Alliance Development Works

Brot für die Welt · welt hunger hilfe · terre des hommes Hilfe für Kinder in Not · medico international · MISEREOR

Focus: Environmental degradation and disasters

WorldRiskReport 2012

In cooperation with

UNITED NATIONS UNIVERSITY

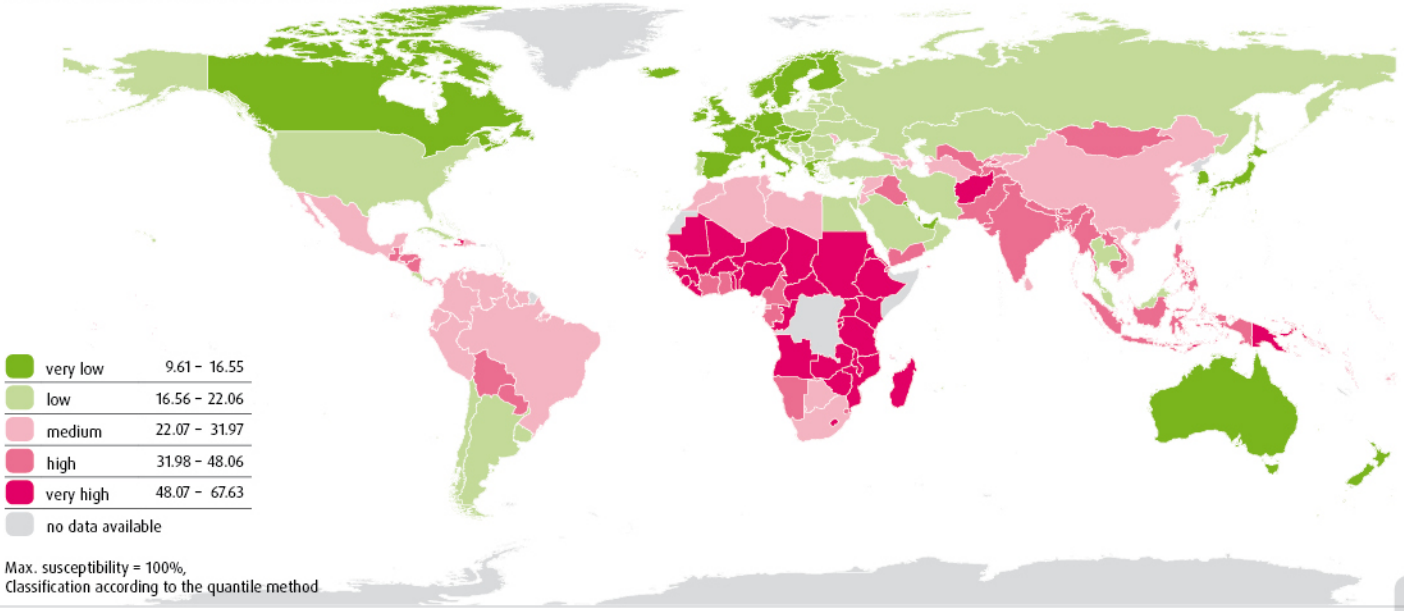
UNU-EHS
Institute for Environment and Human Security

The Nature Conservancy
Protecting nature. Preserving life.™

Together for people in need.

Susceptibility

dependent on public infrastructure, nutrition, income and the general economic framework



very low	9.61 – 16.55
low	16.56 – 22.06
medium	22.07 – 31.97
high	31.98 – 48.06
very high	48.07 – 67.63
no data available	

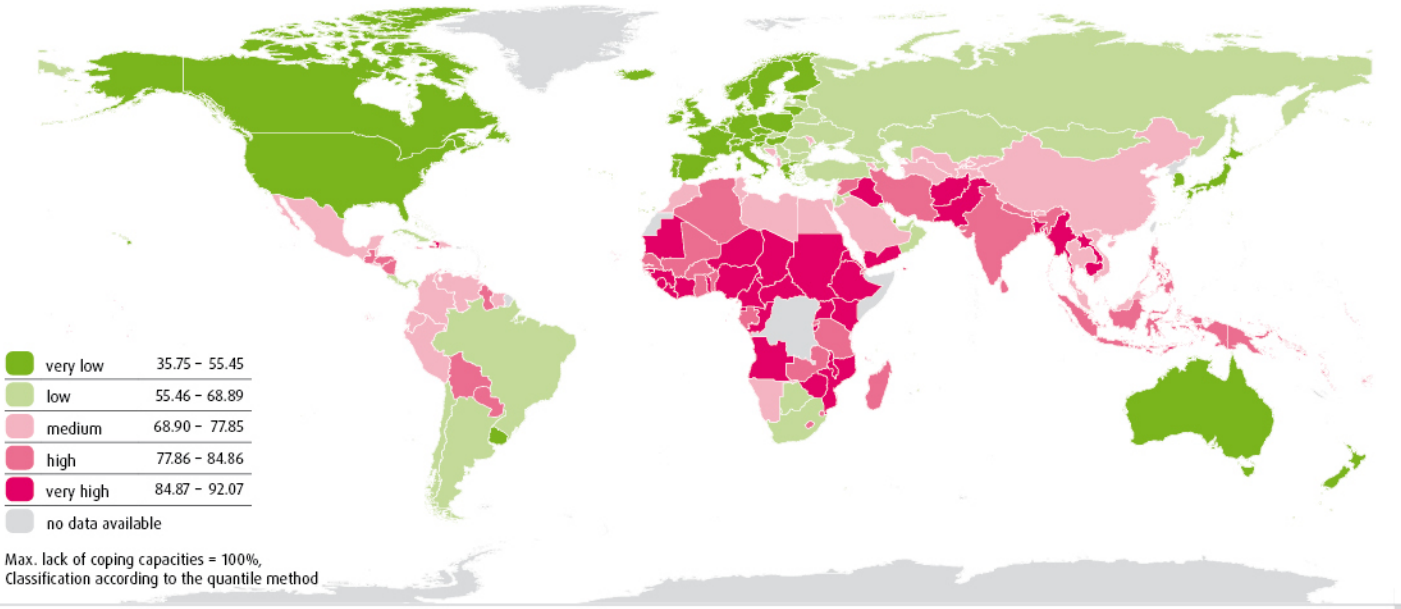
Max. susceptibility = 100%,
Classification according to the quantile method

