

**Second International
Symposium
on Disaster
Reduction
and Global
Environmental
Change**

German Committee
for Disaster Reduction - *DKKV*
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Bonn, Germany



**Common Problems,
Common Solutions:
Linking the Scientific and
Disaster Risk Reduction
Communities**

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Second Symposium on Disaster Risk Reduction and Global Environmental Change

Toward a common understanding of future trends

“Disaster loss is on the rise with grave consequences for the survival, dignity and livelihood of individuals, particularly the poor, and hard-won development gains. Disaster risk is increasingly of global concern and its impact and actions in one region can have an impact on risks in another, and vice versa. This, compounded by increasing vulnerabilities related to changing demographic, technological and socio-economic conditions, unplanned urbanization, development within high-risk zones, under development, environmental degradation, climate variability, climate change, geological hazards, competition for scarce resources, and the impact of epidemics such as HIV/AIDS, points to a future where disasters could increasingly threaten the world’s economy, and its population and the sustainable development of developing countries. In the past two decades, on average more than 200 million people have been affected every year by disasters.”

(Hyogo Framework for Action I.A.2.)

Against this backdrop the German Committee for Disaster Reduction (DKKV), in cooperation with the Secretariat of the United Nations International Strategy for Disaster Reduction (UNISDR) and the United Nations Environment Programme (UNEP), organized a symposium on Disaster Risk Reduction and Global Environmental Change in December 2005 in Bonn.

The symposium provided the forum for continuing a dialogue between the global change and the disaster reduction community that began at the first International Symposium on Disaster Reduction and Global Environmental Change in Berlin, June 20 -21, 2002 in preparation to the World Summit on Sustainable Development in Johannesburg.

At the first symposium, participants declared: *“There is increasing evidence that global environmental change and natural disasters are linked. Future trends with regard to natural disasters are expected to be non-linear,*

featuring critical thresholds caused by abrupt changes in earth system dynamics. Extreme weather events having particularly severe impacts on certain regions of the world are expected likely to increase. At the same time economic marginalization and population shifts towards more hazardous regions will increase people's vulnerability to extreme events such as hurricanes, coastline flooding, droughts, wildland fires, river floods and famine. Poor people tend to live in high-risk areas and urban settlements that are often not adequately prepared to deal with such extreme events. Increasing attention therefore needs to be given to the vulnerability of urban settlements and their infrastructure.”

The second international symposium brought together representatives of five United Nations organization (UNISDR, UNEP, UNFCCC, UNCCD and UNU-EHS) with the International Human Dimension Programme (IHDP), and major related international and national scientific and research institutes, including Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Centre for Development Research of the University of Bonn (ZEF), Germanwatch, Germany's National Meteorological Service (DWD), the German High Performance Computing Centre for Climate and Earth System Research (MPI), the Earthquakes and Megacities Initiative (EMI), Diakonie Katastrophenhilfe, Centre for Environmental Research (UFZ), as well as the universities of Köln, Bayreuth and Bonn.

Participants in the Second International Symposium aimed to develop a common understanding of recent trends and needs, and to provide concrete recommendations to guide policy work in the next biennium (2006-2007).

The objectives of the symposium were

- To translate key knowledge into practical policy actions.
- To propose the structure, policies and activities for integrating emerging risk reduction into the new ISDR system and future UNEP activities.
- To provide clear guidelines for decision makers on how to cope with the future trends of global change with regard to disaster risk reduction.

Conclusions

The current trends in cost and damage caused by natural disasters is alarming. In the period between 1990 and 1999 damage costs were more than 15 times higher (calculated in constant dollars) than they were between 1950 and 1959. While the death toll could be dropped over the last decades, the number of people affected by natural disasters has grown from 1.6 billion (1984-1993) to 2.6 billion (1994-2003)¹.

These trends are going to continue. Projections of hazard occurrence and vulnerability into the future show steeply increasing numbers of disasters of natural origin. The different aspects of global change like environmental degradation, climate change and urbanization are going to become major drivers of these trends, if not counter acted with effective adaptation/disaster risk reduction measures.

Data collected by different actors like World Bank, CRED and Munich Re clearly show that disasters caused by natural hazards are not at all a phenomenon of future. They occurred in the past and they occur right now. The massive and growing amount of damage and human suffering requires immediate action by all stakeholders.

Disasters can wipe out development gains of years within seconds. Thus, disaster risk reduction needs to be integrated into all development activities. While disasters can negatively affect developing and developed countries, there are some areas which require particular attention, like urban areas and environmentally degraded ones.

A close interaction between the communities of Global Change and Disaster Risk Reduction is needed with the aim to minimize negative future effects of Global Change. The Global Change community to provide information about projections of risk and vulnerability patterns to enable the design and implementation of future oriented disaster risk reduction strategies. The Disaster Risk Reduction community to provide their know-how on adaptation measures to counter act negative trends of vulnerability development. Successful disaster reduction means continuously adapted strategies. Adaptation strategies to global change are part of the broader concept of disaster risk reduction.

¹ Figures from World Bank, "Hazards of Nature, Risks to Development", Washington 2006



Recommendations

Environmental degradation

- Capacity development in environmental management must include DRR and vice versa to facilitate the realization/awareness of the links between global environmental degradation and DRR.
- Greater effort must be made to bridge the gap between individuals/organizations working on hazard issues (e.g. model projections) and those working on vulnerability issues (e.g. livelihoods snapshots).

Climate Change

Promote the consideration of climate change on all levels of legislation and planning for disaster reduction, which should be flexible enough to accommodate future assessments by:

- Enhance the awareness of policy makers on impact of climate change and disasters, stressing the need of immediate action.
- Inform policy makers of the socio-economic impacts of climate change and disaster risk on the national development process.
- Promote cost-benefit analysis of DRR and adaptation to climate change.

Urbanization

- Identification of a lead agency for urbanization and DRR issues within the United Nations system and also among other international organizations at the international level².
- Promotion of specialized research programmes by scientific communities on coping mechanisms needs and gaps in urbanization, mega-urban-areas and urban issues in general. (e.g. IHDP core five-year science projects on urbanization).
- Any city development plan has to incorporate existing risks.

² Note: The participants confirmed that the important role and competency of UN-HABITAT and of course UNDP is recognized on broader scale. Here to refer which core agency will centralize the methods, recommendations, information and knowledge on specifically "Mega-Urban-Areas (Mega-Cities)" DRR's policy processes? This entity could be (or been) one of their sub-entity tasks or an interagency secretariat.



The symposium focused on three most urgent issues of global change, namely:

1. Global Environmental Degradation and Disaster Risk Reduction:

In some regions environmental conditions play a pivotal role in reducing the risks of natural disasters. They can influence the frequency and intensity of natural hazards, buffer communities from disaster impacts and provide vital resources and services that promote community resiliency. Freshwater wetlands, upland watersheds, coral reefs, coastal vegetation and dune ecosystems stand out for their contributions in this regard.

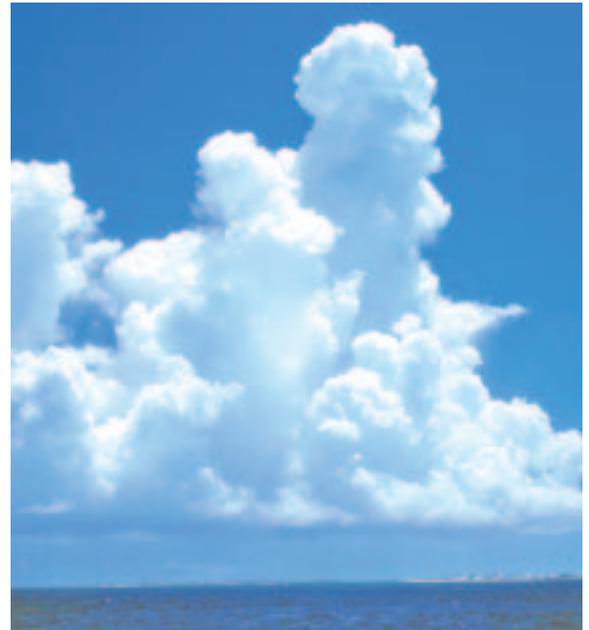
While significant advances in environmental protection and management may be noted; population pressure, urbanization and industrialization remain persistent drivers of environmental degradation and of vulnerability.

Mangroves, for instance, are disappearing faster than any other forest type and with them important buffers from tropical storms and other coastal hazards. Since 1980, 35% of the world's mangroves have been lost (up to 80% in some countries). Similarly drought and desertification constitute some of the greatest challenges to the achievement of the goals of poverty reduction and disaster risk reduction.

Insufficient attention has been given to evaluating the impacts of environmental degradation on disaster risk. If change is not accounted for and monitored, estimations of vulnerability may be compromised. In addition, precious opportunities to capture the "prevention dividends" associated with wise environmental management are being lost.

2. Climate Change and Disaster Risk Reduction:

More than two-thirds of all disasters are weather related. In vulnerable communities extreme weather events, such as floods and windstorms, can take a high toll in lives lost and damaged infrastructure, while droughts bring prolonged devastation and famine to many millions.



The impacts are especially severe on the poor, who must often settle in areas prone to floods, droughts and other hazards, and who do not have the resources to protect their assets. Moreover vulnerability is increasing as a result of the same drivers causing environmental degradation (see above). Existing vulnerabilities may be exacerbated by long term changes of weather conditions and affect the poorest the hardest. Disaster risk measures such as education, implementation of sustainable environmental practices, development of resilient housing in less vulnerable localities, early warning systems and other practices, increase communities' ability to withstand existing hazards, and additionally those posed by future global and climate changes.

Disaster risk reduction is a potent means of adaptation to future global and climate changes and vulnerability reduction. This idea needs to be incorporated into development policy and practice, as well as in climate change policy. Explicit mechanisms need to be developed to more systematically link the DRR community and its humanitarian sponsors, with the climate change community and its policy activities, and with the development community.

3. Urbanization and Disaster Risk Reduction:

At the end of this decade, more than half of the world's population will be living in cities, mega-cities and urban networks. Understanding urban development phenomena in developed and developing countries is a priority. Rapid rural migration to already high-density urban areas has contributed to an alarming increase in the vulnerability of cities with respect to external events such as extreme weather. Poorer populations tend to live in extremely hazardous places close to rivers and seasonally flooded locations, on steep slopes where landslides are a natural hazard, near waste dumps or hazardous industrial facilities. Construction in cities is often not in line with extreme events. Risk from natural and human-induced hazards continues to increase due to unplanned land use and construction, lack of awareness in the development process, weakness in governance, regulations and lack of awareness among the population and its governing institutions and population increase.

People in globalized societies are much more dependent on infrastructure, such as roads, railway lines, subways, telephone, pipelines and electricity connections. A failure of these services resulting from extreme events can have considerable consequences even for people in areas not directly affected. In major industrial areas, particularly involving the chemical industry, extreme natural phenomena such as earthquakes or floods can result in cataclysmic environmental disasters, a fact not given due consideration in some regions.



Picture Reference: Marqueza L. Reyes

What recent disasters tell us:

The increasing frequency and magnitude of damage inflicted by natural hazards pose a growing threat to sustainable development and human security, with the poor bearing a disproportionately large burden of the risk.

Recent data indicates that disasters have claimed over 600.000 lives and affected over two billion people in the last 10 years. The direct economic losses are estimated at USD 700 billion. These losses exceed financial contributions from international development sources to developing countries and in many cases, claim a significant proportion of national assets³.

Increasing vulnerabilities, climate change, environmental degradation and urban growth in both developed and developing countries present complex emerging new risks. Scientific modelling of global change and assessment of current and future vulnerability remain important areas of research for social scientists, global change and the national and international disaster reduction communities.

As stated by Dr. Rechkemmer, IHDP Executive Director, "Global environmental changes are intimately connected with processes of social, economic, cultural and political globalisation" ... "Our understanding of global changes should go further. We want to understand the second order dynamics of change, THE CHANGE OF CHANGE"⁴. Knowledge of the dynamics of change must be applied to the development of adaptative strategies that reduce disaster risk and strengthen our resilience.

³ UNISDR - Inter-Agency Task Force on Disaster Reduction, Twelfth Session, 22-24 November 2005, Geneva, Palais des Nations, "Proposal for joint work programming and reporting on the implementation of the Hyogo Framework for Action" p. 4.

⁴ Highlights from Global Environmental Change Research, Dr. A. Rechkemmer, DKKV, 19th December 2005, Bonn.

Summaries of Introductory Presentation Given at the Symposium

Global Environmental Degradation and Disaster Reduction

Environmental managers have been active in risk reduction as well. Considerable advances have been made in early warning, prevention and risk awareness, though generally the emphasis has been on the risks that natural hazards poses for economic sustainability and human life and well being. The linkages between environmental change and disaster risk have not received wide attention. Environmental conditions can shape the physical conditions that lead to hazard occurrence, absorb the shock and provide the resources and environmental services that underlie community resilience .

