerability" is a function of the fragility of environmental systems and their continuous change over time, implying impacts for humans only as secondary consequences.

The second point of view regards "environmental vulnerability" as a disruption of environmental services which are essential for human well-being, such as clean drinking water, fertile and non-toxic soils for productive agriculture, etc. From this perspective the impacts of hazards are analysed in terms of the interlinkages between environmental or ecosystem services and human activities and needs. This kind of analytical approach was adopted by the *Millennium Ecosystem Assessment* (2006) and also by GEO-4 (UNEP 2002, p.303). This second view is philosophically anthropocentric as opposed to bio-centric, and has become the dominant departure point of international research (e.g. notions of "sustainable human development" and "environment and development.") *The Hyogo Framework for Disaster Reduction* contains this set of assumptions as well to the extent that it prioritized "mainstreaming" disaster risk reduction into development.

Against this background Renaud formulated key questions which have to be answered in order to set up indicators to measure environmental vulnerability in coastal areas to tsunami and other coastal hazards.

- What role and value do the different environmental components in terms of protection (exposure) have?
- What services are provided by an ecosystem for a human community (vulnerability)?
- What is the state of the resource: quality, quantity and reliability?
- To which extent are environmental services accessible to human communities and the different social groups?
- What are the capacities to cope and to adapt possessed by both the environmental and eco-system components and the human community (and constituent groups – e.g. to climate change or increased climate variability)?

Regarding the first question, the situation in Sri Lanka after the tsunami indicated some intact mangrove stocks had buffering effects on the waves, which means they mitigated the impact of the tsunami (protection) on coastal communities. By contrast, where these natural buffers were replaced by urban infrastructure major fatalities and destruction occurred.

The impact of the tsunami on environmental services can also be examined in Sri Lanka by looking at wave action on agricultural fields and the water resources (e.g. wells) that are essential for a community in every day life. The tsunami caused a contamination (salinisation) of wells. Overall, the contamination and salinization of wells increased the level of vulnerability of rural coastal communities in Sri Lanka. Some communities now depend solely on one source of water, usually a source provided as relief assistance. In this case, the resulting increase in vulnerability is intuitively clear since this single new source could be disrupted by a future extreme event leaving community members without a back-up source.

Since the dependency of communities on environmental services is highly diverse and locally specific, the use of general statistics at the national level is not sufficient to assess environmental vulnerability. Information needs to be collected locally that allows understanding of likely hazards as well as spatially specific data on the fragility and vulnerability of environmental services and how human livelihoods and basic needs are dependent on them.

An interesting discussion followed about how to capture such place-based features of environmental vulnerability and how to scale up local information to the district or to the sub-national level for planning and policy making purposes.

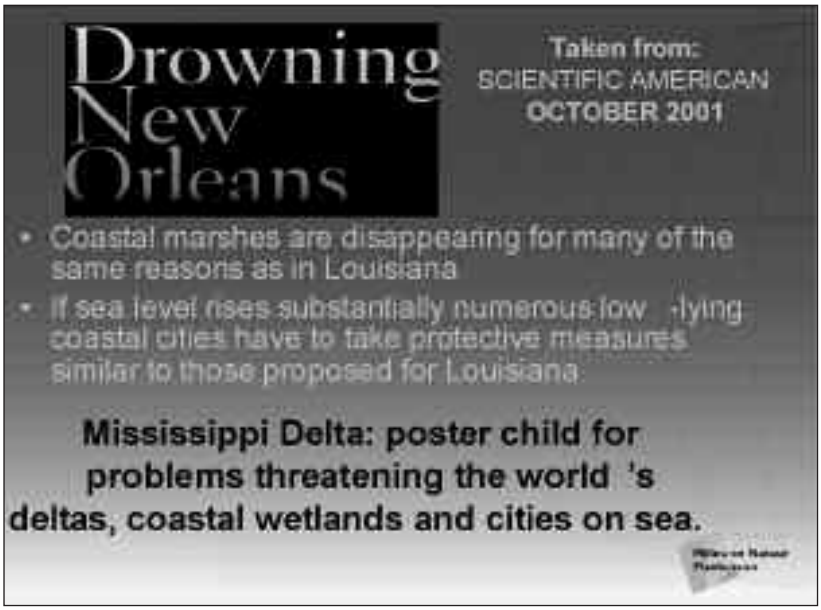
In contrast to such a detailed, place-based (and often participatory) process of assessment, UNEP's annual GEO report attempts to portray different aspects of vulnerability to environmental change in one composite indicator in order to be able to compare countries and regions. Global comparisons are useful for other purposes than community based action planning and the building up of community resilience. World wide and regional trends may be revealed with sufficient clarity by the latter to call for investment and political will at the national and international level.

UNEP´s report is structured according to a state-pressure-impact-response type of model common in global change research (e.g. the Millennium Ecosystem Assessment). Its conceptual basis lies in the vulnerability framework of Turner et al. (2003), which includes a sophisticated way of thinking about the coupling of human and environmental vulnerabilities (Figure 7).

Returning to the work presented by Kok, a special local-global up-scaling methodology has been developed – the archetype approach (see BOX 10).

This approach identifies environmental – human well being corridors or pathways that are exposed to stressors at the local level but can be observed to occur in other parts of the world – thus desertification, for example, brings into play local stressors that are very similar in Rajasthan, Northeast Brazil, and the Sahelian zone of West Africa. That means the archetype approach focuses on a specific, representative pattern of the interactions between environmental change and human wellbeing.

BOX 10: Example for an Archetype Approach (Kok 2005)



Referring to this archetype approach, Wisner pointed out that one has to be careful when constructing the archetypes of vulnerability. He warned against researchers' possible strong Euro-centric perceptions of what an archetype of vulnerability might be, while a local African community might view the same processes differently. Therefore, he suggested integrating local stakeholder knowledge within the development of archetypes.

V. Vulnerability: A Topic in the Political Arena?

Being institutionally located at the interface of science and policy making, UNU-EHS pays special attention to the identification of areas of vulnerability research that enable the scientific community to mainstream research outcomes into decision making processes of governments and other entities (private sector, NGOs, foundations, international organizations, etc.). Therefore the *Expert Working Group II* put special emphasis on the question how scientifically-based vulnerability assessments should be set up in order to be appropriately integrated into decision making. This was part of the panel discussion on the first day and ongoing debates in the second and third day of the meeting.