Map B1

Map B2

Lack of coping capacities

dependent on governance, medical care and material security



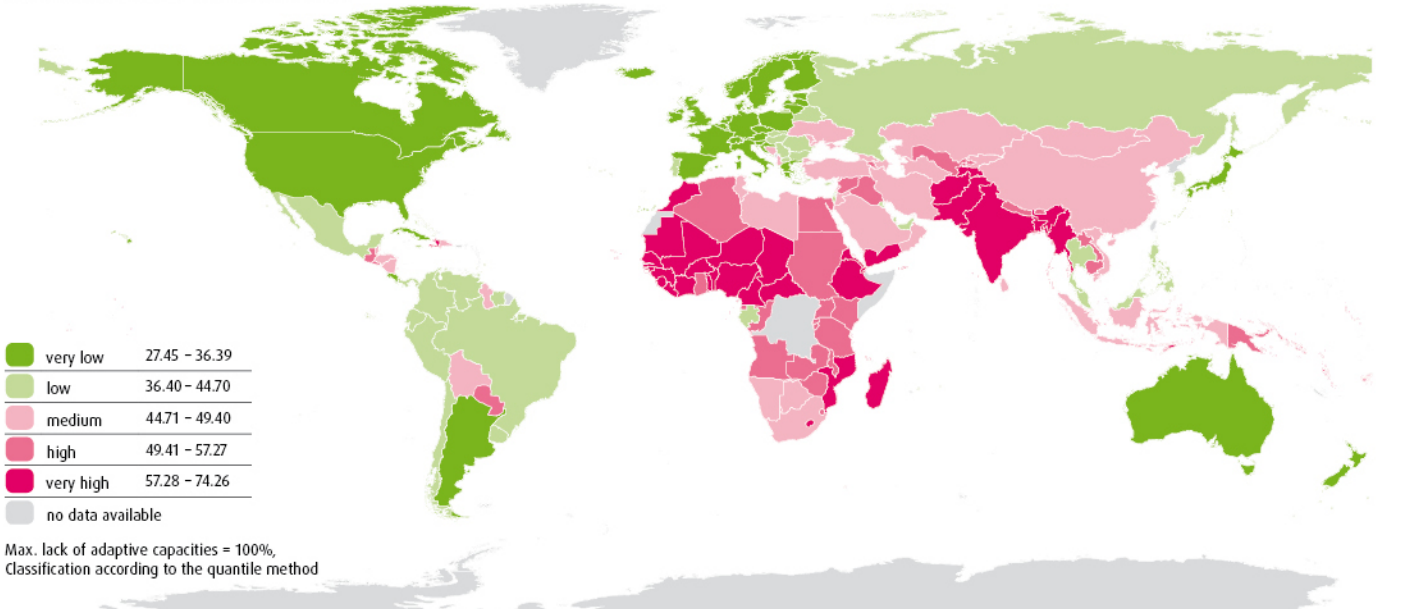
very low	35.75 – 55.45
low	55.46 – 68.89
medium	68.90 – 77.85
high	77.86 – 84.86
very high	84.87 – 92.07
no data available	

Max. lack of coping capacities = 100%,
Classification according to the quantile method

Map B3

Lack of adaptive capacities

related to future natural events and climate change



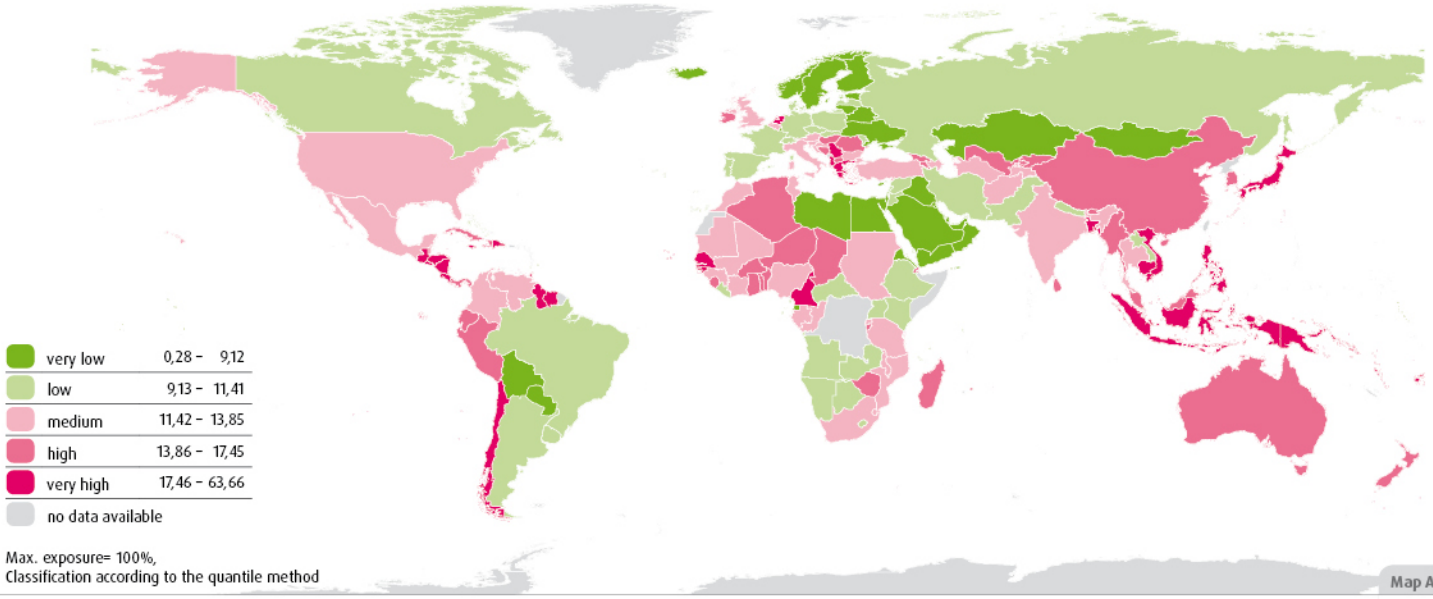
very low	27.45 – 36.39
low	36.40 – 44.70
medium	44.71 – 49.40
high	49.41 – 57.27
very high	57.28 – 74.26
no data available	

Max. lack of adaptive capacities = 100%,
Classification according to the quantile method

Data: Source UNU-EHS, based on the PREVIEW Global Risk Data Platform, CReSIS, CIESIN and global databases; detailed information at www.WorldRiskReport.org

Exposure

Exposure of the population to the natural hazards earthquakes, storms, floods, droughts and sea level rise.