References to Environment and Natural Resource Management in the Hyogo Framework for Action

"Reducing underlying risk factors" is identified as a priority area for action in the Hyogo Framework. Key activities include Environmental and natural resource management. Specific reference is made to:

- **Encourage the sustainable use and management of ecosystems, including through better land-use planning and development activities to reduce risk and vulnerabilities.**
- **Implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction, including structural and non-structural measures, such as integrated flood management and appropriate management of fragile ecosystems.**
- **Promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change, which would include the clear identification of climate-related disaster risks, the design of specific risk reduction measures and an improved and routine use of climate risk information by planners, engineers and other decision-makers.**

Environmental management can in some regions provide a range of measures that support risk reduction. UNEP's World Conservation Monitoring Center recently published, "In the Frontline: Shoreline Protection and



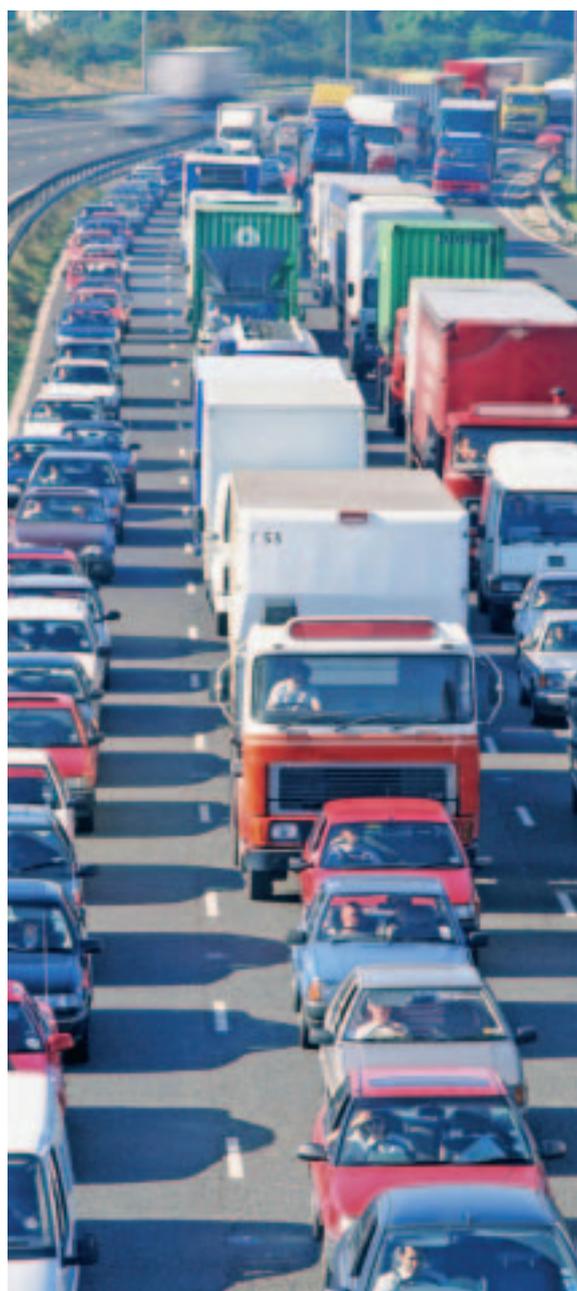
Other Ecosystem Services"¹⁴, which identifies key elements of the roles played by mangroves and coral reefs in reducing disaster risk. Land use management, including erosion control and maintaining forest cover can prevent landslides in many circumstances. The environment provides vital waste treatment services that can reduce the health risks associated with contaminated water and soil, particularly in post disaster situations. The food and raw materials supplied by healthy ecosystems are essential in the recovery process but are also fundamental to supporting and sustaining community development. Conversely, environmental degradation is clearly linked to poverty, which is widely recognized as a significant factor in determining vulnerability to disaster risk. Healthy ecosystems also provide natural habitats and refuge in time of disturbance; wetlands are especially valuable in this regard. Also, notable, is the role of environment in providing critical information such as indicators of change and even early warning. While there has been greater attention to estimating the value of these services and to understanding how environmental management practices can be used to capture "prevention dividends", no instrument for calculating the costs of environmental degradation's impact on disaster risk has yet been developed.

¹⁴ Available online at:

http://sea.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series/24.cfm

Opportunities ahead

While our understanding of the relationship between environmental degradation and disaster risk is improving, much research is needed to identify the causal relationships and critical thresholds that can guide site-specific interventions. Substantial challenges remain, but through increased cooperation between the scientific technical community and disaster risk reduction and environmental management practitioners, we can move from broad generalizations to operational level knowledge. This includes, among others, estimating the value of environmental services for risk reduction, calculating the “prevention dividends” accrued from good environmental management and monitoring changes in risk and anticipating how changing settlement dynamics, climate change and new patterns of environmental degradation will affect risk and vulnerability.



Climate Change and Disaster Reduction

Since the entry into force of the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, efforts to reduce greenhouse gas emissions have been the focus of the international negotiations on climate change. In recent years, however, adaptation to the adverse effects of climate change has progressively received a broader share of attention, partly due to the perceived increase in frequency and intensity of weather-related natural disasters and associated losses. The interests of the communities of climate change and disaster reduction converge on the concept of adaptation, given the synergies for the two areas of work.

References on Climate Change in the Hyogo Framework for Action

- **Promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change, which would include the clear identification of climate-related disaster risks, the design of specific risk reduction measures and an improved and routine use of climate risk information by planners, engineers and other decision-makers.**
- **Mainstream disaster risk reduction measures appropriately into multilateral and bilateral development assistance programmes including those related to poverty reduction, natural resource management, urban development and adaptation to climate change.**

Based on our current understanding of climate change, a general strategy to deal with climate change and changes in weather extremes can be sketched. Obviously, for the next few decades a global warming and hence, a change in weather extremes, seems to be possible. Therefore, adaptation to climate change and changes in weather extremes is mandatory to maintain welfare for the decades coming. Since adaptation depends on societal and economic constraints, adaptation has to happen regionally.

Since anthropogenic forcing is likely to be, and most likely to become, the strongest driver of climate change, it is reasonable to expect a human influence on changes in weather extremes. There is, however, no known approach that would allow a successful management of climate change. Weather extremes are often defined in relation to potentially dangerous weather impact. Weather extremes could be defined in many different terms, which have to prove their appropriateness with respect to the weather processes involved and the effects they evoke. An extreme event occurs whenever the meteorological parameter under consideration exceeds the mean value of a given period in time by several standard deviations. This only becomes of interest when comparing to the design criteria valid of the structures of an urban area, a landscape, a region. In many cases design criteria rely more on experience with failures rather than long term measurements, which are the weak point of such analyses. For example, the occurrence of intense hurricanes, say of category 5, is known reliably only for the last several decades. Hence, it is hard to judge whether the recent increase in the number of intense hurricanes (Emanuel, 2005) is part of a decadal oscillation or is a trend that could be related to global warming (Landsea, 2005).

During the last decades, tremendous progress has been made in the understanding of climate system dynamics such that most statements with respect to global climate change are robust. However, the regional details of global climate change and the dynamics of extremes are much less understood. Hence to assist the planning of adaptation, climate research has to focus on these weaknesses. Furthermore, climate research encompasses not only climate modelling but also climate monitoring. While global scale observing systems are pursued and are well underway, less consideration is given to comprehensive long-term, high quality climate stations. The continued maintenance of existing long-term climate stations is a sine qua non of climate research.

Challenges Ahead

It is necessary to keep in mind the long-term effects of anthropogenic activities. Besides adaptation, mitigation of greenhouse gas emissions and land-cover change is needed for a sustainable welfare beyond the next decades. Perhaps, it is useful to note that welfare not only includes economic welfare, but also societal well being and efficient ecosystem services. Sustainable development (in its general meaning) requires a dual approach: regional, short-term adaptation to changes in climate and weather extremes as well as a long-term, global commitment to mitigation.

Fortunately, the Conference of the Parties (COP) to the UNFCCC has taken decisions that acknowledge the importance of the disaster reduction context in climate change action. The most notable of these is decision 5/CP.7 on supporting developing country needs arising from the adverse effects of climate change.



Urbanization and Disaster Reduction

Cities are where disasters are the most complex to mitigate and manage. Experience has shown that we cannot hope to minimize the effects of disasters upon cities through the application of scientific and engineering approaches alone. As our cities and settlements need to be safeguarded from further devastating losses, it is our ability to make and enhance sustainable choices that needs to be improved upon. Concepts of sustainability and sustainable development offer a valuable framework for integrating DRR with other social and environmental goals - before, during and after a disaster.

References on Urbanization in the Hyogo Framework for Action

- **Institutions dealing with urban development should provide information to the public on disaster reduction options prior to constructions, land purchase or land sale.**



- **Incorporate disaster risk assessments into the urban planning and management of disaster-prone human settlements, in particular highly populated areas and quickly urbanizing settlements. The issues of informal or non-permanent housing and the location of housing in high-risk areas should be addressed as priorities, including in the framework of urban poverty reduction and slum-upgrading programmes.**
- **Mainstream disaster risk reduction measures appropriately into multilateral and bilateral development assistance programmes including those related to poverty reduction, natural resource management, urban development and adaptation to climate change.**

The trend of urbanization seems irreversible. Over the course of 50 years, the world population has changed its complexion from predominantly rural (70 percent) in 1950 to half-way urban (50 percent) in 2005. This trend will apparently continue, according to the UNHABITAT (2002): by the year 2030, the world population will have become predominantly urban with 60 percent of the human inhabitants of this planet preferring to live and work in urban areas.

This rapid urbanization process worldwide will take place in the less developed countries (LDCs) of the world. In the LDCs, population in urban areas is projected to grow at 2.35 percent annually from 2000 to 2030 or a doubling time of 29 years. This is particularly rapid when compared to the urban growth rate in more developed countries (MDCs), which is estimated at 0.38 percent, so that, by 2030, 80 percent of the world's urban dwellers will be concentrated in LDCs.

To illustrate, from 1975 to 2015, the number of mega-cities will have grown from five - three of them in the developing world - to 21, all but four are located in the developing world (UN, 2002) (*Table 1, page 31*). Mega-cities, large urban agglomerations with at least 10 million people, are a twentieth century phenomenon, and based on these trends, more and bigger megacities are inevitable in the twenty-first century. We have to realize that natural disasters in these urban agglomerations have the potential to create regional and/or even global negative effects.

This unprecedented growth increases the vulnerability of the urban system as a whole and, in particular, threatens public health. Additionally, large agglomerations increasingly face a "metropolitan dilemma" of rapid expansion, segregation and socio-spatial polarisation. The latter means that the rich and the poor, the robust and the vulnerable, the healthy and the ill are moving closer in space. Given the concentration and density of people, infrastructure systems and accelerating political and social processes, urban agglomerations are particularly vulnerable to all kinds of hazards, which results in losses of life and reduction of health.

Cities, therefore, are where disasters are the most complex to mitigate and manage. Urbanization is further exacerbated as a consequence of endemic vulnerability to cyclical disasters in rural areas causing movement of rural populations into cities, further stretching existing urban capacities. Despite of improvements in early warning systems and

telecommunications, the number of people affected by disasters triggered by natural hazards each year has been growing steadily. This trend is not expected to change - due to this ever-increasing rate of unplanned urbanization and concentrations of people in disaster prone areas - an increasingly worrying feature of modern society.

Challenges Ahead

The mega-city itself represents a new kind of disaster risk. Considering its sheer size alone, the physical, social and economic vulnerabilities of megacities are unparalleled. Coupled with climate changes, widespread environmental degradation, and unrelenting natural hazards, potential disaster losses in megacities have never been greater.

While cities are expanding endlessly, in many places co-inhabiting with ever-increasing mega slums, and with the rate of urbanisation often beyond control, the effect of natural calamities are likely to occur with more frequency and devastation. Creating a culture of prevention is literally becoming a matter of life or death, yet the dominant approach to disaster relies heavily upon emergency responses and comparatively little investment in risk reduction.

The first steps are to start identifying and addressing the underlying factors that determine vulnerability in our cities - the prevalence of poverty, the standards of governance and the perceptions of risk. This is the basis to address future disaster reduction.