Bohle suggested that some basic questions arise when designing policy relevant indicators for the assessment of vulnerability. Among other questions one has to take the following into consideration:

- Vulnerability of what?
- Vulnerability to what?
- Vulnerability assessment for whom?
- Vulnerability assessment of whom?
- Vulnerability assessment for what purpose?

These questions imply the recognition of the horizontal and vertical multi-dimensionality and complexity of vulnerability and the diversity of stakeholders, decision-makers and interest groups at different levels who act according to their political mandate and material interests. That means for example that the *Social Protection Unit of the World Bank* or a governmental institution of a developing country or a local environmental justice movement looks at vulnerability from different perspectives. Some focus more on the coping or the exposure side, for example. Diverse groups of decision makers see vulnerability reduction in a specific context such as spatial planning, poverty alleviation, disaster preparedness, or political empowerment.

The last three of Bohle's questions also clearly suggest there is power dynamics at work. Interests are at stake in any assessment of vulnerability. Although the *Hyogo Framework of Action* and other consensual documents such as the *Manizales Declaration* (UNDP 2004) emphasize "community participation" and co-responsibility for the creation of a "culture of prevention," in fact, in most places empowerment of communities to protect themselves and to demand social protection from government is seldom a byproduct of vulnerability assessment.

Leaving to one side the previous knotty problem, EWG participants asked, "What do decision makers need to know about vulnerability"?

This question is sensitive and can even be a dangerous one in Bohle's opinion. Politicians usually take what they want from any report or assessment. It might be futile to debate whether it is sufficient to provide decision makers with aggregated overview information or better to try to communicate in-depth assessments and detailed research outcomes. The latter might enable political decision makers to make better judgments, but such a desirable outcome depends on the entire political system, not on whether a certain key political figure has more or less information available. Even worse, sometimes politicians instrumentalize the information they get for their own purposes.

> *"Special attention needs to be paid to the process of the development of knowledge based vulnerability indicators and how to smoothly translate them into politically applicable assessment tools without being misused by decision-makers."*
>
> Bohle (EWG II 2005)

In this context it is important to lay open the assumptions constituting aggregated data or any assessment tool for measuring vulnerability. Thus, special attention needs to be paid to the process of the development of knowledge-based vulnerability indicators and how to smoothly translate them into

politically applicable assessment tools. To ensure that this is understood by the general public and not just by political decision makers, a simple language should be used, including the local vernacular.

Considering also the many dedicated and honest government officials that are in evidence all over the world, care needs to be taken in "packaging" assessment tools and results in ways that are compatible with their work situation – time and resource limits as well as technical capacities. Careful give-and-take between researcher and end user is the key to developing products that fit into the average workload of someone making routine decisions in a government ministry or agency.

BOX 11: Horses for Courses

> Vulnerability assessment can be very simple if the purpose is clear and the institutional conditions are good. For example, in Cuba there are frequent hurricanes. Given the purpose of protecting lives from a hurricane and given that there are a great deal of institutional resources available to support the neighbourhood community it is possible for neighbourhood level assessment to take place before each hurricane season to identify risk and vulnerability. There are certain circumstances the neighbourhood community actually identifies via neighbourhood committees before the hurricane comes. They may, for example, identify the presence of pregnant and nursing women or a disabled person. Thus when it comes to evacuation, this can be done precisely in relation to these pre-assessed vulnerability conditions, including special shelters for pregnant and nursing women. In this way Cuba lost only 18 lives to hurricanes between 1996 and 2004. So I think assessment can be very simple, but it requires specific preconditions in governance and political will.
>
> Wisner (EWG II 2005)

Figure 21: Participants at EWG II Public Panel Discussion on the First Day

(UNU-EHS, Garschagen)

This important, cross-cutting discussion touched on the area of institutional vulnerability since the overlapping issue of "good governance" was emphasized by Nikitina, Wisner, Pelling, Cardona and Bohle. They argued in discussion that institutional capacities, decision and investment frameworks, and behavioural roles matter when trying to measure vulnerability. In line with this argumentation Nikitina called for better tools to assess institutional capacities. Cardona pointed out the need for governments to manage multidimensional vulnerability concerns, implying that national and local administrative levels need different information and different tools to measure vulnerability. Bohle stressed the need for a coherent, vertically integrated measurement of vulnerability that links bottom-up and top-down approaches, leading to more successful balances and transparency in decision making.

Overall one can conclude that both more and less developed countries lack innovative, cross-cutting and transparent decision making procedures conducive to facilitate reconciliation of risk reduction, safety and resilience interests of diverse stakeholders at different administrative levels. Vulnerability assessment, starting with the development of goals, definition of "acceptable risk," use of indicators for assessment, action planning on the basis of assessments and evaluation of action call for new approaches to governance.

This brought up the question which direction vulnerability assessment research should take in future. In this regard, Bogardi raised the question whether it is possible and useful to engage with the international political process and to mainstream the issue of vulnerability and vulnerability reduction by organizing an international conference on vulnerability assessment. By referring to the science-policy links between *United Nations Framework Convention on Climate Change* (UNFCCC) and *Intergovernmental Panel on Climate Change* (IPCC) the question was raised whether similar scientific structures were needed for land degradation and for vulnerability to mainstream scientific assessment and concepts into the political process.

> *"Is it possible and useful to engage with the international political process and to mainstream the issue of vulnerability and vulnerability reduction by organizing an international conference on vulnerability assessment?"*
>
> Bogardi

VI. Conclusions and Recommendations

6.1 Progress Since the First EWG Meeting

The EWG II meeting included more participants and disciplinary backgrounds than the first *Expert Working Group* meeting, a facet that complemented the aims of EWG II. Engineers, practitioners, social scientists, and natural scientists came together, speaking different professional languages, coming from different institutions and cultures. This diversity made it possible to share new methods and experiences in developing tools to measure vulnerability. There were also new debates. These debates improved the participants´ ability to provide "ground truth" and apply similar reality checks to their work.