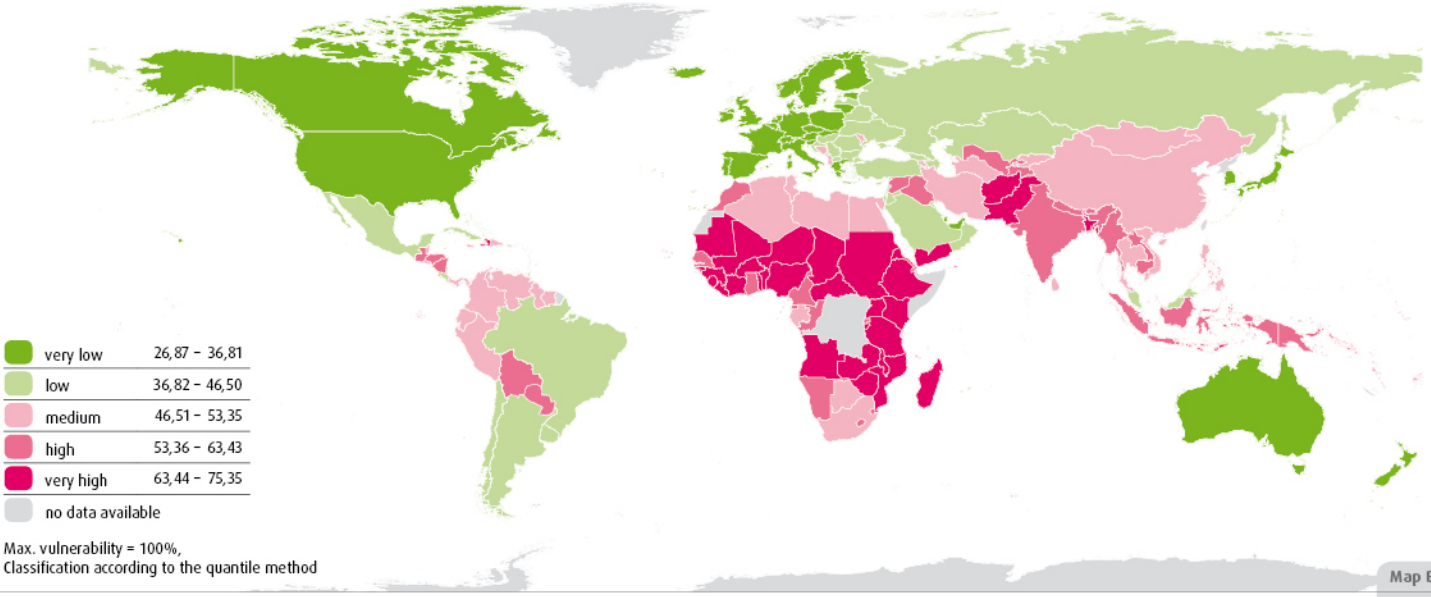
very low	0,28 – 9,12
low	9,13 – 11,41
medium	11,42 – 13,85
high	13,86 – 17,45
very high	17,46 – 63,66
no data available	

Max. exposure= 100%,
Classification according to the quantile method

Map A

Vulnerability

Vulnerability of society as the sum of susceptibility, lack of coping capacities and lack of adaptive capacities



very low	26,87 – 36,81
low	36,82 – 46,50
medium	46,51 – 53,35
high	53,36 – 63,43
very high	63,44 – 75,35
no data available	

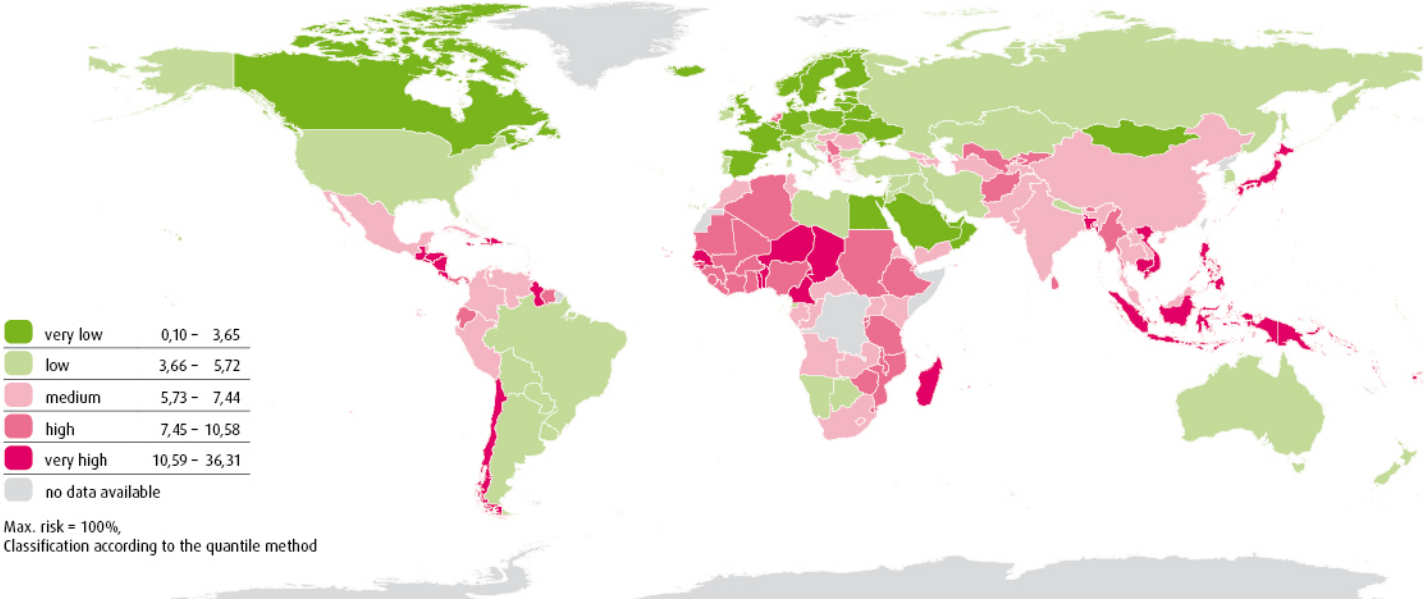
Max. vulnerability = 100%,
Classification according to the quantile method

Map B

Map C

WorldRiskIndex

WorldRiskIndex as the result of exposure and vulnerability



very low	0,10 – 3,65
low	3,66 – 5,72
medium	5,73 – 7,44
high	7,45 – 10,58
very high	10,59 – 36,31
no data available	

Max. risk = 100%,
Classification according to the quantile method

WorldRiskReport 2012

1. Disaster risk, environmental degradation and global sustainability policy

Peter Mucke

When the full force of nature hits human settlements, this can have disastrous results: The lives of countless people are threatened, and through the destruction of buildings and infrastructure, progress made over years of development is destroyed in many countries. However, it is not alone the strength of a natural event that determines the extent of harm and damages. The risk a country runs of becoming a victim depends crucially on social, economic and institutional factors – in a nutshell, the condition of society within that country. The WorldRiskReport 2012 has devoted its focus to a significant driver of disasters: the worldwide increase in environmental degradation.

Human intervention in the global ecosystem raises the threat and increases the extent of disasters ensuing from extreme natural events. More and more people in all parts of the world are exposed to floods, drought, earthquakes and cyclones. In the decade of 2002-2011, 4,130 disasters were recorded worldwide. More than a million people became victims of them, and economic damages amounted to at least USD 1.195 billion. A total of 302 such disasters occurred alone in 2011, affecting more than 200 million people and causing economic damage of an estimated USD 366 billion (UNISDR 2012). The tendency is on the rise.