Introductory Presentations

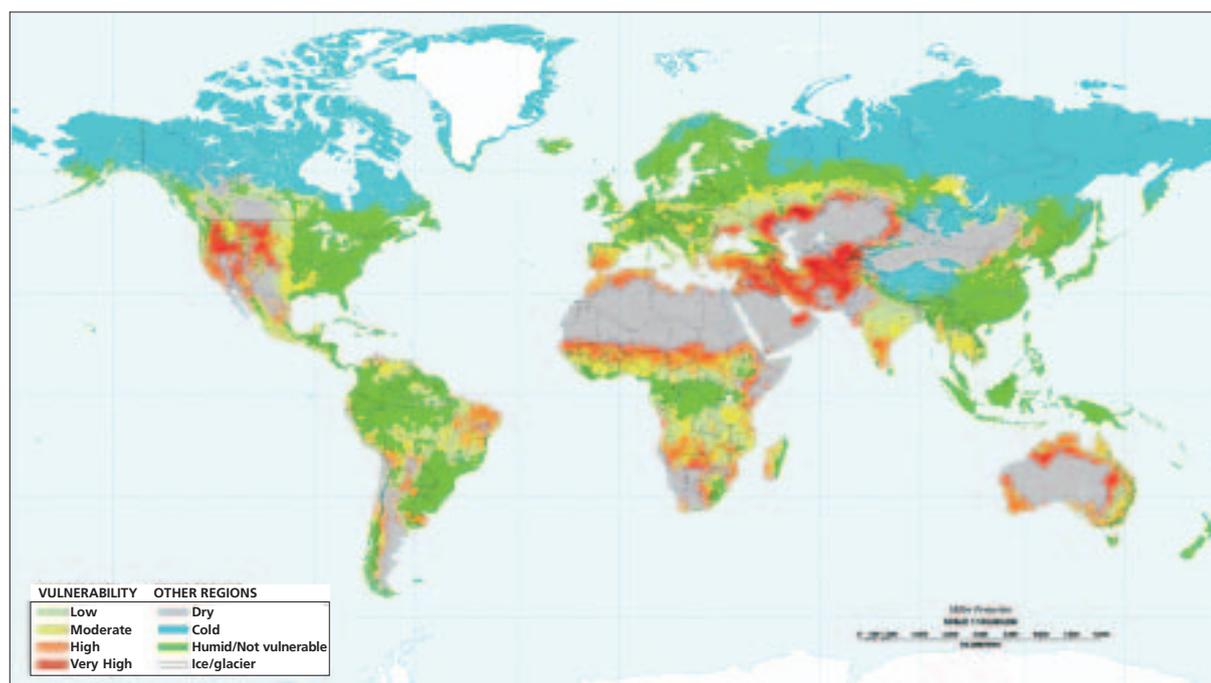
Understanding Early Warning Systems for Desertification:

A contribution from the UNCCD secretariat for the joint DKKV-ISDR symposium on Global Environmental Change and Disaster Risk Reduction

*Prepared by Arnaud de Vanssay,
Douglas Pattie
United Nations Convention to Combat
Desertification (UNCCD)*

The Hyogo framework has recognized the UNCCD as an important multilateral development and instrument of the international community to address, the environmental (drought, desertification/land degradation) and humanitarian emergencies (food security, floods, fires, dust and sand storms) in a timely and appropriate manner. People affected by well-publicised environmental disasters such as the 2005 earthquake in Pakistan, the Asian tsunami or the recent U.S. Gulf Coast hurricanes benefit from the mobilisation of private and public sector generosity and humanitarian relief. However, countless millions of others around the world are uprooted by slow developing environmental changes such as desertification, land degradation and the rising sea levels. It is estimated that from the Sub-Sahara, 60 million people are expected to migrate toward North Africa and Europe by 2020.

*Figure 1. Desertification Vulnerability.
Source: USDA-NRCS, Soil Survey Division, 1998.*



Knowing the Risk

While natural hazards will continue to occur, human action can either increase or reduce the vulnerability of societies to these hazards and related technological and environmental disasters by focusing on the socio-economic factors determining such vulnerability. Knowing about risks that lead to disasters, understanding how they affect our livelihoods or environment and more generally human well-being, are crucial to the design of strategies to protect our lives, our possessions, our social assets and indeed the land, water and natural resources on which human life depends. Desertification is a major threat that should be characterized within the disaster reduction context. The UNCCD benchmark and indicators (B&I), desertification monitoring and assessment and early warning systems (EWS) have been identified as the integral components of the holistic approach to understanding the causal factors and spatio-temporal characteristics of drought and desertification processes.

Characterizing vulnerability

In recent decades an emphasis has been put on the assessment of risk/vulnerability of land resources regarding their exposure to processes such as soil degradation and vegetation cover loss. Land cover and use changes have been assessed with increasing precision. Often only biophysical parameters (mostly soil and climatic parameters) have been taken into account. However, socio-economic factors should also be integrated as a major component in assessing vulnerability.

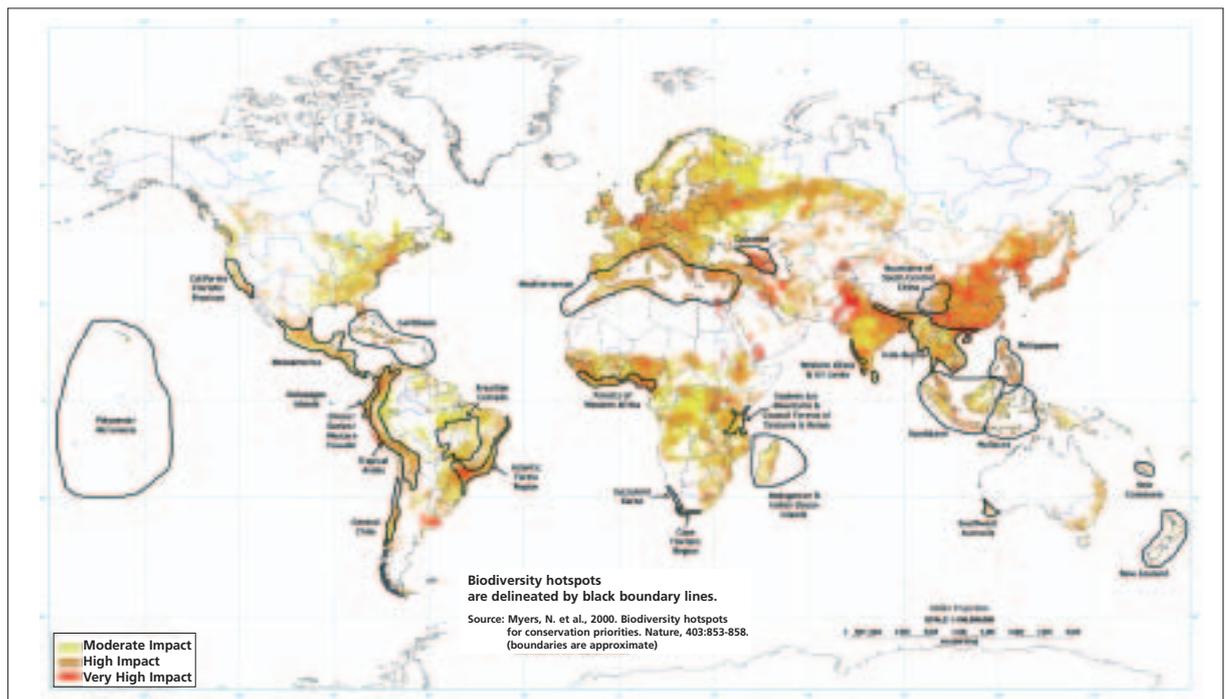


Figure 2. Tension zones. Source: USDA-NRCS, Soil Survey Division, 2000.

Several attempts have been made to assess desertification vulnerability. Figure 1 has been based on soil status maps. Figure 2 identifies global tension zones which combines land quality and population density. Integrating socio-economic data (figure 3) has been studied as a way to identify people affected by drought.

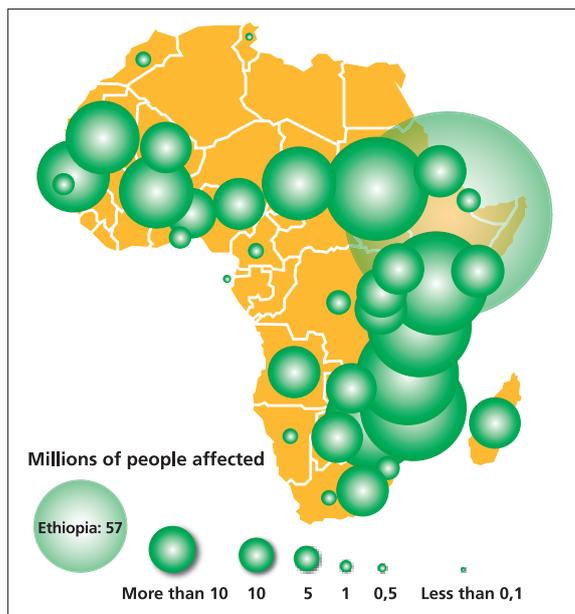


Figure 3. People affected by drought. Source: UNEP/GRID Arendal (2004): Environment and Poverty Times, Vol.2, 2004.

A Culture of Prevention

Dryland populations lag far behind the rest of the world in term of human well-being and economic development. Two major drivers of desertification, poverty and population growth are higher in drylands than in any other ecosystem type. People in drylands are often socially and politically marginalized due to their impoverishment and remoteness from centres of decision-making. People living in arid zones are one of the most vulnerable in the world. For those people, what matters most is knowing which land is currently at risk because it is easier and cheaper to prevent desertification than to rehabilitate already desertified land. Disaster risk reduction is a key for their development. It includes, prevention, mitigation and adaptation of drought and desertification.

The UNCCD has a role to play by increasing the interaction and cooperation between the natural and social science communities working in disaster risk reduction. This dialogue should now be centered on the management of disaster risks by reducing the vulnerability of the affected people, increasing their capacity to cope, and tackling the root causes of vulnerability which are the underlying social, economic, institutional, and political structures. In this regard, UNCCD considered EWS of drought and desertification as a powerful tool. Both knowing the risk, the vulnerability of the population, and the proposed strategies to mitigate, prevent and adapt should be two major parts of an EWS for desertification.

A policy framework

The public policy framework on natural disaster should be one that ensures that a desertification and drought management plan is elaborated to include a communication and information strategy which serves local communities. These policies must be demand-driven rather than occurring from a top-down technological push. Under a technologically driven, fast-changing environment, some of the critically important traditional knowledge may lose its relevance. Traditional knowledge is based on local environmental conditions and can have higher relevance with which to form the basis for stakeholder involvement in policy formulation.

The UNCCD approach emphasizes the importance of involving those people at risk, through community empowerment, communication and exchange of information, methods of raising awareness, planning, and a bottom-up approach which is integrated with a set of principles, policies, legislation and agreements at regional and national levels.

An EWS is considered as an important part of an holistic approach to sustainable development and poverty reduction. There is a need to integrate land degradation and drought into disaster risk reduction strategies and develop the issue within the Hyogo framework as the next step toward a more comprehensive approach of disaster risk reduction. The UNCCD National Action Programmes (NAPs) constitute the fundamental public policy framework for desertification preparedness and the implementation of an EWS. Article 10 of the UNCCD Convention states that the "development of National Action Programmes should include the establishment of early warning systems, the strengthening of drought preparedness and management, and the establishment and strengthening of food security systems." Also, Article 16 of the Convention notes that the "Parties

agree, according to their respective capabilities, to integrate and coordinate the collection, analysis and exchange of relevant short term and long term data and information to ensure systematic observation of land degradation in affected areas and to understand better and assess the processes and effects of drought and desertification. This would help accomplish, inter alia, early warning and advance planning for periods of adverse climatic variation in a form suited for practical application by users at all levels, including especially local populations."

Desertification Early Warning Systems (EWS):

The Conference of Parties at its third and fourth session appointed Ad Hoc Panels of experts to review and elaborate on technical topics such as the evaluation and prediction of drought and desertification, and measures for preparedness, in cooperation with the follow-up to the International Decade for Natural Disaster Reduction (the 1990's). The Panels' work focused on a critical analysis of the performance of EWS and monitoring and assessment systems, linking traditional knowledge and EWS, especially in the areas of the collection of data, dissemination of information and measuring for drought preparedness. The Panel examined methods for and approaches to the prediction of drought and monitoring of desertification, as well as, examining mechanisms to facilitate an exchange of information between scientific and technological institutions. The work included analysis of more detailed measures for drought and desertification preparedness, in cooperation with the approaches, from hazard protection to risk management as adopted by the International Strategy for Disaster Reduction. Results of the panels were compiled in a publication available at the following link:

http://www.unccd.int/cop/cst/adhocpanel/booleet_EWS.pdf.