These improvements were also made possible by the inclusion of partners from specific study areas UNU-EHS is involved with (Sri Lanka, Russia and Tanzania), and by the field work background that participants brought from other countries, aired in discussions as well as formal presentations (Colombia, Central America, South Africa, Germany). The inclusion of young scientists in the meeting and its nesting in the context of the larger conference of the IHDP open meeting (IHDP 2005) provided further enrichment.

6.2 Creative Tensions and Conclusions

COMPLEXITY VERSUS SIMPLICITY

In measuring and assessing vulnerability, there is a tension between complexity (cultural and microeconomic – especially as regards livelihood and survival strategies, institutional and political) versus mathematical parsimony. The creative tension is between the need in some cases for a single number that expresses vulnerability and in others for the need for "thick descriptions" (Geertz 1973) or other narratives that capture the dynamism and specificity of the processes in daily life that make a group vulnerable.

Conclusion: One should ask what the measurement or assessment is for, whose interests it serves, speak with the stakeholder and listen to them. Tools and methods should suit the researcher´s / institution's purpose and constraints.

PROCESS VERSUS PRODUCT

At one extreme, methods such as those that include the vulnerable groups as active participants or co-investigators in research tend to privilege the process of the research itself over the outcome. For example, some NGOs use community based risk assessment as a method of empowerment of local people. The benefits of such approaches are that locals understand their own ability to cope with risks and can articulate their needs vis-à-vis government and donors, and local elites (landowners, factory owners, etc.). Such methods focus on the process of investigation rather than a concrete deliverable such as a report, hazard map, etc. At the other extreme, governments and donors focus on products or outcomes. They often are quite unaware of the social impact of decisions they make about method or process. For example, at the moment – particularly in the current reconstruction phase – Sri Lanka needs various proxies and indicators of vulnerability, maps, etc. to help them pursue immediate tsunami recovery. In such a circumstance, it is important to provide the appropriate products, including approximate ones that are useful for rapid appraisal, emergency and evacuation planning and mid- and long-term recovery efforts. Later, however, a more participatory and process-conscious approach will likely be necessary if the majority of tsunami affected people are to accept measures such as the controversial buffer zone.

Conclusion: Process and product are both important in different ways. Researchers should keep both explicitly in mind in the various stages of work during which the balance between the two may change. Moreover, in rushed and dynamic conditions (e.g. recovery process), it is necessary to work in incremental and iterative terms: to build an indicator set, test it, see its status, improve it, and continue using the modified approach.

UNDERSTANDING VERSUS IMPLEMENTATION

Partners in some disaster affected places reported that there is a tension between fully understanding the complexities of vulnerability, coping, and recovery versus business-as-usual human development planning, service delivery, and finance. Despite years of discussion of the "disaster-development continuum," (UN 2006) governments, international organizations, and donors still find it difficult to transition from a post-disaster situation to "routine" governance and social life without losing many of the "lessons" of the prior disaster. Will these lessons be learned in Sri Lanka? In Tanzania? In Russia? Are the methods and tools for vulnerability assessment presented to the EWG II adequate to ensure "mainstreaming" and incorporation of lessons from the tsunami, from drought, or from flood into "routine" decision making?

Conclusion: Use of remote sensing (as in Sri Lanka) and large scale questionnaire surveys (as in Tanzania and Sri Lanka) are important first steps toward understanding vulnerability but do not yet accomplish the task. More is needed to provide in depth understanding of the coupled human-environment systems at the local level and how political and economic power at the national and international levels affects locally experienced vulnerability. However, since government and agency professionals are more used to information of the kind that remote sensing and questionnaire surveys present, these first steps are also excellent ways to engage with such professionals and begin a discussion that can then extend to more detailed examination of local reality and driving forces that shape local conditions.

DEVELOPMENTAL VERSUS ENVIRONMENTAL CONTEXT

The emerging notion of environmental vulnerability is anthropocentric, and focuses on the relations within coupled human-environment systems. The approach focuses our attention on the impact extreme events have on ecosystems and ecosystem services. Additionally, the notion underlines the impact of human economic and social development on ecosystems, including, for example, land degradation and deforestation. The concept of environmental vulnerability also reminds us that economic activity impacts ecosystems as well and that in the past common socio-economic development strategies proved to be inappropriate to achieve a balance between socio-economic demands and the environmental capacities of various ecosystems.

Conclusion: There is no contradiction between developmental human need and welfare focused approaches to vulnerability assessment and methods that focus on the environment. However, work in

BOX 12: Challenges Ahead

- Are decision makers interested in this subject?
- How can we learn about the wishes and needs of the policy makers?
- Should we have a three-day workshop where half of the people would be real policy makers in executive, legislative and their constitutive branches of government?
- Are we ready to assist them?
- How to proceed to be policy relevant?

Bogardi (EWG II 2005)

this area can be enriched by more dialogue with the climate change community and others concerned with global environmental change, where discourse about risk, vulnerability, resilience, and adaptation parallels the concerns of the EWG.

6.3 Recommendations

Exhortations are easy. What is harder are the systematic changes in governance and in the practice of science that would bring the two together in building a culture of prevention. Certainly from the side of science, one only has to consider the difficult birth of such interdisciplinary (even trans-disciplinary) endeavours as Earth System Science – from the early notion of multi-disciplinary cooperation at the beginning of UNESCO's *Man and the Biosphere Program* [early 70ies] to the publication of the *Millennium Ecosystem Assessment* in 2005 to realize how long and difficult it is to accept new methods of work. Therefore, the recommendations below are short-term and address the next steps in building the inter-disciplinarity and inter-positionality required not only to choose or develop approaches of measuring vulnerability but also to put them to work in practice. They take the form of four clusters of related recommendations.

Recommendation Cluster 1: Systematic meta-review is needed

A systematic meta-review is needed of precisely what kinds of end users and stakeholders need what kind of assessments and measurements of vulnerability for what kinds of purposes. The work of EWG I and II shows clearly that no "one size fits all" definition or way of "capturing" vulnerability will serve the planning, decision making, and evaluation needs of all end users at international, national, sub-national, and local levels.