So far, people have rarely been the direct trigger of such disasters. But with their devastating interventions in nature, they have massively raised the hazard potential. The destruction of mangrove forests and coral reefs, for example off the coasts of Southeast Asia, has reduced protection against tidal waves and flooding. The clear-cutting of mountain forests exacerbates soil erosion and thus, as in Pakistan, the extent of floods. Climate change and the more frequent occurrence of "climate extremes" are permanently aggravating the hazard situation and increasing vulnerability (IPCC 2012a). The United Nations Secretariat notes: "Environmental degradation and climate change contribute to the increasing occurrence of disasters linked to natural hazards." (UN DESA 2011)

Additionally, there is an increasing danger of natural disasters being directly triggered by human action or uncontrollable high technology. The nuclear super MCA of Fukushima in March 2011 is the most obvious example of this. Increasingly discussed proposals to permanently manipulate the climate by technological interventions in the shape of "geo-engineering" bear a new dimension of incalculable risks for humans and for nature (ETC Group 2010). Whether a natural event turns into a disaster depends on the strength of the hazard as well as on the vulnerability of the people. Vulnerability develops through high susceptibility, a lack of coping capacities and a lack of adaptive capacities. It is this core understanding that forms the basis of the WorldRiskIndex, which gives the probability with which a country or a region will be hit by a disaster (Alliance Development Works 2011). Four components characterize this basic notion, and they are put into concrete terms by five categories each. In turn, the four components are mathematically combined as modules, thus forming the WorldRiskIndex (see Figure 1).

The WorldRiskIndex seeks answers to the following questions:

+ How probable is an extreme natural event, and will it affect people?
+ How vulnerable are the people to the natural hazards?
+ To what extent can societies cope with acute disasters?
+ Is a society taking preventive measures to face natural hazards to be reckoned with in the future?

The concept of the WorldRiskIndex, with its modular structure, was developed jointly by scientists and development experts. The calculation of the Index, which the United Nations University Institute for Environment and Human Security, Bonn (UNU-EHS), has been commissioned to perform by Alliance Development Works, is carried out via the four components:

+ Exposure towards natural hazards such as earthquakes, cyclones, flooding, drought and sea level rise
+ susceptibility depending on infrastructure, nutrition, housing situation and economic framework conditions
+ coping capacities depending on governance, disaster preparedness and early warning,

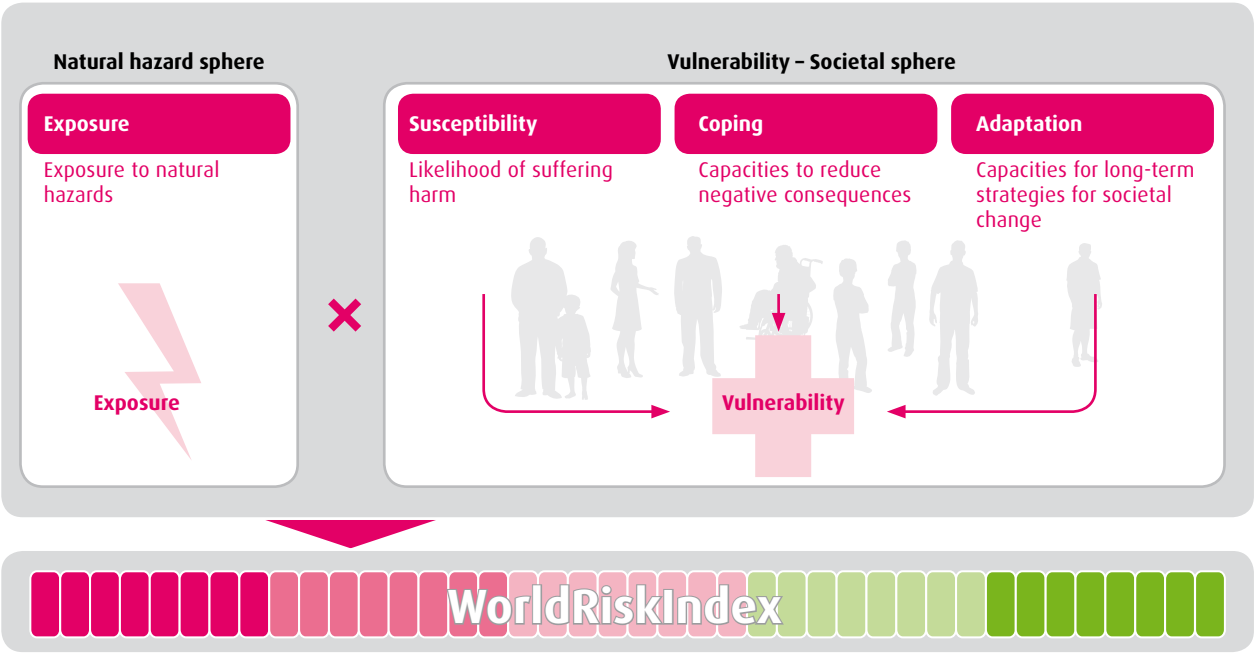


Figure 1: The WorldRiskIndex and its components

medical services and social and material coverage

+ adaptive capacities relating to forthcoming natural events, to climate change and to other challenges.

In order to provide an optimum representation of the disaster risk for all the countries in the world, globally available data are used. One of the special features of the approach explained in detail in the WorldRiskReport 2011 is that categories are also considered for which no global data base exists so far. Whereas, for example, the number of hospital beds or per capita income are regularly established at the level of the national states, the data on national disaster preparedness policy, on self-help capacities, social networks and neighborly help, on the urban and spatial structure and on national adaptation strategies are not globally available. But these data are of considerable importance for risk assessment and have therefore been included in the concept of the WorldRiskIndex.

The preponderance of technical or economic factors, which are easier to measure, and which can frequently be observed in worldwide analyses, is to be overcome in the WorldRiskIndex in the course of the next few years. The modular structure of the WorldRiskIndex allows for this since it enables supplements and extensions to be made (Alliance Development Works 2011). Once new, globally available and secure data are newly available, they can be used to calculate the Index. Currently, however, in drawing conclusions in risk assessment, it still has to be borne in mind that the social factors in the WorldRiskIndex have less of an effect than the technical or economic ones.

The structure of the WorldRiskIndex can be used analogously for a local or regional risk index. Often, other or further data will be available at regional level that is relevant to a risk assessment. In the WorldRiskReport 2011 this was demonstrated by the UNU-EHS Institute with the example of several

www.WorldRiskReport.org

The printed version of the WorldRiskIndex has a volume ensuring fast readability. The texts of the Report are supplemented and further illustrated by maps, diagrams and images. Additional, more in-depth information, scientific details of the methodology and tables are available at www.WorldRiskReport.org. There, the 2011 and 2012 Reports as well as teaching material on the topic are available for downloading.

administrative units in Indonesia (Birkmann et al. 2011).