The UNCCD ad hoc panels recommended the production of guidelines on a methodology for building a multi-scale desertification EWS. The guidelines should include a plan for dissemination and transfer at all levels. Comparative pilot studies of proposed desertification EWS should take place in selected risk areas. Several weaknesses exist in areas related to desertification assessment and monitoring, dissemination of information to end users, institutional arrangements and in the coordination mechanisms. Targeted interventions should include, note or be based on the following:

- Assessment procedures have been empirical and focused on the symptoms of desertification rather than on the underlying drivers and processes. There is lack of integration between human and climate drivers as well as spatial and temporal scale which affected desertification phenomena;
- Temporal data analysis remains scarce despite its importance in understanding the dynamics and intensity of desertification and land degradation;
- There is still not a commonly used, and accepted, indicators and data format system for both desertification monitoring and assessment and EWS;
- No baseline exists for monitoring desertification at the global level;
- Data accessibility is still subject to several constraints. There is a need for the use of meta-data assuring data reliability and compatibility among scales of analysis;
- The integration of traditional knowledge and local communities in data collection, discussion and validation of the results, and developing strategies for combating desertification is still to be achieved;
- The information is not always efficiently disseminated because of the lack of credibility of ill-designed warning messages and/or the fail of dissemination systems that must convey the information derived from the assessment and prediction procedures to the population at high risk;

- There is a lack of genuine partnership between the main stakeholders. Political and biased uses of the information by a few stakeholders have tended to result in EWS as a tool for political and misguided uses; and
- The coordination between EWS and decision makers is poor. A clear definition of the role of EWS in national desertification policies and programmes, and who is the responsible authority, is absolutely necessary for ensuring effectiveness.

There is a gap in the dissemination of information to end-users and the application of EWS for desertification. The integration mechanisms for the effective use of EWS in the decision-making chain to combat desertification needs to be identified and the assessment of strategies for ensuring exchange and dissemination of information needs to be put in place. There is also a need to establish the processes to convey proper warning messages to target groups. Each of the nodes (actors, institutions, groups) of the information network should be identified as well as their information rights and ownership.

UNCCD initiatives:

Publication on EWS:

http://www.unccd.int/cop/cst/adhocpanel/booklet_EWS.pdf

Know risk reprint:

http://www.unccd.int/science/docs/cst_public_r.pdf

Prevention and control of Dust and Sandstorms in Northeast Asia:

http://www.unccd.int/publicinfo/publications/docs/dustsandstorms_northeastasia.pdf

Global Alarm, Dust and Sand Storms from the World's dryland:

<http://www.unccd.int/publicinfo/duststorms/menu.php>

Ecosystem Services and Disaster Risk Reduction:

Trends in Environmental Change and Management

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Introduction

Environmental management has for decades adopted a risk perspective, though less attention had been given to vulnerability, considerable advances have been made in early warning, prevention and risk awareness. Environment plays a pivotal role in risk and vulnerability as it can shape the physical conditions that lead to hazard occurrence, absorb the shock and provide the resources and environmental services underlie community resilience.

The Hyogo Framework of Action identifies environmental and natural resource management as top of the list for reducing underlying Risk Factors.

Environment and Natural Resource Management in the Hyogo Framework for Action

Reducing Underlying Risk Factors

- Encourage the sustainable use and management of ecosystems, including through better land-use planning and development activities to reduce risk and vulnerabilities.
- Implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction, includ-

ing structural and non-structural measures, such as integrated flood management and appropriate management of fragile ecosystems.

- Promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change, which would include the clear identification of climate-related disaster risks, the design of specific risk reduction measures and an improved and routine use of climate risk information by planners, engineers and other decision-makers.

Ecosystems Provide Vital Services for Disaster Risk Reduction

The environment provides many services for risk reduction such as disturbance prevention, climate regulation and waste treatment; producing food and raw materials; providing natural habitats and refuge in time of disturbance; and, providing critical information such as indicators of change and even early warning.

In recent years greater attention has been given to calculating these values and to understanding how environmental management practices can be used to capture the "prevention dividends".

Managing the environment to sustain and capitalize on these services. Moreover, while applying the precautionary principle, UNEP and others are keen to identify the economic values of these services.



Freshwater Wetlands, Mangroves, Upper Watersheds, Coral Reefs and Coastal Dunes all play a role in influencing the frequency and intensity of hazards and hazard impacts. UNEP's World Conservation Monitoring Center recently published, "In the Frontline: Shoreline Protection and Other Ecosystem Services"⁵, which identifies key elements of the roles played by mangroves and coral reefs in reducing disaster risk.

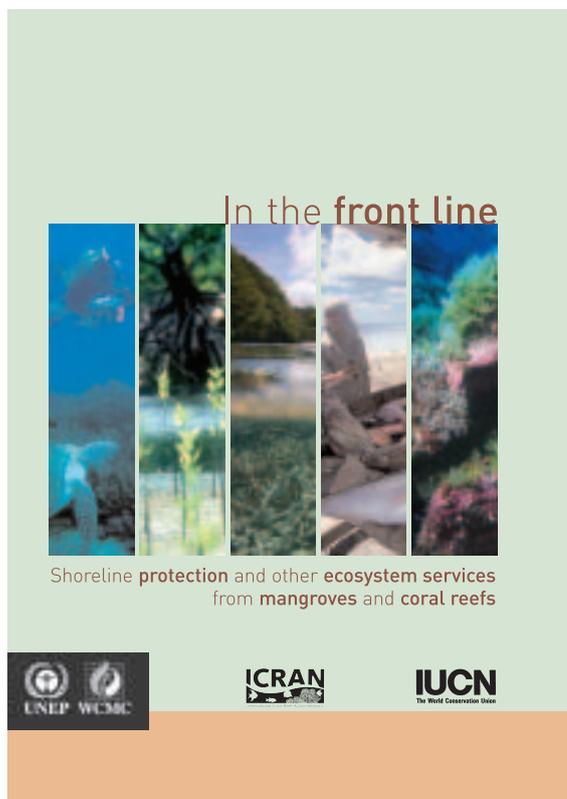
Coral Reefs, for instance, have been demonstrated to dissipate wave energy though the potential as a natural buffer is dependent various features such as the type of wave, tide, coastal profile, fragmentation. In the case of tsunami, shores adjacent to deep water tend to receive less impact than those adjacent to shallow or sloping shelves regardless of presence of reefs. The value for shoreline protection has been estimated at USD 9 Billion annually worldwide. In Indonesia, values range from USD 829/km - USD 1 million/km depending on the settlement patterns and the presence of infrastructure.

These factors add considerable cause for concern over recent trends in the degradation of coral reefs globally. Thirty percent of reefs worldwide are already seriously damaged and up to 60% may be lost by 2030. In the Caribbean, two-thirds of reefs are at risk from human activities. The main drivers are changes are over fishing, pollution from agriculture and coastal development and global climate change.

Similar conditions pertain to Mangrove forests which can serve as a Natural Buffer. In some cases, 200 meter swath of mangrove can yield up to a 75% reduction in wave energy while a 1.5 km belt could virtually eliminate the energy of a one meter wave. The buffering capacities of mangrove depend on depth, bottom configuration, density of mangrove forests and the type of wave.

Though there are signs that the degradation of mangroves has slowed somewhat recent years, the world continues to lose an estimated 2.834 km sq/year - more than any other forest type. In all, 35% have been lost since 1980. Some countries have lost as much as 80% of their native mangroves. The main drivers include aquaculture, timber and fuel wood, rice paddies and freshwater diversion.

Coral Reef and mangrove systems produce the natural resources for subsistence and livelihoods and commercial industries. In addition to the fishery and forest products, these ecosystems also provide valued opportunities for the retail and service sectors, particularly where tourism are established or have potential.



⁵ Available online at:

http://sea.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series/24.cfm

Environmental Management and Disaster Risk Reduction

Environmental managers have a long history of convince policy makers, public and private sector to invest in risk reduction and, notably for mainstreaming these issues across sectors through the development and advancement of integrated planning models (such as integrated coastal zone management, integrated water resources management, integrated mountain development etc); these lessons should be made available to the champions of disaster risk reduction.

Environmental management, in addition to protecting environmental services, has other direct relevance for disaster risk reduction. For instance, good environmental governance promotes risk reduction, community resilience and adaptive capacity.

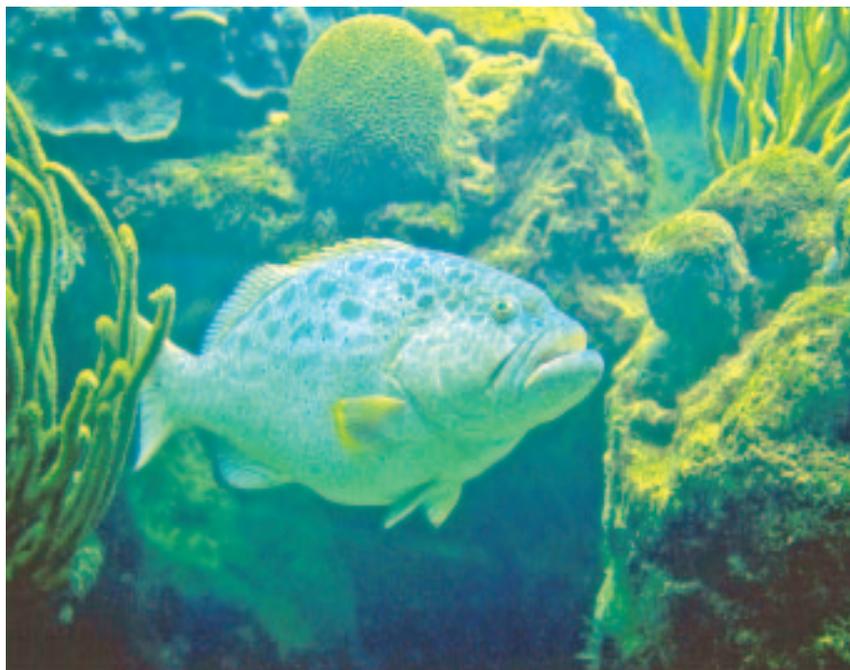
Similarly, environmental management provides a number of relatively simple conduits for introducing disaster risk reduction. For instance, including risk and vulnerability mapping as standard components of integrate planning programs just noted. Operational Support for Ecosystem management and Sustainable Livelihoods clearly supports the goals of disaster risk reduction as well. Safer, more sustainable technologies can both protect the environment and can reduce disaster risk.

Environmental information systems particularly those in which environmental change is monitored and brought into an interactive planning environment provide opportunities for cost-effectiveness and synergistic applications if disaster risk concerns were to be mapped and monitored as well.

UNEP and National Environmental Authorities

UNEP continues its efforts to develop and strengthen the capacity of environmental authorities to support disaster risk reduction and address environmental concerns in the response to and recovery from natural and human-induced disasters. In addition to the long standing activities of the Disaster Management Branch, Early Warning and Assessment Initiatives, Awareness and Preparedness for Environmental Emergencies at Local Level (APELL) and response to environmental emergencies through the UNEP-OCHA Joint Unit for Environmental Emergencies, UNEP has also launched an Environmental Recovery Programme and a project on Environmental Information and Assessments for Early Warning.

The Environmental Recovery Programme focuses on Rebuilding Environmental management capacities, Environmental Infrastructure, Environmental Screening, Eco-Housing and supporting Sustainable Livelihoods. It also advocates for attention environmental issues in the UN Interagency Standing Committee (IASC) Early Recovery Cluster.



IATF Working Group on Environment and Disaster Risk Reduction

In May, the 11th session of the IATF/DR agreed to establish an Ad Hoc Working Group on Environment and Disaster Risk Reduction. This decision follows discussions prior to and during the WCDR in January 2005, which recognized the urgent need to ensure that environmental management concerns and capacities are reflected in the follow up to the WCDR and to build on the synergies between these two fields of practices.

Thirteen organizations joined the working group: United Nations Environment Programme (UNEP), International Federation Red Cross (IFRC), World Food Program (WFP), Asian Disaster Reduction Center (ADRC), Council of Europe, Global Fire Monitoring Center (GFMC), World Meteorological Organization (WMO), Asian Disaster Preparedness Center (ADPC), United Nations Development Program (UNDP), African Union Commission, World Conservation Union (IUCN), United Nations University (UNU), and UN Center for Regional Development (UNCRD).

Seven of these organizations met in Nairobi on October 27-28, 2005 and agreed that a Working Group on Environment and Disaster Risk Reduction in the Inter Agency Task Force for Disaster Reduction (IATF-DR) provides a valuable opportunity to convene experts to reflect on the gaps, priorities for action and strategies for strengthening the role of environment and environmental managers in disaster risk reduction and to bring these insights to the attention of many of the organizations supporting disaster risk reduction.

The EDWG aims to foster understanding and integration of environmental concerns in the implementation of the Hyogo Framework of Action from local to global levels

The EDWG will achieve its mission through an approach that draws on the broad range of available skills and capacities to effectively integrate environmental concerns in disaster risk reduction.

Objectives

- Advocate for more authoritative understanding of the two-way linkages between environment and disaster risk reduction, from the scientific and policy perspectives.
- Respond to requests for guidance on related issues from the ISDR System
- Sharing information with similar groups working at regional/national levels

The group will prepare a compendium of relevant issues and mechanisms for addressing environmental concerns in the implementation of the Hyogo Framework at all levels, recommendations to the ISDR System on mechanisms to sustain attention to these issues and a collection of case studies and summary of good practices, illustrating issues raised by the WG.