Having established, essentially, the answers to Bohle's questions ("for whom", etc.), this research should canvass the existing methods and metrics available, objectively evaluate limits of their accuracy, pre-requisites, cost (in financial and human resources), and past (observed) benefits. Attention should be paid to non-state as well as state actors (Wisner & Haghebaert, 2006) in carrying out this research.

Recommendation Cluster 2: Link methods to capacity building

Process and product are both important in different ways in the course of measurement and assessment. We should keep both explicitly in mind at various stages of our work during which the balance between the two may change. In concrete terms, *introduction of methods for measuring and assessing vulnerability to institutions should be accompanied by in depth capacity building.*

Ideally, the methods themselves will be user-friendly and dynamic enough to "surprise" the user and re-awaken awareness of the scope and seriousness of the decisions under consideration.

The problem is that extreme events that may trigger disasters are uncommon relative to other factors that affect decision making. There may be long months and even years of "routine" planning and decision making between them. How, then, do civil servants and other end users maintain their alertness and critical edge? This is a challenge for researchers, trainers, and software developers. While some

5 "Positionality" is the situation that a professional or decision maker (no matter what disciplinary background) inhabits as defined by the total cultural and political context of her or his work – type of institutional setting (government, NGO, business, etc.), job description and responsibilities, work load, human and financial resources available to do her/ his job, seniority/ gender/ ethnicity, informal networks and access to "short cuts" with the bureaucracy. Hence, "inter-positionality" refers to development of networks of people who make decisions about risk reduction from a broad cross section of such "positions" who are able to communicate their diverse needs for different kinds of vulnerability measurements and act as a "focus group" to evaluate tools and methods that may be available "off the shelf."

innovative methods have been developed,[6] they generally do not include enough follow up and in-service refresher training. As there is considerable attention at the moment to South-South exchange and co-learning, attempts should be made to link introduction of vulnerability assessment methods to emerging South-South dialogues.

Recommendation Cluster 3: Balance approaches to characterize vulnerability

Without pre-judging the result of the systematic review recommended above, the results of EWGs I and II strongly suggest that in most cases at all scales, some adequate mix of quantitative and qualitative as well as macro and micro data is required to characterize vulnerability.

Better quality and longer data series are also required. The practical recommendation implied is that more effort is required in cross-training and team formation/ maintenance so that full advantage is taken of earth observation data, socio-economic data, institutional and community profiles, narratives and oral histories. Optimism that this can happen comes, from among other developments, the existence of a well-established worldwide network using participatory GIS for many purposes including disaster risk reduction (PGIS Net, 2006).

Use of remote sensing (as in Sri Lanka) and large scale questionnaire surveys (as in Tanzania and Sri Lanka) are important steps towards measuring and understanding vulnerability. However, more is needed to provide in depth understanding of the coupled human-environment systems at the local level as well as how political and economic power at the national and international levels affects locally experienced vulnerability.

Recommendation Cluster 4: Dialogue between different research communities

Although vulnerability research has progressed significantly in recent years, it is evident that further research is needed to address the intersection and interactions between human and environmental systems and their dynamics, and their significance for vulnerability.

Dialogue and cooperation among those engaged in disaster risk, vulnerability research, climate change research, the sustainable development policy and practice should be strengthened. This conversation will enrich interdisciplinary research on human security. Vulnerability, resilience, coping and adaptation are – although differently defined – common concerns.

6 Among others, see the simulation methods developed by Crowding the Rim used by a cross section of state and non-state actors from Pacific Rim countries during a "summit" meeting at Stanford University in California, USA in 2001. Three tools were developed: Rim Sim, a simulation for setting priorities in post-disaster reconstruction; HazPac, GIS-based hazard maps to facilitate risk assessment and decision making; and the Education Module, which gives students an appreciation of natural hazards risk. Unfortunately its web site is now, five years later, disconnected and there seems to be no continuing use of these innovative tools (See on CTR Purpose: USGS 2006; on CTR tools: ADPC 2006; for overview of CTR approach: UNCLOS 2006).

List of Abbreviations

ADRC	Asian Disaster Reduction Centre
ARL	Academy for Spatial Research and Planning [Akademie für Raumforschung und Landesplanung]
BBC	Bogardi-Birkmann-Cardona
BRCP	Bureau for Crisis Prevention and Recovery
CASA	College of Assiciated Scientists and Advisors
COGSS	Coalition for Global School Safety
CRA	Community Based Risk Assessment
CRED	Centre for the Research on the Epidemiology of Disasters
DDI	Disaster Deficit Index
DEFRA	Department for Environment Food and Rural Affairs
DFID	Department for International Development
DLR	German Aerospace Agency [Deutsches Zentrum für Luft- und Raumfahrt]
EMERCOM	Ministry of Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters
EO	Earth Observation
ESPON	European Spatial Planning Observation Network
EU	European Union
EWG	Expert Working Group
GEO	Global Environmental Outlook
GIS	Geographical Information System
IFRC	International Federation of Red Cross
IHDP	International Human Dimensions Programme on Global Environmental Change
IKONOS	Name of a high resolution imagery satellite
IPCC	Intergovernmental Panel on Climate Change
LTTE	Liberation Tigers of Tamil Eelam
NGO	Non-Governmental Organization
PGIS	Participatory GIS
PPEW	Platform for the Promotion of Early Warning
UCLASS	University College of Lands and Architectual Studies
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN/ISDR	United Nations International Strategy for Disaster Reduction
UNU-EHS	United Nations University – Institute for Environment and Human Security
WCDR	World Conference on Disaster Reduction
WIDER	World Institute for Development Economics Research
ZEF	Center for Development Research [Zentrum für Entwicklungsforschung]

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Annex I: List of Participants

1. **Prof. David Alexander**
University of Florence
Borgo Sarchiani 19
50026 San Casciano in Val di Pesa,
Firenze, Italy
d.alexander@virgilio.it
Tel: +39 055 822 9423

2. **Prof. Sarath Amarasinghe**
University of Ruhuna -
Department of Sociology
N°495B Ruwanpura Road, Aggona
Angoda, Sri Lanka
sarath@soci.ruh.ac.lk
Tel: +94 41 2792202
Fax: +94 41 2223133