In the case of both the local and the global level, unsolved problems relating to poverty, a scarcity of resources and weak governance raise the susceptibility of societies to natural hazards as well as the lack of coping and adaptive capacities. At the same time, these social parameters are negatively influenced by extreme natural events. In a nutshell, disasters prevent development progress, and a lack of development progress raises the disaster risk. In order to break this cycle, disaster risk reduction strategies would have to become an integral part of comprehensive sustainable development strategies. The links between the topics of environmental degradation, poverty and disaster risk have already been discussed since the 1970s, although the political discourses on the issue have frequently been pursued independently of one another. With the UN Conference on Sustainable Development ("Rio+20") in June 2012, this has visibly changed: Disaster risk reduction has become one of the emerging issues on the international agenda. The term resilience towards natural hazards, which was already coined in the Anti-Disaster Program of Hyogo, became a central keyword at the Rio Conference 2012.

At the same time, intensive debates have now started on the future of the Millennium Development Goals (MDGs), agreed at UN level, after their target year of 2015. In this context, more fundamental debates are also taking place in politics, science and civil society on the future concept of the international development agenda. This offers the opportunity to comprehensively consider the links between poverty, environmental degradation and disaster risks.
It is for this reason that the WorldRiskReport 2012 focuses on "Environmental Degradation and Disasters".

It is supplemented by case studies demonstrating how the members of Alliance Development Works are acting at the interface between the reduction of disaster risk and addressing progressive climate change and environmental degradation.

The Report aims to replace what has as a rule been a short-term observation of disasters with a development approach: Aspects such as prevention, the protection of particularly susceptible groups and risk management have to be at the forefront of analyses and future measures. The social, ecological and economic dimensions of risk are combined with classical hazard analyses of natural events in the WorldRiskReport. This enables risk assessment to be extended.

The concept of Alliance Development Works is to regard emergency relief and development cooperation as a combined entity and link the two aspects more closely in practice. Risk assessment, prevention, and coping and adaptive strategies are components of this concept – the claim the Alliance makes in the WorldRiskReport 2011 still applies unchanged: "Whether an earthquake or a tsunami, a hurricane or a flood, the risk that a natural event will develop into a disaster depends only partially on the strength of the event itself. A substantial cause lies in the living conditions of people in the affected regions and the opportunities to quickly respond and help. Those who are prepared and who know what to do during an extreme natural event have higher survival chances. The countries that anticipate natural hazards, prepare for the consequences of climate change and provide the necessary financial resources are better equipped for the future."

Results at a glance

The Index identifies global disaster risk hotspots: for example in Oceania, in Southeast Asia, in the southern Sahel and in Central America. There, high exposure to natural hazards and climate change coincides with very vulnerable societies. What is conspicuous is that among the 15 countries with the highest risk worldwide (see right-hand table), eight happen to be island states – including Vanuatu, Tonga and the Philippines at positions 1 to 3. Owing to their proximity to the sea, island states are particularly exposed to the natural hazards of cyclones, flooding and sea level rise. Very high exposure is a significant risk driver, although a high development level of society can counteract this substantially, as the example of the Netherlands shows. In terms of exposure, this country ranks twelfth among the states most at risk worldwide. However, thanks to social, economic, ecological and institutional factors, the Netherlands has reduced its disaster risk enormously, and in terms of risk ranking worldwide, it is ranked 51st. Liberia is the opposite example. Despite a low level of exposure (position 113 in the Exposure Index), extreme social vulnerability (position 7 in the Vulnerability Index) results in this country being ranked 60th in the WorldRiskIndex – and thus coming into the second-highest risk class. Liberia stands for many countries in Africa, the hotspot of social vulnerability: There are 13 African states among the 15 countries showing the greatest vulnerability, alongside Haiti and Afghanistan.

WorldRiskIndex

Rank	Country	Risk (%)
1.	Vanuatu	36.31
2.	Tonga	28.62
3.	Philippines	27.98
4.	Guatemala	20.75
5.	Bangladesh	20.22
6.	Solomon Islands	18.15
7.	Costa Rica	17.38
8.	Cambodia	17.17
9.	Timor-Leste	17.13
10.	El Salvador	16.89
11.	Brunei Darussalam	15.92
12.	Papua New Guinea	15.81
13.	Mauritius	15.39
14.	Nicaragua	15.36
15.	Fiji	13.69
146.	Germany	3.27
159.	Estonia	2.50
160.	Israel	2.43
161.	Egypt	2.33
162.	Norway	2.31
163.	Finland	2.24
164.	Sweden	2.15
165.	United Arab Emirates	2.07
166.	Bahrain	1.81
167.	Kiribati	1.78
168.	Iceland	1.53
169.	Grenada	1.46
170.	Saudi Arabia	1.31
171.	Barbados	1.15
172.	Malta	0.61
173.	Qatar	0.10


VENTA DE MATERIALES DE
CONSTRUCCION Y SERV DE
TRANSPORTE

2. WorldRiskIndex 2012: Concept, updating and results

Torsten Welle, Jörn Birkmann, Jakob Rhyner, Maximilian Witting, Jan Wolfertz

Whether natural hazards will turn into disasters depends not only on the intensity of an event but is also crucially determined by a society's level of development. The WorldRiskIndex, which estimates the risk that 173 states worldwide are exposed to of becoming victims of disasters resulting from extreme natural events, sets out from this understanding. The Index shows that the global hotspots for a risk are located where a high exposure to natural hazards and climate change coincides with vulnerable societies – for example in Oceania, Southeast Asia, the Southern Sahel and Central America.