Indicative Challenges

While our understanding of the relationship between environmental degradation and disaster risk is improving, much work remains to be done to better recognize causal relationships and critical thresholds and to design and implement appropriate interventions that support safer and more sustainable communities. Challenges such as moving from generalizations to operations estimating the value of environmental services for risk reduction, calculating the "prevention dividends" accrued from good environmental management and monitoring changes in risk and anticipating how changing settlement dynamics, climate change and new patterns of environmental degradation will affect risk and vulnerability are substantial but through increased cooperation between the scientific technical community and the disaster risk reduction/environmental management practitioners progress is possible.

**Disaster Preparedness:
The Aspect of Public Health**

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Introduction

The challenges of urban expansion, such as the need for shelter, services or employment, are particularly visible in large agglomerations or large and rapidly growing urban settlements. At global scale, urbanisation has reached a turning point: more than 50% of the world’s population lives in urbanites. This concentration of population is often associated with an intense exploitation of natural resources, such as air, water and land. In addition, poverty and illegal activities are the consequences of a loss in governability.

All these processes increase the vulnerability of the urban system as a whole and, in particular, threaten the health of the public. Additionally, large agglomerations increasingly face a “metropolitan dilemma” of rapid expansion, segregation and socio-spatial polarisation. The latter means that the rich and the poor, the robust and the vulnerable, the healthy and the ill are moving closer in space. Given the concentration and density of people, infrastructure systems and accelerating political and social processes, urban agglomerations are particularly vulnerable to health hazards, which results in elevated health risks.

The present paper is focused on human health risks. Health is threatened in the immediate aftermath of natural disasters. Health problems, such as epidemics due to infections or in result of environmental contamination, may form a stand-alone disaster, or can be one crisis in a chain of disasters released by a natural disaster, such as a storm or flood.

As to the public health, disaster preparedness means that the public, the officials, and also the scientists are aware of the following practical and research needs.

Executive requirements for public health preparedness professionals

Planning for and responding to a natural disaster, infectious disease outbreak or other public health threat or emergency requires that health departments have capacities and action-oriented, practice-based, and peer-developed models and plans. These plans are designed for use as a standard approach to prepare, respond and assess the health risks. They will enable state and local public health agencies to identify their community’s hazards, assess the likelihood of occurrence, and quantify their impacts on the public’s health. This information will be useful for the prioritization of response and mitigation options. *Tab. 1* summarises a list of key topics to be considered when preparing to health threats.

Disasters	Key topics
Flood	<ul style="list-style-type: none"> ■ Prevention of epidemics/pandemics ■ Carbon monoxide poisoning
Storm	<ul style="list-style-type: none"> ■ Cleaning a house/basement after a flood, cleaning indoor sewage spills ■ Emergency toilets ■ Disinfection of private wells
Earthquake	<ul style="list-style-type: none"> ■ Finding hidden water supplies in an emergency ■ Safe water after a disaster if you use public water supplies
Drought	<ul style="list-style-type: none"> ■ Hypothermia ■ Power failure and how to protect foods ■ Safety precautions after a disaster
Power failure	<ul style="list-style-type: none"> ■ Septic tank systems during power outages or floods ■ Truck transportation of potable water for public use ■ What to do when a "Boil Order" is issued
Fire	<ul style="list-style-type: none"> ■ What to do when the power goes out ■ Which foods and medicines are safe after a flood disaster
...	<ul style="list-style-type: none"> ■ Mental health needs (emotional reactions to traumatic events) ■ Ensure communication

Table 1: Key topics of health emergency preparedness.

Scientific requirements for the public health researchers

Another important aspect of disaster preparedness is the research into the interaction of environment and health. For example, if the infrastructure and the fabric of the buildings are insufficiently low, such as in the situation of Favela, or with poor hygienic conditions and high environmental pollution and contamination there is a breeding ground for public health problems.

Generally, research is needed to understand the complex and interwoven processes determining vulnerability and hazards of health. The probabilistic/statistical aspect is natural to all risk assessment procedures.

As an example, we present a statistical approach to the spatial distribution of the *Helicobacter pylori* infection in the urban districts of the region of Leipzig, Germany. In an epidemiological study 3795 schoolchildren were tested for the prevalence of the *H. pylori* germ in their stomach.

Environmental conditions	Health risks
Favela syndrome	<ul style="list-style-type: none"> ■ Emerging new viruses ■ Threat of epidemics / pandemics
Quality of water supply	<ul style="list-style-type: none"> ■ Emerging new environmentally caused diseases ■ Asthma, Allergies and heart diseases advancing ■ Changes in food quality
Socioeconomic conditions	<h4>Research tasks</h4>
Air pollution	<ul style="list-style-type: none"> ■ Identification of indicators ■ Identification of vulnerable population groups
...	<ul style="list-style-type: none"> ■ Establishing limit values for these indicators ■ Establishing measures for reduction of vulnerability

Table 2:
Increasing vulnerability and (creeping) health risks due to poor environmental conditions.

Besides disasters occurring in sudden bursts, also a creeping development of new health risks may occur, which is linked with poor environmental conditions (*Tab. 2*).

This study was designed to search for the path of contagion, which is so far not fully understood. Our results as well as the recent literature suggest that hygienic conditions (type of toilet, number of persons per sqm in the flat, drinking water, etc.) are the most important factors for the transmission of *H. pylori*. The maps in *Fig. 1* reflect the spatially heterogeneous distribution of risk for infection. This statistical approach can be transferred to other infectious diseases occurring in an urban area in the aftermath of a natural disaster, when poor hygienic conditions exist.

Since a probabilistic approach takes stochastic fluctuations into account, we calculated the statistical significance of the district-wise health risks (see *right hand side of Fig. 1*). This helps distinguishing between randomly altered risks and significant elevations/reductions.

Conclusion

Focusing on public health, disaster preparedness requires close cooperation between the public health preparedness professionals, which develop and realise action-oriented, practice-based, and peer-developed procedures for preparation and response to disasters, and the public health scientific com-

munity, which investigates the interaction between environment and health as well as the vulnerability of individuals and population groups.

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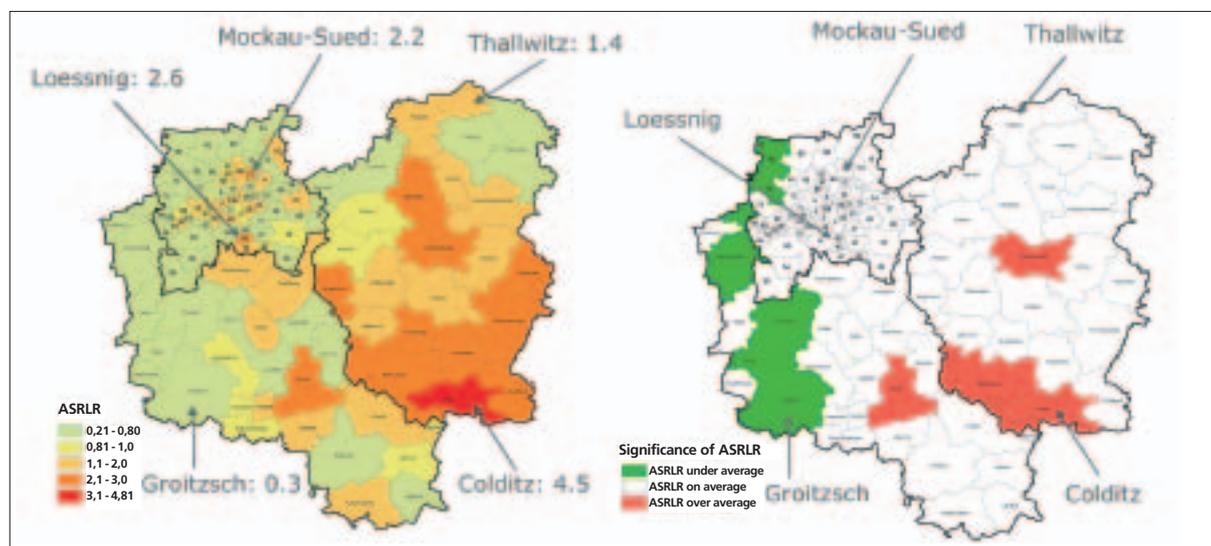


Figure 1: District specific relative risk (left) of *Helicobacter pylori* infection of second-class children in Leipzig (city and rural districts) adjusted for known risk factors (p -value: 0.02); statistical significance (right hand side) is marked for districts of elevated (red) and lowered (green) risk.

Climate Change and Extremes

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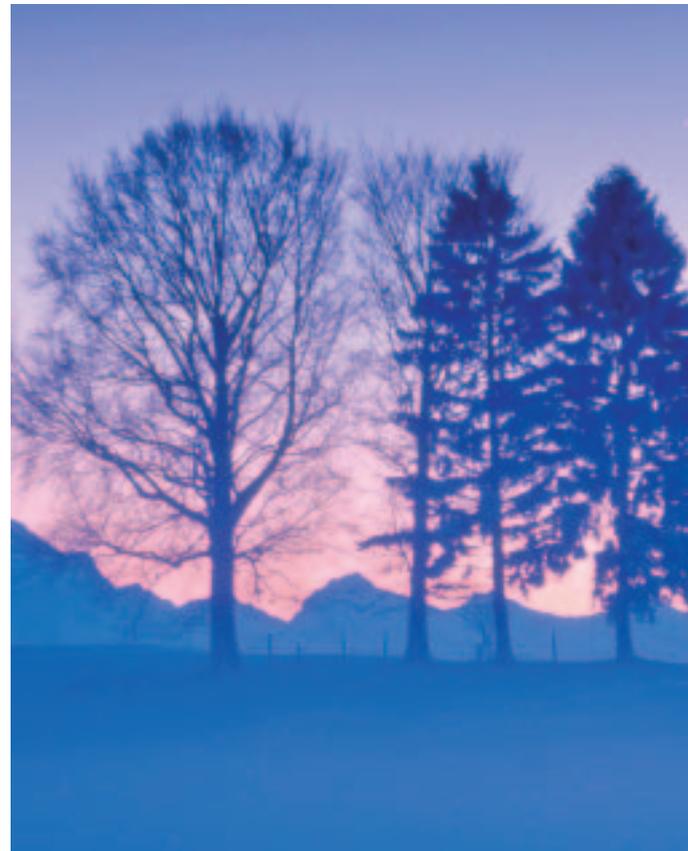
Climate and Climate Change

Traditionally, climate is defined in terms of state and statistics of the atmosphere. In climate physics, a wider definition of climate in terms of state and statistics of the climate system has proven to be useful. The climate system is defined to encompass the atmosphere, the hydrosphere (mainly the oceans), the marine and terrestrial biosphere, the cryosphere (mainly ice sheets, snow, permafrost, ...), the pedosphere (soils and rock) and, if long time scales are considered, the upper Earth mantle (e.g., Houghton et al., 2001, Appendix). Regardless of whether climate is viewed as a property of the atmosphere or of the climate system, its definition is related to statistics. This implies that climate cannot make any statement about the actual state of the atmosphere, or weather, or about single extreme events.

Climate varies because of changes in external forcing. For example the solar energy flux is not a constant; it varies by a few per mill over decades and centuries. Moreover, the Earth orbit around the sun and thus, the geographical distribution of insolation, changes at periods from 21.000 years to 400.000 years. With respect to shorter climate variations, volcanic activity plays a role and, if the last two centuries are considered, anthropogenic land cover change and greenhouse gas emissions (Claussen, 2006). Climate variations also arise because of instabilities in various climate system components. Weather in the atmosphere or calving of ice sheets or ice shelves are example of such instabilities. Since all climate components interact with each other by exchanging energy, momentum and mass (like water, nutrients, ...) apparently random variations in one component are transferred - of course in a somehow filtered way - to the other components (Saltzman, 2002). These internal, or free, climate variations have to be compared with the external forced variations which make the attribution of climate change to a specific forcing difficult.

The human contribution

A number of results obtained from climate system models suggest that over the last millennium, mainly natural forcing such as changes in solar energy flux and changes in volcanic activity can result in the medieval warm period, the cooling towards the so-called Little Ice Age and the warming over the last 150 years (Jones and Mann, 2004). However, natural forcing alone cannot explain the amplitude of climate variations over the last 150 years. It appears the anthropogenic forcing has prolonged the Little Ice Age a few decades, presumably due to deforestation, while the emission of greenhouse gases has contributed significantly to the warming of the last century (Bauer et al., 2003). In particular for the last two to three decades, changes in anthropogenic forcing seem to outweigh changes in natural forcing, and it is expected that changes anthropogenic forcing clearly will dominate changes climate forcing in the next centuries (Houghton et al., 2001) - unless, of course, something unexpected, like the impact of a meteorite, happens.