3. **Ms Maria Arkhipova**
UNU-EHS "Young Scientists Award"
Institute of Environmental Geosciences,
russian Academy of Sciences
Ulansky pereulok 13, Building 2
101000 Moscow, Russia
masha-a@yandex.ru
Tel: +7 095 924 7257/923 31 11
Fax: +7 095 923 18 86

4. **Ms Maria Bilia**
Prime Minister's Office
P.O Box 3021 - Magogoni Street
Dar-Es Salaam, Tanzania
mhbilia@yahoo.com, maria@pmo.go.tz
Tel: +255 222 1172 49/50
Fax: +255 222 1172 66

5. **Dr. Peter Billing**
European Commission
Civil Protection Unit
Rue de la Loi 200
1049 Brussels
peter.billing@ec.europa.eu
Tel. +32 2 2968671

6. **Dr. Jörn Birkmann**
United Nations University
Institute for Environment and Human Security
UNU-EHS
UN Campus
Hermann-Ehlers-Str. 10
53113 Bonn, Germany
birkmann@ehs.unu.edu
Tel: +49 228 422 8150208
Fax: +49 228 422 8150299

7. **Prof. Janos Bogardi**
United Nations University
Institute for Environment and
Human Security
UNU-EHS
UN Campus
Hermann-Ehlers-Str. 10
53113 Bonn, Germany
bogardi@ehs.unu.edu
Tel: +49 228 422 8150202
Fax: +49 228 422 8150299

8. **Prof. Hans-Georg Bohle**
University of Bonn
Institute of Geography
Meckenheimer Allee 166
53115 Bonn, Germany
bohle@giub.uni-bonn.de
Tel: +49 228 73 7232
Fax: +49 228 73 9657

9. **Prof. Klaus Borchard**
Academy for Spatial Research and
Planning (ARL)
Hohenzollernstr.11
30161 Hannover, Germany
ProfBorchard@aol.com
Tel: +49 511 34842 37
Fax: +49 511 34842 41

10. **PD. Dr. habil Hans Günter Brauch**
UNU-EHS, CASA fellow
Free University of Berlin,
AFES-PRESS
Alte Bergsteige 47
D-74821 Mosbach
brauch@afes-press.de
Tel: + 49 6261 12912
Fax: + 49 6261 15695

11. **Prof. Dr. Omar D. Cardona**
Universidad Nacional de Colombia
Manizales
Carrera 27 64-60
Manizales, Colombia
odcardonaa@unal.edu.co
Tel: +57 1 5300828
Fax: +57 1 5300827

12. **Geoffrey D. Dabelko**
Environmental Change and Security Program
Woodrow Wilson International Center for Scholars
1300 Pennsylvania Ave., NW
Washington, DC 20004-3027
geoff.dabelko@wilsoncenter.org
Tel: 202 691-4178
Fax: 202 691-4184

13. **Dr. Thomas E. Downing**
Stockholm Environment Institute
266 Banbury
Road, Suite 193
Oxford OX2 7DL, United Kingdom
TomDowning@sei.se
Tel: +44 1865 426316
Fax: +44 1865 421898

14. **Dr. Indranil Dutta**
United Nations University - World Institute for Development Economics Research
Katajanokanlaituri 6 B
00160 Helsinki, Finland
dutta@wider.unu.edu
Tel: +358 9 61599212
Fax: +358 9 615 99333

15. **Mr. Nishara Fernando**
Department of Sociology,
University of Colombo, Reid Avenu,
Colombo -3, Sri Lanka
nishara2000@yahoo.com
nishara.fernando@gmail.com
nishara@arts.cmb.ac.lk
Tel: +94 1 2500452
Fax: +94 1 2500452

16. **Ms Zsuzsanna Flachner**
RISSAC- Hungarian Academy of Sciences Academy of Sciences
Herman O. Street 15
1022 Budapest, Hungary
flachner@rissac.hu
Tel: +36 1 2253201

17. **Mr. Oscar Frausto**
Universidad Autonomía de Yucatán
Av. Andrés Quintana Roo S/N
077600 México, México
ofrausto@correo.uqroo.mx
Tel: +52 987 8729108
Fax: +52 987 879112

18. **Prof. Roland Fuchs**
International START Secretariat
2000 Florida Avenue, NM Suite 200
Washington, DC 20009, USA
rfuchs@agu.org
Tel: +1 202 462 2213
Fax: +1 202 457 5859

19. **PD Dr. Stefan Greiving**
University of Dortmund - Faculty of Spatial Planning
August-Schmidt Str. 6
44221 Dortmund, Germany
stefan.greiving@uni-dortmund.de
Tel: +49 231 755 2213
Fax: +49 231 755 3424

20. **Prof. John Handmer**
Geospatial & Mathematical Sciences
Centre for Risk and Community Safety
RMIT GPO - Box 2476V
Melbourne Vic 3001, Australia
john.handmer@rmit.edu.au
Tel: +61 3 9925 2307
Fax: +61 3 9663 2517

21. **Dr.-Ing. Dirk Heinrichs**
Centre for Environmental Research - UFZ
Permoserstr.15
04319 Leipzig, Germany
dirk.heinrichs@ufz.de
Tel: +49 341 235 2686

22. **Prof. Sitti Hettige**
University of Colombo, Social Policy Analysis
and Research Centre - SPARC
N°9/11 First Lane, Pagoda
Nugegoda, Sri Lanka
sthetti@webmail.cmb.ac.lk
Tel: +94 1 2811484 or 2553188

23. **Ria Hidajat**
Advisory Project "Disaster Risk Management
in Development Cooperation"
German Technical Cooperation (GTZ) GmbH
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
Germany
ria.hidajat@gtz.de
Tel: +49 (0) 61 96 79 74 30
Fax: +49 (0) 61 96 79 80 7430

24. **Dr. Alexander Ivanov**
UNESCO Chair, University of Architecture and Civil Engineering
Ilinskaya str. 65
603950 Nizhniy Novgorod, Russia
ivanov@nngsu.ru
Tel: +78312301877
Fax: +79027869172