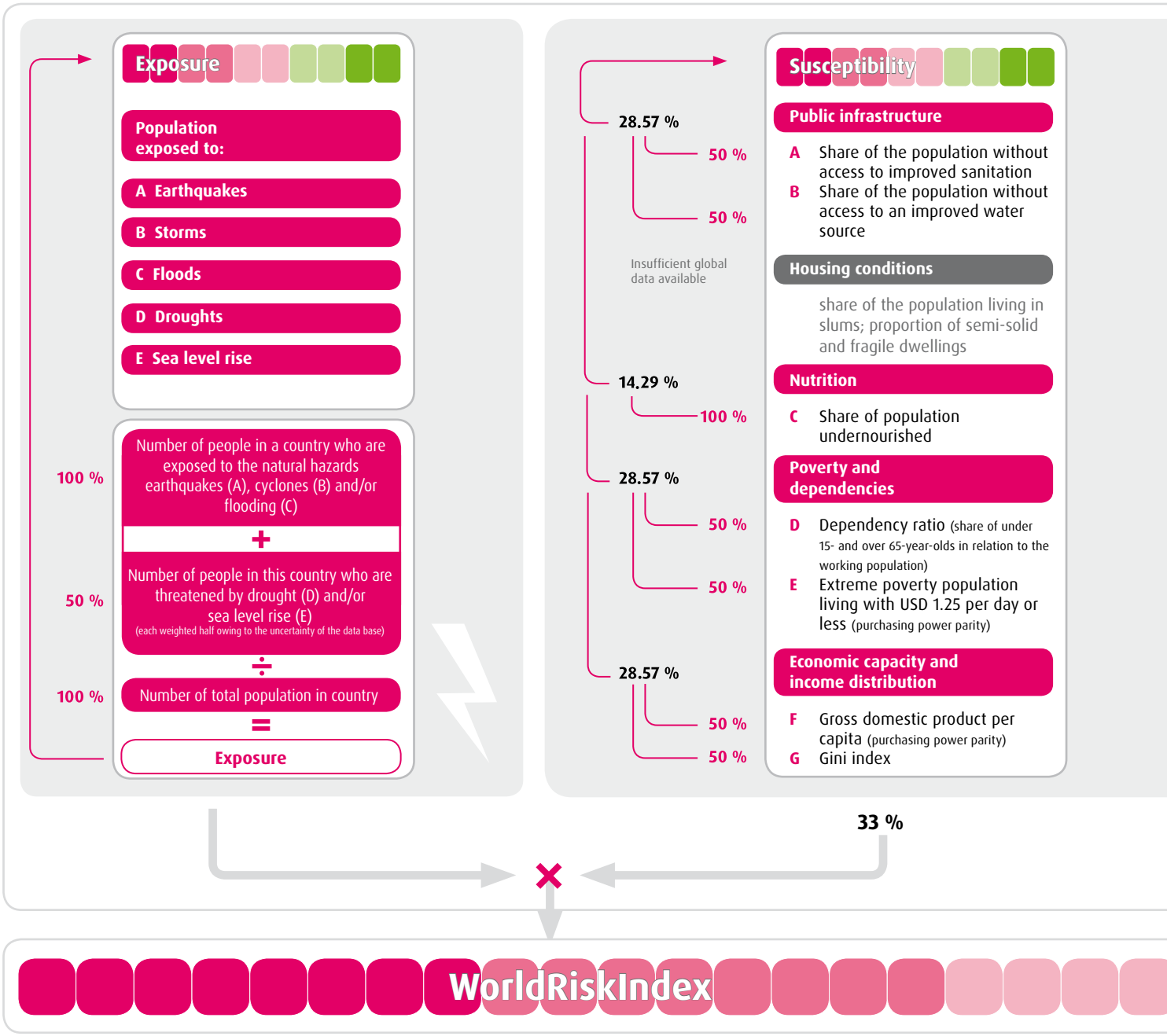
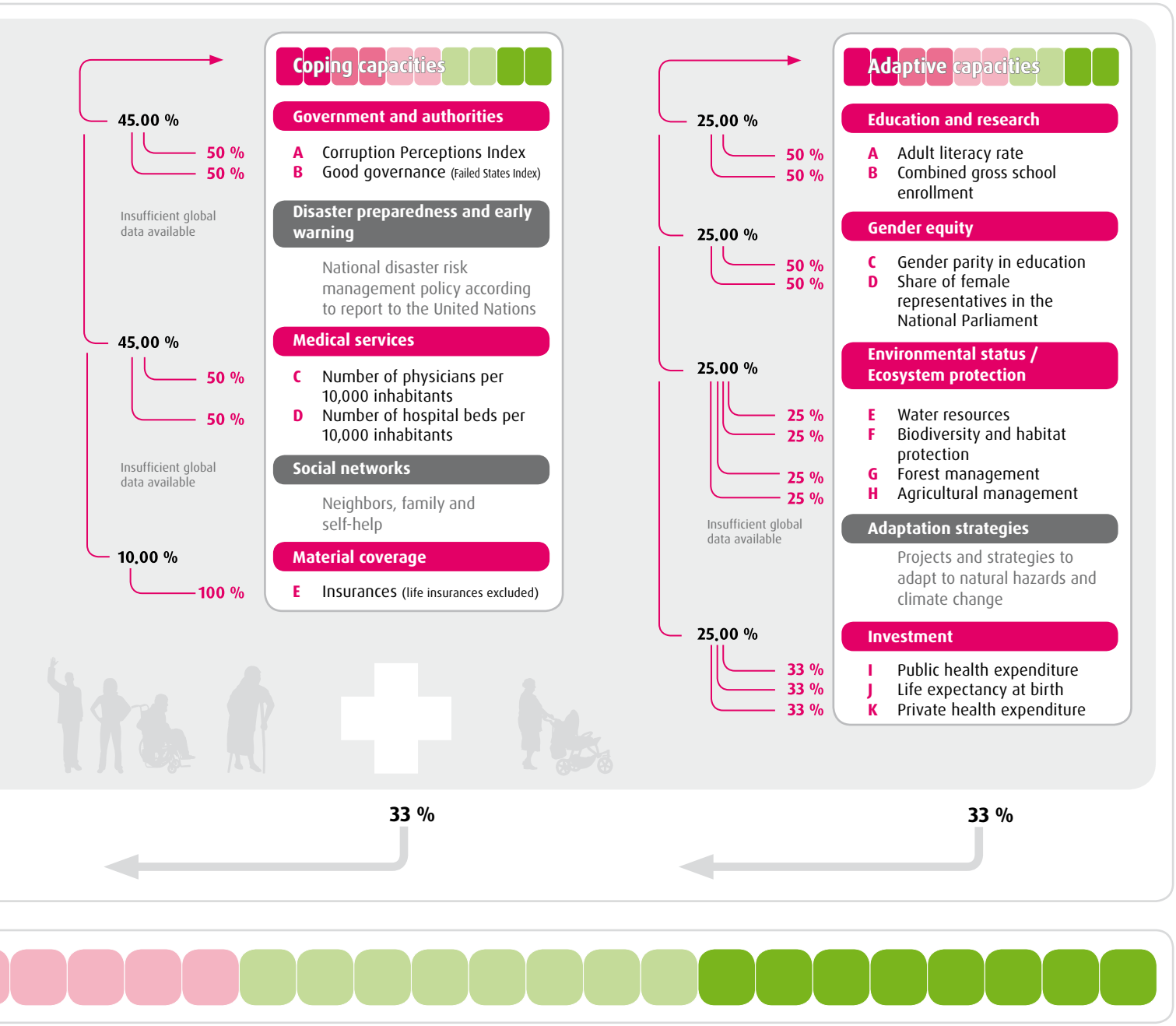


Figure 2: Calculation of the World Risk Index

2.1 Concept and structure of the WorldRiskIndex

The WorldRiskIndex is a tool to assess the disaster risk that a society or country is exposed to by external and internal factors. Setting out from 173 countries, it illustrates that a country's disaster risk may depend on several factors, so that a country also has several means at its disposal to reduce risks (cf. Birkmann et al. 2010; IPCC 2012). The aim of the Index is to sensitize the public as well as political decision-makers towards the important topic of disaster risks. The Index focuses attention on the people, countries and regions, precisely because the emergence of disasters is crucially determined by domestic social factors. Thus the WorldRiskIndex is based on the core understanding that a society's disaster risk is influenced by its structure, processes and framework



conditions, which in turn may be affected by natural events and the effects of climate change.