Climate extremes

Since anthropogenic forcing is likely to be, and most likely to become, the strongest driver of climate change, it is reasonable to expect a human influence on changes in climate extremes. Definition of climate extremes is often done in relation to potentially dangerous climate and weather impact. Climate extremes could be defined in terms of annual mean temperature, or in terms of a number of days during which a temperature threshold is exceeded, or a combination of drought and heat, for example. An extreme event occurs whenever the meteorological parameter under consideration exceeds the mean value of a given period in time by several standard deviations. The length of time series is the weak point of such analyses. For example, the occurrence of intense hurricanes, say of category 5, is known reliably only for the last several decades. Hence, it is hard to judge whether the recent increase in the number of intense hurricanes (Emanuel, 2005) is part of a decadal oscillation or is a trend which could be related to global warming (Landsea, 2005).



Some preliminary results of climate system modelling done at the Max Planck Institute for Meteorology in Hamburg (MPI-M) indicate that for Europe, the duration of heat waves, the total number of frost days, or the numbers of consecutive dry days have not changed over the past decades - in line with observations. For the next century, however, the number of consecutive dry days could increase, the duration of heat wave could almost triple, while the total number of frost days could strongly decrease. These results seem to be independent of the scenario of greenhouse gas emissions (J. Sillmann, MPI-M, personal communication).

Climate surprises

A particularly interesting, and from the economical point of view potentially threatening, climate extreme is a shift in the mode of operation of the climate system. For example, there are plausible theoretical estimates that the meridional overturning circulation in the Atlantic might collapse, if the greenhouse gas emissions continue to grow and to accelerate for the next centuries. Greenhouse gas-induced warming could modify the hydrological cycle and could lead to a melting of glaciers such that the freshwater input into the Northern North Atlantic exceeds a threshold. Such a collapse of the meridional circulation could cause a reversal of the warming and eventually a cooling in the North Atlantic and North European region (Rahmstorf and Ganopolski, 1999). Likewise a steady growth of temperature above some 2 - 3 degrees in the global mean could cause a melting of Greenland ice sheet which then would eventually lead to an increase in sea level by some 7 metres (Gregory et al., 2004).

Adaptation and Mitigation

Based on our current understanding of climate change sketched above, we can outline a fairly general strategy to deal with climate change and change in climate extremes. Obviously, for the next few decades a global warming and hence, a change in climate extremes, seems to be unavoidable. Therefore, adaptation to climate change and change in climate extremes is mandatory to maintain welfare for the decades coming. Since adaptation depends on societal and economic constraints, adaptation is a regional effort mainly.

At the same time, it is necessary to keep in mind the long-term effects of anthropogenic activities. Besides adaptation, mitigation of greenhouse gas emissions and land-cover change is needed for a sustainable welfare beyond the next decades. This statement is subject to a controversial discussion and hence, is posed here more as a hypothesis. Perhaps, it is useful to note that welfare not only includes economic welfare, but also societal well-being and efficient ecosystem services. In conclusion, a sustainable development (in its general meaning) requires a dual approach: regional, short-term adaptation to changes in climate and climate extremes as well as a long-term, global commitment to mitigation.

A final word concerns a sustainable policy regarding climate research. During the last decades, tremendous progress has been made in the understanding of climate system dynamics such that most statements with respect to global climate change are robust. However, the regional details of global climate change and the dynamics of extremes are much less understood. Hence to assist the planning of adaptation, climate research has to focus on these weaknesses. Furthermore, climate research encompasses not only climate modelling, but also climate monitoring. While global scale observing systems are pursued and are well underway, less consideration is given to comprehensive long-term, high quality climate stations. The continued maintenance of existing long-term climate stations is a sine qua non of climate research.

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Climate Change and Disaster Reduction: A UNFCCC Perspective

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Since the entry into force of the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, efforts to reduce greenhouse gas emissions have been at the forefront of the focus of the international negotiations relating to climate change. In recent years, however, adaptation to the adverse effects of climate change has progressively received a much broader share of attention, partly due to the perceived increase in frequency and intensity of weather-related natural disasters and associated losses. The interests of the communities of climate change and disaster reduction converge on the concept of adaptation, which is the focal point of any potential for synergy between the two areas of work.

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as an “adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities”. Despite this precise definition, it has not been always possible to delineate the boundaries that distinguish an adaptation activity from other types of activities in pursuit of sustainable development or disaster reduction. One of the main lessons we have learned in the past years is that there are really no specific defining characteristics of an adaptation action.

The only thing that distinguishes an adaptation action from other activities is not what it looks like, but rather the “motivation” for which it was implemented, i.e. to respond to the adverse effects of climate change. In fact, an adaptation action in one region could be ineffective in another, and could even cause maladaptation in yet a third.

The ISDR Process has taken up references to adaptation just like the climate change process has referenced disaster reduction. Examples in the Hyogo framework where adaptation is given prominence include:

- Promoting the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change;
- Mainstreaming disaster risk reduction measures appropriately into development assistance programmes including those related to, inter alia, adaptation to climate change.

On the other hand, the mention of disasters and extreme events in the UNFCCC context is less explicit:

- In its preamble, the UNFCCC labels the following as particularly vulnerable: “low-lying and other small island countries, countries with low-lying coastal, arid and semiarid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems;
- In its Article 4.8, the UNFCCC mandates consideration of actions to support, inter alia, “countries with areas prone to natural disasters”.



Fortunately, the Conference of the Parties (COP) to the UNFCCC has taken decisions that acknowledge the importance of the disaster reduction context in climate change action. The most notable of these is decision 5/CP.7 on supporting developing country needs arising from the adverse effects of climate change. That decision mandates financial support for:

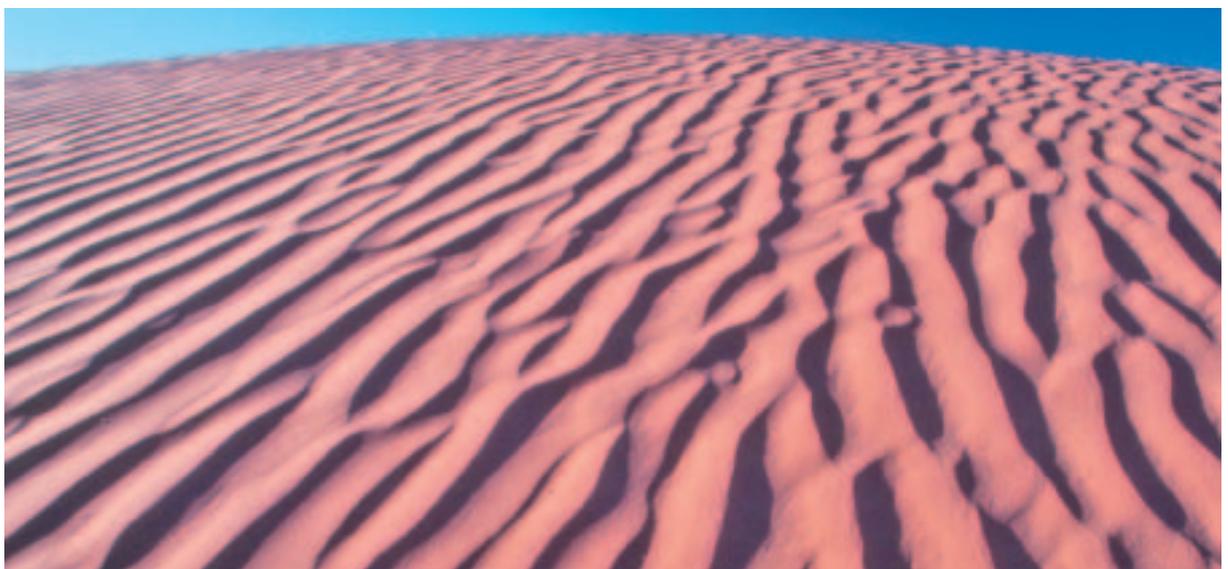
- Capacity-building for preventive measures, planning, and preparedness of disasters relating to climate change, including contingency planning, in particular, for droughts and floods in areas prone to extreme weather events;
- Strengthening/establishing early warning systems for extreme weather events in an integrated and interdisciplinary manner to assist developing country Parties, in particular those most vulnerable to climate change;
- Supporting capacity-building for preventive measures, planning, preparedness and management of disasters relating to climate change, including contingency planning, in particular, for droughts and floods in areas prone to extreme weather events;
- Strengthening/establishing national and regional centres and information networks for rapid response to extreme weather events.

This financial support is to be provided by the Trust Fund of the Global Environment Facility, the Special Climate Change Fund, the Adaptation Fund and other bilateral and multilateral sources. In addition, Least Developed Country (LDC) Parties can avail of support from the LDC Fund to support their urgent adaptation

activities, including those relating to disaster reduction.

At its eleventh session in Montreal, the COP also adopted a five-year work programme on adaptation to be implemented by its Subsidiary Body for Scientific and Technological Advice (SBSTA), which is aimed at furthering the scientific and methodological basis of adaptation, as a complement to the support to be provided for the implementation of adaptation action. This work programme is still in its early stages of evolution, and will take more concrete shape during the course of 2006.

Different sectoral communities dealing with climate change adopt different approaches in conceptualizing the issue. In this context, and despite the overlap in focus, the climate-change and disaster-reduction communities exhibit differences in outlook towards the same problems that they seek to address. For example, the disaster-reduction community is seen to focus more on bottom-up action, single occurrences of disasters rather than long term trends, and giving an added focus on preparedness for the "last disaster" that has received worldwide attention (the recent Asian tsunami for example). The climate change community, on the other hand, has underlined top-down methodologies and long-term climate impacts without a concrete focus on specific areas or impacts. While this can reflect an incongruence in terminology and approaches, it also represents opportunities for synergy whereby the two communities can complement and strengthen each others' work.



As mentioned above, given the early availability of resource channels to address their adaptation concerns, the LDC Parties have taken great strides in identifying and prioritizing their urgent and immediate adaptation needs. They represent the first practical example in the climate change process in which a bottom-up approach has been formalized as a means for adaptation assessment and implementation. Each LDC has been working on producing a prioritized list of its adaptation needs, assessed through a stakeholder consultation process, which ultimately constitutes what is known as a "National Adaptation Programme of Action" (NAPA). The four NAPAs submitted by the end of 2005 were from Bangladesh, Bhutan, Mauritania and Samoa. They provide valuable insight on where communities have identified natural-disaster related action as a priority in addressing climate change impacts.

Following are some examples from the Bangladesh NAPA:

- Construction of flood shelters (at a budget of USD 5 million);
- Enhancing resilience of urban infrastructure and industries to climate change impacts, including floods and cyclones (USD 2 million);
- Exploring options for insurance and other emergency preparedness measures to cope with climatic disasters (USD 2 million).

The UNFCCC secretariat has acknowledged that much of the adaptation action undertaken at community level provide efficient, appropriate and time-tested means for coping with climate change. The secretariat has thus developed an online database of local coping strategies, which includes a number of adaptation measures, including disaster reduction activities, undertaken by communities. It is available at:
<http://maindb.unfccc.int/public/adaptation>.

The aim is to promote a South-South transfer of knowledge and sharing of experience on adaptation action directly undertaken by those who are vulnerable, without reliance on external intervention.

The following are some examples from the database that relate to disaster reduction:

Examples in response to tropical cyclones:

- Community-based disaster preparedness and early warning in the Philippines;
- Cyclone preparedness programme in Bangladesh;
- Typhoon preparedness in Japan.

Examples in response to floods:

- Flood preparedness programmes in Costa Rica, Kenya, Nepal and Thailand;
- Post-flood rehabilitation programme in Bangladesh;
- Mitigating effects of glacial lake outburst floods in Nepal.

Examples in response to droughts:

- Indigenous forecasting in Australia, Burkina Faso, India and Kenya;
- Early warning and disaster preparedness in Kenya.

This short paper has presented just some of the activities and areas of interest in which the climate change process and that of disaster reduction overlap. In order to fully benefit from the similarities and differences of approaches and activities in the two processes, more proactive dialog and cooperative action between the two communities would be beneficial, and would help foster further synergistic action.



Mainstreaming Disaster Risk Management in Metropolitan Planning The Case of Metro Manila, Philippines

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An Urban World

Rapid global urbanization and rural-to-urban migration are two of the underlying forces behind the phenomenon of mega-cities. Whether due to international or internal migration, cities continue to burst at the seams and form complex urban regions. In addition to migration, rapid natural increase and the ensuing reclassification and integration of surrounding suburbs into these expanding conurbations propelling urban growth. From 2000 to 2030, the world's urban population is expected to increase by an average annual rate 1.85 percent.