25. **Dr. Stefan Jäger**
geomer GmbH
Im Breitspiel 11 B
69126 Heidelberg
sj@geomer.de
Tel.: +49 (0)6221/89458-40
Fax: +49 (0)6221/89458-79

26. **Prof. Roger Kasperson**
The George Perkins Marsh Institute, Clark University
950 Main Street
Worcester, MA 01610-1477, USA
rkasperson@clarku.edu
Tel: +1 508 751 4607
Fax: +1 508 751 4600

27. **Dr. Ulrike Kastrup**
Benfield Hazard Research Centre
University College London
United Kingdom
kastrup@alumni.ethz.ch

28. **Marcel T.J. Kok**
Netherlands Environmental Assessment
Agency (MNP)
PO-box 303
3720 AH Bilthoven
The Netherlands
marcel.kok@mnp.nl
Tel: +31 30 2743717
Tel secr: +31 30 2743425/3728
Fax: +31 30 2744464

29. **Mr. Ferenc Kovács**
UNU-EHS "Young Scientists Award" –
University of Szeged, Department of Physical Geography and Geoinformatics
Egyetem utca 2-6
6722, Pf653 Szeged, Hungary
feri@earth.geo.u-szeged.hu
Tel: +36 62 546 485
Fax: +36 62 544 158

30. **Dr. Joanne Linnerooth-Bayer**
International Institute
for Applied Systems
Analysis, IIASA -
Risk, Modeling and Society
Schlossplatz 1
2361 Laxenburg, Austria
bayer@iiasa.ac.at
Tel: +43 2236 807 308
Fax: +43 2236 807 466

31. **Mr. Jessie Manuta**
College of Arts and Sciences - Ateneo de Davao University
E. Jacinto Street
Davao City 8016, The Philippines
jbmanuta@addu.edu.ph
jbmanutaqhotmail.com
jbmanuta@yahoo.com
Tel: +6382 221 2411
Tel: +6382 226 4116
Fax: +6382 221 2413

32. **Dr. Elena Marakova**
UNU-EHS "Young Scientists Award" -
Volghskaya Street 49, kv.51
Astrakhan, 514045, Russia
el_marakova@yahoo.com
Tel: +8512 33 40 68 +8512 593277

33. **Ms Monika Naßl**
Mobile: +49 173 15 36 287
Monika.Nassl@gmx.de

34. **Dr. Elena Nikitina**
EcoPolicy Research & Consulting
Piluigina, 14-1-182
Moscow, 117393, Russia
enikitina@mtu-net.ru
Tel: +7 095 9468581
Tel: +7095 77 33 687
Fax: +7 095 9468581

35. **Dr. Karen O´Brien**
Department of Sociology and Human Geography
University of Oslo
P.O. Box 1096 Blindern
0317 Oslo, Norway
karen.obrien@sgeo.uio.no
Tel: +47 22 85 84 80

36. **Prof. Anthony Oliver-Smith**
University of Florida - Department of Anthoropology
1112 Turlington Hall
Gainesville, Florida 32611, USA
aros@ufl.edu
Tel: +1 352 392 2253 251
Fax: +1 352 392 6929

37. **Prof. Ursula Oswald-Spring**
National University of Mexico
Centro Regional de Investigaciones Multidisciplinarias, CRIM-UNAM
Priv. Ró Bravo Num. 1 Col. Vistahermosa
62290 Cuernavaca, Mexico
uoswald@servidor.unam.mx
Tel: +52 7773 291 833
Fax: +52 7773 175981

38. **Mark Pelling PhD**
Reader in Human Geography
Department of Geography
King's College
The Strand
London WC2R 2LS UK
mark.pelling@kcl.ac.uk
Tel: +44 (0)20 7848 2462
Fax: +44 (0)20 7848 2287

39. **Prof. Erich Plate**
University of Karlsruhe
Am Kirchberg 49
76229 Karlsruhe, Germany
plate@iwk.uka.de
Tel: +49 721 468752
Fax: +49 721 9463984

40. **Dr. Ulrich Ranke**
Federal Institute for Geosciences and Natural Resources (BGR)
Stilleweg 2
30655 Hannover, Germany
Ulrich.Ranke@bgr.de
Tel: +49 511 643 2371
Fax: +49 511 643 2304

41. **Dr. Fabrice Renaud**
United Nations University
Institute for Environment and Human Security
UNU-EHS
UN Campus
Hermann-Ehlers-Str. 10
53113 Bonn, Germany
renaud@ehs.unu.edu
Tel: +49 228 422 8150211
Fax: +49 228 422 8150299

42. **Stefan Schneiderbauer**
Joint Research Centre / European Commission - Institute for the Protection and Security of the Citizen (IPSC)
Via E. Fermi, 1 - PT 267
Ispra 21020 (VA), Italy
stefan.schneiderbauer@jrc.it
Tel: +39 0332 785967
Fax: +39 0332 785154

43. **Ms Michaela Serban**
UNU-EHS "Young Scientists Award" – Institute of Geography, Romania Academy
Dimitrie Racovita, Sector 2
Bucharest 70307, Romania
mserban@geoinst.rnc.ro

44. **Prof. Pál Támas**
Hungarian Academy of Sciences
Institute of Sociology
Uri Utca 49
1014 Budapest, Hungarn
tamas@socio.mta.hu
Tel: +361 2246740
Fax: +361 2246741

45. **Dr. Jayasingam Thangamuthu**
Eastern University
Department of Botany
Chenkaladi, Sri Lanka
jay_one@sltnet.lk
Tel: +94 5 22 40490 ext.204
Fax: +94 5 22 40758
Mobile: +94 773 059 927

46. **Mr. Zhan Tian**
UNU-EHS "Young Scientists Award"
Institute of Geographical Sciences and
Nature Resources Research,
Chinese Academy of Sciences
11A Datun road Anwai
Beijing, 100101, China
tianz@lreis.ac.cn
Tel: +86 10 62944575

47. **Prof. Anna Vári**
Hungarian Academy of Sciences
Institute of Sociology
Uri Utca 49
1014 Budapest, Hungary
anna.vari@socio.mta.hu
Tel: +36 1 224 6743
Fax: +36 1 224 6741