The concept of the Index stresses that not only the magnitude of frequency of a natural event but indeed also the social, economic and ecological factors characterizing a country essentially determine whether a natural hazard can turn into a disaster. One advantage that the Index has is its modular structure based on four components:

+ Exposure to natural hazards
+ Susceptibility
+ Coping capacities
+ Adaptive capacities

The modular structure may be applied not only at national but also at regional and local level. A detailed description of the individual components and the methodology can be found in the WorldRiskReport 2011. This WorldRiskReport (Alliance Development Works 2011) is available for downloading at www.WorldRiskReport.org.

Risk is understood as interaction between a hazard (earthquake, flood, cyclone, drought, rising sea level) and the vulnerability of societies. In this context, vulnerability refers to social, physical, economic and environment-related factors that make people or systems susceptible to the impacts of natural hazards and adverse consequences of climate change. Additionally, the Index examines the abilities and capacities of people or systems to cope with and adapt to negative impacts of natural hazards. Vulnerability comprises the components of susceptibility, coping capacities and adaptive capacities (cf. Birkmann et al. 2011).

The WorldRiskIndex is based on 28 indicators. The data required for its calculation are freely available and can all be called up in the Internet, which ensures transparency and verifiability. In order to be mathematically aggregated into indices, the indicators are transformed in dimensionless rank levels between 0 and 1, i.e. they can be read as percentage values. Figure 1 shows the modular structure of the indices for exposure, susceptibility, coping capacities and adaptive capacities as well as their corresponding sub-categories and weighting factors. For better comprehension and cartographic transformation, the individual indices have been transformed into percentage values and classified with the aid of the quantile method integrated into the ArcGIS10 software packet. The five classes calculated contain the same number of cases and are translated into a qualitative classification of "very high – high – medium low – very low" (see maps on the fold-out pages of the cover).

Exposure

The term exposure refers to entities (population, built-up area, infrastructure component, environmental areas) being exposed to the effects of one or more natural hazards (earthquakes, cyclones, droughts and floods). In the WorldRiskIndex, exposure relates to the annual average number of individuals who are potentially exposed to hazard events. In this regard, the frequency of hazards is also taken into account. Additionally, the number of people are considered who would potentially be affected by the sea level rising by one meter. To calculate exposure to earthquakes, cyclones, floods and droughts, the Physical Exposure data of the PREVIEW-Global Risk Data Platform (http://preview.grid.unep.ch/) of the United Nations Environmental Program (UNEP) have been used. These include the number of people per approx. 20 square kilometers who are exposed on average to the above-mentioned natural hazards per country and per year.

Calculating exposure to a rise in sea level by one meter is based on data from the Center for Remote Sensing of Ice Sheets (CreSIS) at the University of Kansas. This data was combined with the population statistics of the Global Rural-Urban Mapping Project (GRUMP) run by the Center for International Earth Science Information Network (CIESIN) at Columbia University with the aid of a Geographical Information System (GIS) in order to establish the potential exposure of communities to rising sea level. Only half of the number of individuals exposed to droughts and also to sea level rises have been weighted since the model for the calculation of droughts bears some uncertainties (cf. Peduzzi et al. 2009) and it is not possible to calculate an annual average exposure to sea level rise, in spite of a considerable hazard potential being an issue affecting numerous coastal regions.
In order to calculate the exposure index that describes the share of the population exposed

for each country, all exposed people per natural hazard have been added up and divided by the number of inhabitants per country.

Susceptibility

Susceptibility generally refers to the likelihood of harm, loss and disruption in an extreme event triggered by a natural hazard. Thus susceptibility describes structural characteristics and framework conditions of a society. The following five sub-categories (see Figure 2), which outline the living situation and living conditions in a country, have been chosen to represent susceptibility: "public infrastructure", "housing conditions", "nutrition", "poverty and dependencies", "economic capacity and income distribution". Housing conditions are an important factor in defining susceptibility. In Figure 2, however, they are marked gray, since they have so far not been included in Index calculations owing to a lack of global data. While data and methods do exist to assess housing conditions, such surveys have so far only been carried out for a few cities worldwide owing to the high time and cost effort involved so that presently, no sufficient information is available for this aspect at global level. Within the five sub-categories, the susceptibility indicators (A-G) and their respective weighting factors are listed in percentages. The index Susceptibility is represented worldwide as Map B1 (left fold-out page of the cover).

Coping capacities

Coping and coping capacities comprise various abilities of societies and exposed elements (for example critical infrastructure such as nuclear power stations) to minimize negative impacts of natural hazards and climate change through direct action and the resources available. Coping capacities encompass measures and abilities that are immediately available to reduce harm and damages in the occurrence of an event.

Figure 2 shows the five sub-categories of coping capacities ("government and authorities", "disaster preparedness and early warning", "medical services", "social networks", "material coverage") and the indicators used (A-E) together with their weighting factors. Due to their high importance, the sub-categories "disaster preparedness and early warning" and "social networks" are included in the coping capacities component. However, they are marked gray since no global data referring to them is available. Hence it has so far not been possible to establish them in the Index. To calculate the WorldRiskIndex, the opposite value, i.e. the lack of coping capacities, has been used, which results from the value 1 minus the coping capacities (Map B2, left fold-out page of the cover).

Adaptive capacities

In contrast to coping, adaptation is understood as a long-term process that also includes structural changes (cf. Lavell et al. 2012; Birkmann 2010). In addition, adaptation encompasses measures and strategies dealing with and attempting to address the negative impacts of natural hazards and climate change in the future. Five sub-categories have been chosen for calculation that describe capacities for a long-term adaptation and change within a society: "education and research", "gender equity", "environmental status/ecosystem protection", "adaptation strategies" and "investments". Owing to insufficient global data, Figure 2 shows these five sub-categories and the eleven selected indicators (A-K) as well as their corresponding weightings. The sub-category of adaptation strategies (marked grey) could not be integrated into the calculations either. In analogy to the coping capacities, the lack of adaptive capacities is included in the WorldRiskIndex (Map B3, left fold-out page of the cover).