Over the course of 50 years, the world population has changed its complexion from predominantly rural (70 percent) in 1950 to half-way urban (50 percent) in 2005. This trend will appear to continue, according to the UN

(2002). And by the year 2030, the world population will have become predominantly urban with 60 percent of the human inhabitants of this planet preferring to live and work in urban areas (*Figure 1*).

Another facet of this rapid urbanization process worldwide is that most of this urban growth will take place in the less developed countries (LDCs) of the world. In the LDCs, population in urban areas is projected to grow at 2.35 percent annually from 2000 to 2030 or a doubling time of 29 years. This is particularly rapid when compared to the urban growth rate in more developed countries (MDCs) which is estimated at 0.38 percent, so that, by 2030, 80 percent of the world's urban dwellers will be concentrated in LDCs (*Figure 2*).

To illustrate, from 1975 to 2015, the number of mega-cities will have grown from five - three of them in the developing world - to 21, all but four are located in the developing world (UN, 2002) (*Table 1*). Mega-cities, large urban agglomerations with at least 10 million people, are a twentieth century phenomenon, and based on these trends, more and bigger mega-cities are inevitable in the twenty-first century.

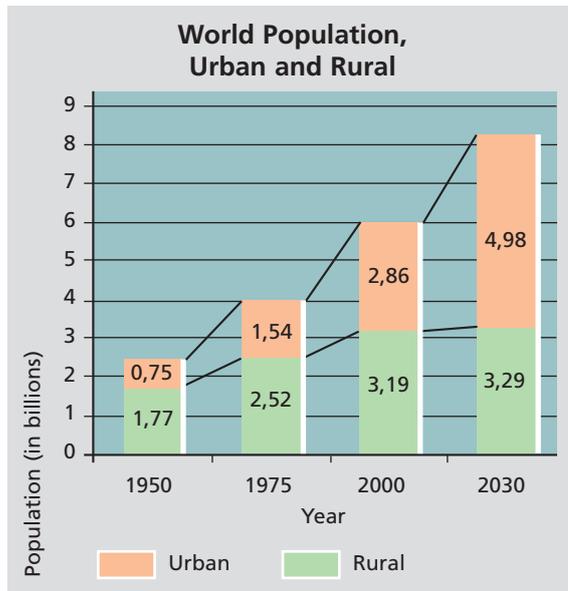


Figure 1

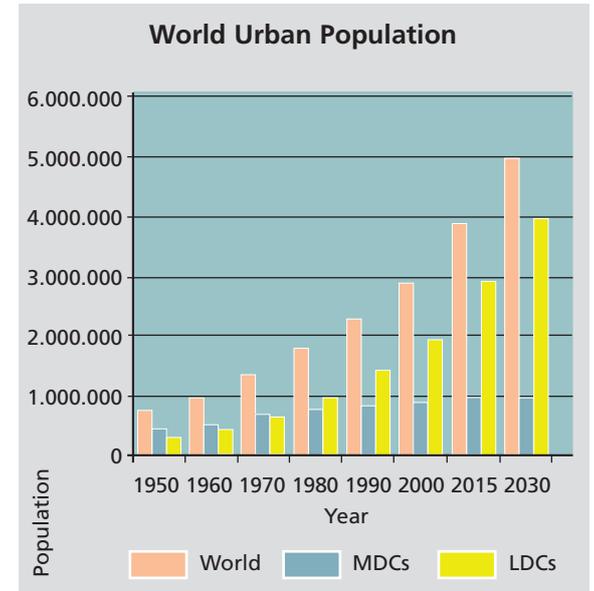


Figure 2

Mega-cities (2000 and 2015)				
City	Rank	Population, 2015	Rank	Population, 2001
Tokyo	1	27.2	1	26.5
Dhaka	2	22.8	8	13.2
Mumbai	3	22.6	5	16.5
Sao Paolo	4	21.2	2	18.3
Delhi	5	20.9	9	13.0
Mexico City	6	20.4	3	18.3
New York	7	17.9	4	16.8
Jakarta	8	17.3	12	11.4
Calcutta	9	16.7	7	13.3
Karachi	10	16.2	16	10.4
Lagos	11	16.0	-	
Los Angeles	12	14.5	6	13.3
Shanghai	13	13.6	10	12.8
Buenos Aires	14	13.2	11	12.1
Metro Manila	15	12.6	17	10.1
Beijing	16	11.7	14	10.8
Rio de Janeiro	17	11.5	15	10.8
Cairo	18	11.5	-	
Istanbul	19	11.4	-	
Osaka	20	11.0	13	11.0

Table 1

Source: UN, 2002.

Living Dangerously

The ongoing urban explosion has exposed millions of people living in cities to disasters. As millions of people continue to prefer to live in large complex urban areas, the physical densification of settlements, high concentration of business investments and economic assets, and the convergence of vital networks together with critical and transport infrastructures all in a very confined area intensify the vulnerability of urban regions to disasters. These factors lead to agglomeration benefits and scale economies that make metropolitan regions nodal centers of commerce, trade, information, transportation, knowledge, culture, and governance. These benefits however come at a cost.

Together with massive over urbanization are critical urban ills besetting the inhabitants of mega-cities and adding pressure on the already strained resources of metropolitan and local governments. Environmental degradation, pollution, traffic congestion, blight, overcrowding, crime, and public health problems have been time and again pointed out

as the common urbanization curse in the mega-cities of the developing world. All these conspire to considerably lower the quality of life of millions of people even as they strive to adapt a modern way of life.

Mega-cities raise the spectre of debilitating disasters. The existence of overcrowded slums on riverbanks, floodplains, and steeply sloping areas, and other hazardous locations expose people, their meager assets and livelihood to flash flooding, river flooding, and landslides. Unplanned and uncontrolled use of land has resulted to urban sprawl and a haphazard land use and development pattern, making it more difficult to manage the megacity even during normal times. Hazardous industrial plants exist side by side with congested informal settlements that lack basic utilities such as water supply and access roads. Informal construction gives rise to settlements made up of substandard self-built housing that is defenceless in the face of typhoons, floods, and earthquakes. Unregulated building practices result to shoddy structures built below code standards and a built environment susceptible to natural hazards.

The mega-city itself thus represents a new kind of disaster risk. Considering its sheer size alone, the physical, social and economic vulnerabilities of mega-cities are unparalleled. Coupled with global climate change, widespread environmental degradation, and unrelenting natural hazards, potential disaster losses in megacities have never been greater.

Institutionalizing Disaster Risk Reduction in Metropolitan Planning

Within this context, the Earthquakes and Megacities Initiative, an international non-stock, non-profit scientific organization, has embarked on a mission to help megacities and complex urban areas rise to the challenge of institutionalizing disaster risk reduction (DRR) in the regular planning and operations of metropolitan governments.

Further, the local land use planning process of cities and municipalities that compose megacities are seen as an untapped opportunity where disaster risk reduction can be mainstreamed and included as one of the planning objectives. Mainstreaming disaster risk reduction as a management process can likewise be achievable if risk reduction objectives and action plans are integrated into the regular processes of urban development and infrastructure planning, poverty reduction programming, and social services provision that are part and parcel of metropolitan administration.

Mainstreaming Prospects in Metropolitan Manila, Philippines

In the EMI's model of mainstreaming (*Figure 3*), certain mechanisms are necessary in order to integrate DRR within an institution's core functions, activities, and processes (Bendimerad and Fernandez, 2005). This mainstreaming model is applied in the implementation of the Disaster Risk Management Master Plan (DRMMP) of Metro Manila in the Philippines as part of EMI's Cross Cutting Capacity Development (3cd) Program. The DRMMP has provided a fertile ground for many lessons learned for a more effective mainstreaming of disaster risk reduction in metropolitan planning. The DRMMP is not only a plan but also a process designed to generate support and commitment to implement concrete risk reduction actions as part of the regular operations and functions of concerned institutions.

Based on the mainstreaming model used by DRMMP, one mainstreaming mechanism applied in Metro Manila is to fully engage both the central and local governments that have jurisdiction over the mega-city or are involved in disaster reduction. The thrust is to have a multi-level governmental collaboration, commitment, and partnership. And through this partnership, institutional capacity building efforts can take place.

Mainstreaming Model



Central Coordination + Local Implementation + Participation

Figure 3. Source: Bendimerad and Fernandez, 2005.



The central government includes the metropolitan authority and the national government agencies, which may include sectoral agencies and research institutions, while the local government units are the autonomous cities and municipalities that make up the metropolis. In Metro Manila, these are the Metropolitan Manila Development Authority, the Housing and Land Use Regulatory Board, and the Philippine Institute of Volcanology and Seismology. Central coordination is necessary for oversight, to facilitate the sharing of resources among autonomous local government units in the metropolis, and coordinate the individual plans of cities and municipalities in order to have a holistic approach to disaster risk management.

Political commitment of local governments is crucial as implementation of disaster risk reduction measures occurs at the local level. At the local level where autonomous city governments formulate and implement different types of plans such as comprehensive land use plans and local development investment plans, the thrust is to integrate DRR in the long-term development process.

Another mainstreaming mechanism is to engage the different stakeholders from other sectors such as the non-government organizations (NGOs) professional societies, business sector, media, and the academe. Disaster reduction as a shared responsibility requires broad and active participation of the whole society. As the public sector is only one cog in the disaster reduction wheel, the engagement of the business sector is another opportunity that can be tapped. Disasters usually strike a big blow to the business sector, and it sustains severe direct and indirect losses. Hence, investing in disaster reduction makes good business sense. The business sector's resources and capabilities can hugely complement the limited resources of the government sector.

The academe and research institutions are instrumental in generating knowledge useful in public policy making. Hence, in order to mainstream and sustain the integration of disaster risk reduction in public planning, one mechanism used by the DRMMP is to bridge the gap between researchers and decision makers to enable the latter to formulate sound public policies that are based on science and research.

Mainstreaming DRR therefore requires the building of alliances and partnerships among the different stakeholders living in the megacity, since disaster reduction is a shared responsibility. Such coalitions then provide an institutional basis on which capacity building in disaster risk management can take place. Through mainstreaming, DRR is integrated into the basic planning and operations of the government and does not remain as an isolated public policy objective. Lastly, mainstreaming recognizes that in spite of ever growing disaster risks in mega-cities, mega-cities offer substantial potentials for sustainable development and opportunities for safer, disaster-resilient societies.

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Urbanization, mega-cities and disaster reduction

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1. (Mega-)urbanisation and global change: current trends

In the last few decades a striking worldwide trend towards rising fatalities and economic losses due to natural and man-made hazards can be observed. Although there is a broadly reverse relationship between disaster-related deaths and damages in the developed world, the number of people affected in the developing world is increasing. One major influencing factor is growing urbanisation, and above all megacities (*Figure 1*) are particularly prone to natural and man-made disasters supply crises, fragmentation, social disorganisation and political unrest due to their high concentration of people and often extreme dynamics of development. Therefore we have to consider (mega-)cities as regional and global risk areas.

The major reasons for increasing disaster-related fatalities and damages in urban areas, even if the frequency of geophysical events remains unchanged and despite a number of efforts for disaster reduction, are to be found in the following complex processes (Kraas, 2003):

- **Population growth:** The number of people likely to be affected by hazards are growing due to constantly rising population numbers and densities and owing to decreasing security of food supplies, malnutrition, inadequate health care and fragile livelihoods.
- **Population dynamics:** Mainly migration leads to the concentration of growing numbers of people in cities, particularly in often unsafe, overcrowded, badly built and predominantly coastal cities.
- **Inequality:** Disparities and fragmentation in cities continue to increase, thereby exacerbating the vulnerability of the different societies.
- **Welfare systems:** While developing countries can not offer a coherent welfare system for large parts of the population, even the developed countries appear to be reducing their commitment to internal welfare and development aid.
- **Economic growth:** The increasing amount of built property, the complexity of economic dynamics, shortages of building land and growing spatial demand contribute to growing exposure to catastrophic property damage.
- **Technological innovation:** Technology offers better forecasting, safer construction techniques and immediate reaction, but also leads to growing dependency and additional potential for hazard.