48. **Dr. Juan Carlos Villagrán de Leon**
United Nations University
Institute for Environment and
Human Security
UNU-EHS
UN Campus
Hermann-Ehlers-Str. 10
53113 Bonn, Germany
villagran@ehs.unu.edu
Tel: +49 228 422 8150210
Fax: +49 228 422 8150299

49. **Ms Evgeniya Vinogradova**
UNU-EHS "Young Scientists Award"
Moscow State University
Smolensky blvd., 24 build 1, office 37
119002 Moscow, Russia
eco-project@mtu-net.ru
Tel: +7 095 246 81 59
Fax: +7 095 589 65 22

50. **Dr. Stefan Voigt**
Deutsches
Fernerkundungsdatenzentrum (DFD) -
Deutsches Zentrum für
Luft- und Raumfahrt (DLR)
Oberpfaffenhofen
82234 Wessling, Germany
stefan.voigt@dlr.de
Tel: +49 8153 28 3678
Fax: +49 8153 28 1445

51. **Prof. Ben Wisner**
Oberlin College, Environmental Studies
373 Edgemeer Place
Oberlin, OH 44074, USA
bwisner@igc.org
Tel: +1 440 775 1390
Fax: +1 440 775 8898

52. **Dr. Peter Zeil**
Centre for GeoInformatics Salzburg
University - Paris.Lodron University
Salzburg
Hellbrunnerstr. 34
5020 Salzburg, Austria
peter.zeil@sbg.ac.at
Tel: +43 662 8044 5264 / 5210
Fax: +43 662 8044 5260

53. **Dr. Natalia Davydova**
Environmental Projects
Consulting Institute
Smolensky blvd., 24 build 1, office 37
119002 Moscow, Russia
eco-project@mtu-net.ru
Tel: +7 095 246 81 59
Fax: +7 095 589 65 22

Annex II: Programme of the Experts Workshop “Measuring Vulnerability”

Wednesday, October 12 2005			at the university of Bonn
INTRODUCTION			
11:00 11:10	Welcome by UNU *Hans van Ginkel, Rector UNU* Welcome by UNU-EHS *Janos Bogardi / Director UNU-EHS*	Welcome	at the university of Bonn
11:10 11:20	Introduction EWG- Results Workshop Kobe *Jörn Birkmann / UNU-EHS*	Introduction	at the university of Bonn
11:20 11:30	Introduction of new participants	Introduction	at the university of Bonn
I PRESENTATIONS - VULNERABILITY AND ITS REDUCTION			**Open for public**
11:30 11:50	Tsunami vulnerability in Sri Lanka and how to measure the current vulnerability *Prof. Hettige / university of Colombo* *Feed-back by Prof. Bohle / univ. of Bonn*	Presentation and feed-back	at the university of Bonn
11:50 12:10	Spatial Planning and Vulnerability *Klaus Borchard / President of the Academy of Spatial Planning, Hannover*	Presentation	at the university of Bonn
12:10 12.30	From hazard analysis to risk assessment – what vulnerability information is needed for an effective early warning – Examples from Indonesia *Jochen Zschau / GFZ Potsdam*	Presentation	at the university of Bonn
12.30 – 14.00 Lunch			
II PANEL DISCUSSION			**Open for public**
14.00 – 15.30 *Discussion*	How to measure vulnerability – and how to reach different target groups, such as policy makers, planners and local people? Chair/Moderation: *Janos Bogardi / UNU-EHS* Panellists *Maria Bile / Prime Minister's Office, Tanzania* *Hans Georg Bohle / University of Bonn* *Klaus Borchard /ARL, Hannover* *Geoffrey Dabelko / Woodrow Wilson Center, Washington* *Steve Lonergan / UNEP, Washington* *Elena Nikitina / EcoPolicy, Moscow* *Mark Pelling / Kings College, London* *Ben Wisner / London School of Economics* *Jochen Zschau / GFZ, Potsdam*	Panel discussion Usefulness of indicators and applicability of different concepts controversial discussion on prepared issues, such as - up and down scaling - single indicators versus high aggregated indices - hazard specific versus multi hazard vulnerability assessment	at the university of Bonn
15.30 – 16.00 Refreshment Break			
16.00 – 17.30	Presentation UNU-EHS activities to measure vulnerability at the local and sub-national level [illegible]	Presentation and discussion	at the university of Bonn

Thursday, 13 October 2005			
[illegible] AT THE LOCAL LEVEL			
[illegible] University of Bonn			
IIIa Measuring economic vulnerability – at UNU-EHS			
[illegible]	Socio-economic vulnerability assessment in Tanzania *Maria Bile / Prime Minister's Office, Tanzania*	Presentation and discussion	at UNU-EHS
[illegible]	[illegible]	Presentation and discussion	at UNU-EHS
[illegible]	[illegible]	Presentation and discussion	at UNU-EHS
[illegible]	[illegible]	Discussion	at UNU-EHS
[illegible] Lunch			
[illegible]	Economic indicators tested in the case studies in Russia and Sri Lanka [illegible]	Presentation and discussion	at UNU-EHS
[illegible]	[illegible]	Presentation and discussion	at UNU-EHS
[illegible]	[illegible]	Discussion	at UNU-EHS
[illegible] Refreshment Break			
IIIb Measuring social vulnerability			
[illegible]	Measuring social vulnerability through the livelihood approach [illegible]	Presentation and discussion	at UNU-EHS
[illegible]	Measuring social vulnerability – first results from Sri Lanka [illegible]	Presentation and discussion	at UNU-EHS
[illegible]	Measuring social vulnerability through self-assessment [illegible]	Presentation and discussion	at UNU-EHS
[illegible]	Measuring social vulnerability at the national level and local level [illegible]	Presentation and discussion	at UNU-EHS
[illegible]	[illegible]	Discussion	at UNU-EHS
[illegible]			