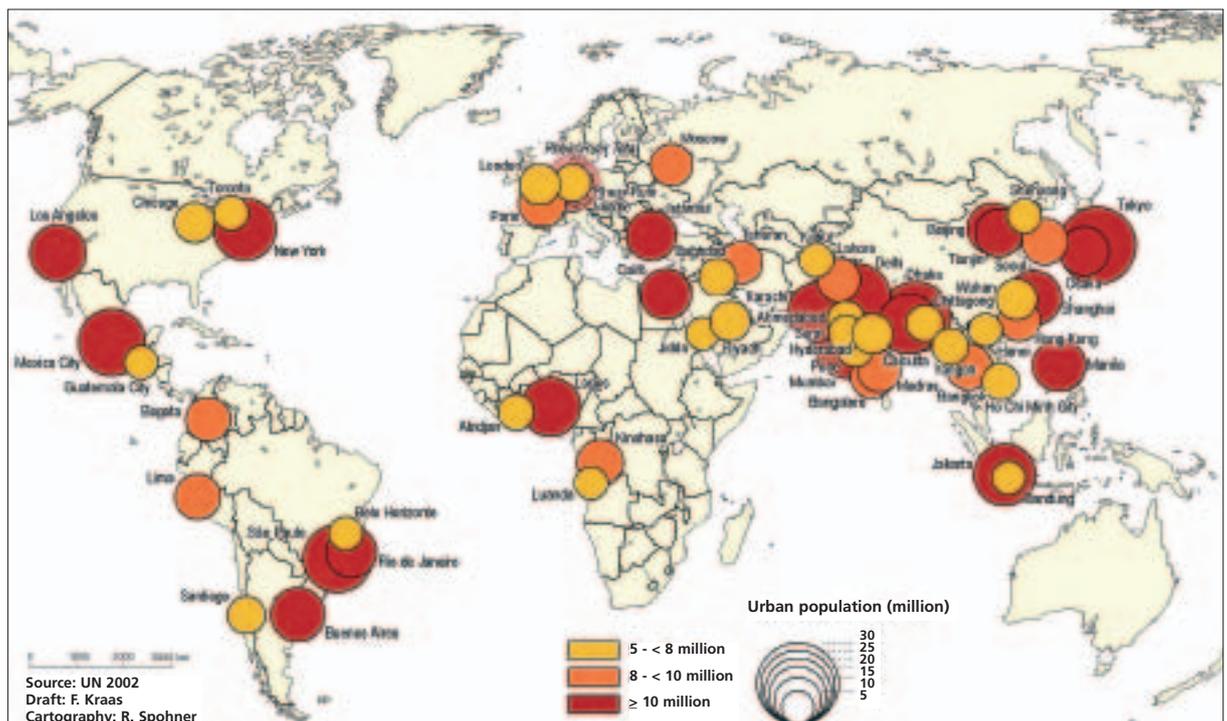


Figure 1

- **Social expectations:** Wealthier societies in particular expect absolute security of supply and services, thus relying more on public systems than on their own coping strategies in case of an emergency.
- **Global interdependence:** The functioning of the world economy is reinforcing hazard vulnerability and growing interdependence affects others far outside the immediate area of impact.

In the context of these developments current urbanisation processes play a key role. Until World War II urbanisation had primarily been a feature of developed countries, only since then has rapid urban growth also begun in developing countries, encouraged by intensified industrialisation and migration to the cities. In 2007, for the first time in the history of human, more than half of the world's population will live in cities (UN 2002). Worldwide, the proportion of the population as a whole living in cities rose from 29.8% (1950) to 37.9% (1975) to 47.2% (2000), and it will probably increase to 57.2% in 2010 or 60.2% in 2030 (UN 2002). In the industrialised countries 73% of the population was living in cities by 1990 (ca. 877 M), while in developing countries the corresponding figure was only 37%, although in absolute figures it was 1,357 M. It is assumed that the rate of urbanization in industrialised countries will only increase slightly to 78%, i.e. 1,087 M people, while in developing countries the increase will be enormous, although it may vary from state to state. With an estimated 57% of the total population, probably more than 3,845 M people will live in cities here in 2025 (Coy/Kraas 2003).

2. International networks and research initiatives on (mega-)urbanisation

Against this background, several networks and research initiatives are addressing the questions of urbanisation, particularly mega-urbanisation, as well as at least in part explicitly risks and disaster reduction. On international level, currently three main initiatives exist, which are related to urbanisation and mega-city research as well as outreach:

(1) The **Mega-City TaskForce of the International Geographical Union:** Its major aims and objectives are (www.megacities.uni-koeln.de): (a) to play a leading role in the development, promulgation and dissemination of new research topics on mega-cities; encourage and promote research programmes on the dynam-

ics of mega-cities; participate in international committee work,

(b) to provide information und service,
(c) to establish a mega-city network and promote cooperation with other initiatives.

(2) **International Year of Planet Earth 2007-2009, key topic mega-cities:** On the 22nd of December the UN General Assembly adopted by consensus a Resolution to proclaim 2008 as the UN Year of Planet Earth, with 2007-2009 as enlarged period of action. One of ten key topics of the International Year of Planet Earth - introduced by a brochure - is "Mega-cities: Our global urban future" (www.yearofplanetearth.org).

(3) The **International Human Dimensions Programme (IHDP)** started a new core project "**Urbanisation and Global Environmental Change**" (**UGEC**) in 2005 which is focusing on global change issues of urbanisation processes (www.ugec.org). Its major focus area and questions are:

(a) urban processes contributing to global change,

(b) pathways through which global change affects urban systems,

(c) interactions and responses within urban systems,

(d) consequences of interaction within urban systems on global change.

On national level, three internationally operating, interdisciplinary research programmes have been approved and are funded by different funding agencies; they have been developed as a complement to each other and are in close cooperation.

(1) The German Federal Ministry of Education and Research (BMBF) is focusing on research on sustainable development of selected emerging mega-cities worldwide (www.emerging-megacities.org).

(2) The Priority Programme of the German Research Foundation (DFG), "Megacities - Megachallenge: Informal dynamics of global change" is focusing on the relationship between informal processes and global change in the two mega-urban areas of Dhaka/Bangladesh and Pearl River Delta/China (www.geographie.uni-koeln.de/megacities-spp).

(3) The Helmholtz Association is focusing on the multiple risks of and in mega-cities, with regional focus on Santiago de Chile as anchor city and, in a later stage, other Latin American mega-cities (www.ufz.de/index.php?en=6143).

The three programmes convene regularly in order to encourage research on key questions concerning mega-cities, to include ecological, economic and social aspects, to bundle multi-disciplinary competences, to enhance exchange among (inter)national research partners, to strengthen the dialogue between science, politics and civil society in and to support the dissemination of information on mega-cities.

3. (Mega-)Urbanisation and disasters: Main questions, needs and policy relevant messages

Cities and mega-cities are particularly endangered as they are increasingly affected by natural and human-made hazards (Figure 2), and they are - as highly complex and vulnerable systems - ever more exposed to global change as well as contributing to it themselves: They can thus be both victims and producers of risks. Still, it must be kept in mind that until now only a few megacities have experienced disasters, and anticipative projections are necessarily speculative (Mitchell 1999: 22-35). Due to their particular characteristics and problems mentioned above, megacities prove to be highly vulnerable in crises and disasters: sudden supply shortages, heavy environmental burdens or major catastrophes can quickly lead to serious bottlenecks or emergencies for a vast number of people, or aggravate further those of the socially weakest groups among the population. Constraints and conflicts may acquire multiple dimensions, as they arise amid poorly co-ordinated administration and planning, the growing influence of an increasingly globalised economy, growing socio-economic disparities and intensifying environmental burdens. Risks are therefore related to complex sources, factors and networks.

As well as the mentioned hazards, symptoms of ecological overload and "consumption" of space will further concentrate in urban areas, resources (e.g. energy, water) are used up at rising rates, sinking land levels become more of a problem (as most mega-cities are located on coasts and flood plains). As far as global societal changes are concerned, particularly mega-cities are prone to growing socio-economic vulnerability because of pronounced poverty, socio-spatial and political fragmentation, sometimes with extreme forms of segregation, disparities and conflicts. Uncontrolled sprawling as well as the absence of land-use planning and control result mainly from the enormous dynamism of growth. The juxtaposition of very different local lifeworlds, life-forms and lifestyles (including ethnic, social and behavioural groups) play a significant differentiating role. Socio-economic polarisation and fragmentation as well as social disintegration in mega-cities endanger the stability and development, especially when these are made even more unstable and prone to disruption because of large socio-economic disparities. The cumulative result of different causes, effects and feedback effects in problem areas interconnected at many levels reinforce each other, which impedes the analysis of material flows and their management. Thus the risk potential increases rapidly in a complex manner. On the other hand, megacities offer positive potential for global transformation (e.g. minimisation of "space consumption", high effectivity of resources applied, efficient disaster prevention - insofar as corresponding strategies for direction and provision have been developed; e.g. Tokyo: Taniguchi, 1999). The above-mentioned high risk potential is already beyond the reach of direction and governability. For many megacities, governability is de facto no longer

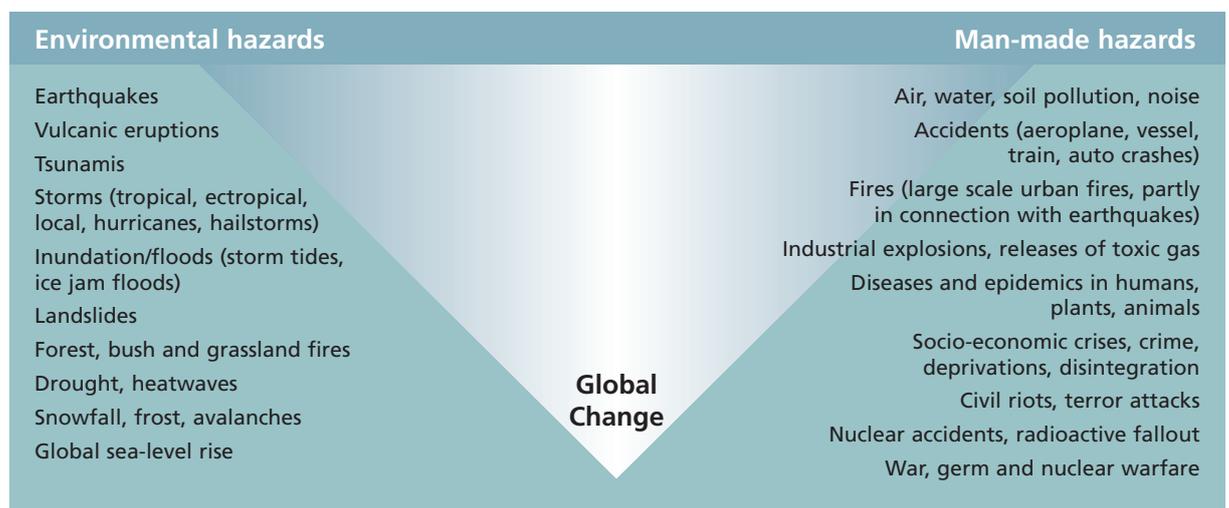


Figure 2: Environmental and man-made hazards

given, and this loss of governability affects planning and control as much as the comprehensive organization and management of urban responsibilities, the establishment of general order, and control over development processes. This is due to (weak) political-administrative decision makers and heterogeneous political-administrative organisations which are not horizontally interconnected (large numbers of independent departments as well as separate municipalities within the mega-agglomeration). Likewise central development and environmental planning as well as their implementation are impossible - especially as the mega-cities' own budgets are not even sufficient for the minimisation of problems, let alone their solution.

Given the insufficiency of broader and detailed studies worldwide, especially concerning comparative work, there is a considerable need for research in the field of natural and human-made hazards, their implications, the actors involved (hazard and risk politics) and causal networks. The same is true for the following themes of risk factors: land-use dynamism, resource consumption, deficits in water supply, rubbish and sewage disposal, the securing of energy supplies, insufficient transport infrastructure, human security and health, social vulnerability, functional interconnections in megaurban economics, crisis and disaster prevention-planning, the investigation and development of systems for administrative direction (best practice models); extended primary research, the implementation and improvement of complex methods of steering and management, the best of these with the aid of improved highest resolution satellite images, GIS and modelling and monitoring systems.

Systematic risk minimisation and risk prevention are essential in the light of the expected global consequences of mega-city risks and impacts. The areas with the greatest need for action, on which strategies should concentrate, are as follows:

- In the area of the environment and health, problems of emission reduction, the provision of clean drinking water as well as sewage and rubbish disposal are the most important issues. The inadequate environmental situation is already directly responsible for more than a quarter of avoidable health problems.
- The problems of habitat and spatial expansion associated with dynamic population growth, together with inadequate land-use

planning and poor achievability continue to be unsolved problems.

- In the case of the rapidly increasing concentration of (international) economic activities, conflict arises between urban economies and national economic interests. Power and its social and spatial effects create polarised active and marginal economic spaces, at a national, regional and local level. The mega-urban economies with their multi-layered interconnections with increasing globalisation and the expansion of the informal sectors have hitherto been little researched.
- Already, existing symptoms of economic, ecological, infrastructural and socio-economic overload are increasing dramatically and are thus extreme urban security risks at a global level.
- Increasing disparities and sometimes extreme socio-economic fragmentation with serious social and spatial segregation are sources of social and political centres of conflict.
- Natural and man-made catastrophic events are an increasing threat for the world's mega-cities; disaster prevention planning is increasing in significance.
- Poor governability and directability inhibit controlling and correcting intervention on the part of state and local authorities in order to minimise or indeed prevent poor conditions.

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