Friday, 14 October 2005			
IIIc Measuring environmental vulnerability			
[illegible]	[illegible]		at UNU-EHS
[illegible]	Environmental indicators of vulnerability [illegible]		at UNU-EHS
[illegible]	[illegible]		at UNU-EHS
[illegible]	[illegible]		at UNU-EHS
[illegible] Refreshment Break			
IIId Measuring institutional vulnerability			
[illegible]	Measuring the institutional dimension of vulnerability – experiences in Asia [illegible]		at UNU-EHS
[illegible]	Indicators to measure institutional vulnerability [illegible]		at UNU-EHS
[illegible]	[illegible]		at UNU-EHS
[illegible]	[illegible]		at UNU-EHS
[illegible] Lunch			
[illegible]			
[illegible]	What did we learn? - Perspective of a scientist [illegible]		at UNU-EHS
[illegible]	What did we learn? - Perspective of a practitioner [illegible]		at UNU-EHS
[illegible]	Discussion of the findings		at UNU-EHS
[illegible] Refreshment Break			
[illegible]	[illegible] in Bonn [illegible]		at UNU-EHS
[illegible]	Closure [illegible]		at UNU-EHS

Annex III: List of Graphics

List of Boxes

List of Figures

List of Tables

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UNU-EHS Publications
UN Campus
Hermann-Ehlers-Str. 10
53113 Bonn
Germany

Tel.: ++49 (0)228 815-0202
Fax: ++49 (0)228 815-0299
E-Mail: roberts@ehs.unu.edu
info@ehs.unu.edu

UNITED NATIONS UNIVERSITY
Institute for Environment and Human Security (UNU-EHS)

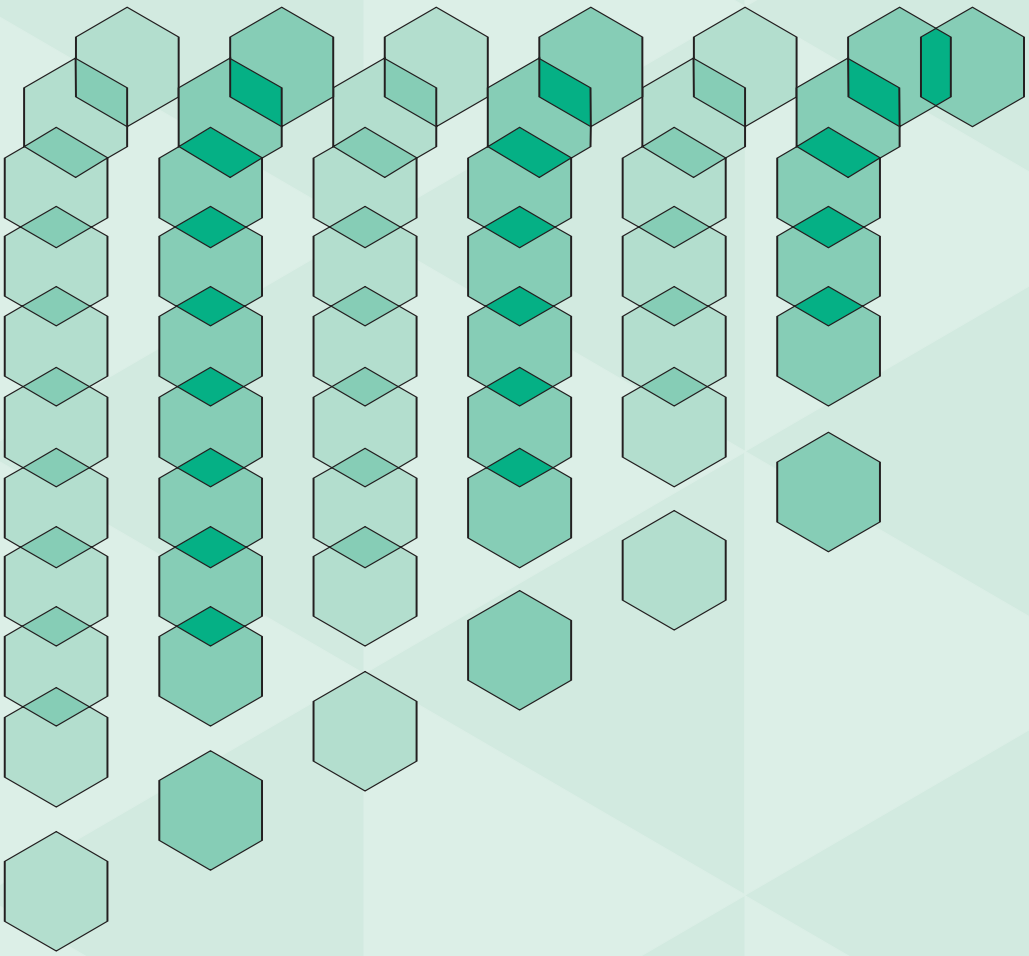
UNU-EHS reflects the overall mission of UNU: 'Advancing Knowledge for Human Security and Development'. UNU-EHS explores threats to human security from environmental degradation, unsustainable land use practices, and from natural and human-induced hazards. The Institute spearheads UNU's research and capacity building activities in the broad interdisciplinary field of 'risk and vulnerability'.

Within this framework UNU-EHS aims to:

- **Foster better understanding of forces and processes of environmental degradations and their influence on hazard magnitude and frequency and subsequent disasters;**
- **Explore links between different hazard events as well as creeping processes such as climate change, soil erosion and their impact on the inherent risk and vulnerability;**
- **Contribute to development, testing and verification of vulnerability indicators, and investigate relationships between risks, vulnerability and coping capacity.**
- **Investigate the relationship between risk, vulnerability and coping capacity, and devise strategies and measures to improve the coping capacity of affected communities.**

Its activities focus on:

- **Generating knowledge;**
- **Building capacity, with focus on young professionals and institutions in developing countries;**
- **Disseminating knowledge to decision makers.**



UNITED NATIONS UNIVERSITY
Institute for Environment and Human Security (UNU-EHS)
UN Campus
Hermann-Ehlers-Str. 10
D - 53113 Bonn, Germany

Tel: ++ 49 (0) 228 815-0202
Fax: ++ 49 (0) 228 815-0299
E-Mail: info@ehs.unu.edu
Website: www.ehs.unu.edu