WorldRiskIndex

Just like in the first WorldRiskReport 2011, the WorldRiskIndex is calculated by combining the four individually calculated components of exposure, susceptibility, lack of coping capacities and lack of adaptive capacities (see Figure 2). In this context, the susceptibility, the lack of coping capacities and the lack of adaptive capacities describe the societal elements of the risk, and combined, they yield the vulnerability index. The latter indicates whether a disaster may actually ensue should an extreme natural event occur. The vulnerability index (Map B, right fold-out page of the cover) multiplied by the exposure index (Map A) yields the WorldRiskIndex (Map C and Diagram on pages 24/25).

WorldRiskIndex as a communicating instrument

The WorldRiskReport 2011 was focused on in at least 450 press articles and reports in more than 30 countries. More than 300 articles appeared in Germany alone. But not only did the WorldRiskReport 2011 enjoy considerable press coverage, it was also given much attention and reflected in politics, science and civil society. The discussions confirm the significance of social vulnerability as a key factor in lowering disaster risks due to natural hazards and climate change. In addition, there have also been controversial debates over the good values that some Middle East states scored in comparison to the hotspots in Latin America. For example, regarding Chile, the opinion was held that the very high risk category was unjustified since Chile generally had good coping and adaptive capacities and bore a low level of susceptibility thanks to its experiences with disasters in the wake of extreme natural events. Interestingly, in some cases, the discussion in the press and in politics led back to science and, specifically, to decision-makers such as the national authority for disaster preparedness in the Philippines, which uses the Index and the Report to draw attention to the relevance of disaster preparedness.

2.2 Updating and modifying the indicators

As shown above, the WorldRiskIndex comprises 28 indicators that are available worldwide. All the 28 indicators referred to in the following are described in detail in specific templates. In calculating the WorldRiskIndex 2012, 26 of the 28 indicators have been updated, while the same data apply for the remaining ones as did last year. The templates for the indicators and the latest available data sets as well as their sources in comparison to the data from the 2011 Index are listed in tables at the website www.WorldRiskReport.org.

Exposure to natural hazards

In the WorldRiskIndex, the data on exposure has been updated regarding:

+ Indicator A: Earthquakes
+ Indicator B: Cyclones
+ Indicator C: Floods
+ Indicator E: Sea level rise.

Exposure to sea level rise (Indicator E) has been newly calculated since more recent population statistics are available with a better

spatial solution (CIESIN 2012). For exposure to drought (Indicator D), the data have been taken from the WorldRiskIndex 2011, since the authors hold the opinion that these data bear less uncertainty than the more up-to-date data available in the data bank on exposure to drought.

Susceptibility

Within the component of susceptibility, 6 out of 7 indicators have been updated:

+ Indicator A: Share of population without access to improved sanitation
+ Indicator B: Share of population without access to clean water
+ Indicator C: Share of population undernourished
+ Indicator D: Share of under 15- and over 65-year-olds in the working population
+ Indicator F: Gross domestic product per capita (purchasing power parity)
+ Indicator G: Gini index.

However, new values are only available for some of the countries regarding Indicator G, the distribution of assets or income (Gini index). No updated values are available in the data banks for Indicator E, the share of population living on less than USD 1.25 per day (purchasing power parity). This is why here, the data from the WorldRiskIndex 2011 have once again been used.

Coping capacities

All the indicators of the component coping capacities have been updated:

+ Indicator A: Perception of corruption
+ Indicator B: Good governance
+ Indicator C: Number of physicians per 10,000 inhabitants
+ Indicator D: Number of hospital beds per 10,000 inhabitants
+ Indicator E: Insurances.

However, like with the Gini index, new data on medical services (Indicators C and D) is not available for all countries.

Adaptive capacities

Extensive modifications have been made to the component adaptive capacities. For one thing, data has been updated for all Indicators:

+ Indicator A: Adult literacy rate
+ Indicator B: Combined gross school enrolment
+ Indicator C: Gender parity in education
+ Indicator D: Share of female representatives in the National Parliament
+ Indicator E: Water resources
+ Indicator F: Biodiversity and habitat protection
+ Indicator G: Forest management
+ Indicator H: Agricultural management
+ Indicator I: Public health expenditure
+ Indicator J: Life expectancy
+ Indicator K: Private health expenditure.

Here too however, as with the Gini index, the restriction applies that the latest and new data are not available for all countries (Indicators A, B, C, D). Modifications of the data base in the sub-category environmental status/ ecosystems protection within the individual indicators (E, F, G, H) represent a further major change that also applies retrospectively to the previous years. The indicators have been taken from the Environmental Performance Index 2012, which has undergone methodological redevelopments and therefore provides a modified data base and weighting for the indicators (for details see Emerson et al. 2012).

2.3 Risk assessment at global level for 2012

Our core statement is that a country's exposure to a natural hazard and the effects of climate change is not the only factor responsible for the disaster risk, but that rather, it is also the social framework conditions and capacities to take action that are reflected in susceptibility, coping capacities and adaptive capacities. These three components describe a society's vulnerability and can shed light on whether the occurrence of an extreme natural event can result in a disaster. Here, however, it has to be borne in mind that the results of the WorldRiskIndex describe a potential risk at macro level and cannot forecast individual events and disasters.

WorldRiskIndex

Also in 2012, Vanuatu is the country with the largest disaster risk worldwide, followed by Tonga, the Philippines, Guatemala and Bangladesh. The WorldRiskIndex 2012 shows that these countries bear the disastrous combination of extreme exposure and high vulnerability.

The WorldRiskIndex 2012 is the product of exposure and vulnerability. The individual values for 173 countries are given in the detailed table in the Annex. For a graphic representation, see Map C on the fold-out page of the cover and the map of the world on pages 24/25.

Eleven of the countries bearing the greatest risk are also among the top 15 of the most exposed countries. But the examples of Japan (ranking 4th in terms of exposure) and the Netherlands (ranking 12th in exposure) show that exposure to natural hazards and climate change alone need not imply an especially high disaster risk. The Netherlands and Japan show similarly high exposure values to natural hazards as Bangladesh (ranking 10th in exposure), but with low vulnerability values (27.76 for the Netherlands, 29.46 for Japan), they can lower the risk value (to 8.48, giving the Netherlands rank 51, and to 13.53 and rank 16 for Japan).

Thus it is owing to the social, economic, ecological and institutional conditions in a society that one country will be vulnerable while another will not. For example, while de facto, no extreme poverty exists in the Netherlands, almost half of the population of Bangladesh (49.60 percent) have to survive on less than USD 1.25 a day. Whereas in the Netherlands, public infrastructure is very well developed, governance is transparent and in accordance with democratic principles, and there are 39 physicians per 100,000 inhabitants on average, Bangladesh has a mere three physicians per 10,000 inhabitants, the country shows poor values for governance, and every fifth inhabitant lacks access to clean drinking water.

The 15 countries with the highest risk

Rank	Country	WorldRiskIndex (%)
1.	Vanuatu	36.31
2.	Tonga	28.62
3.	Philippines	27.98
4.	Guatemala	20.75
5.	Bangladesh	20.22
6.	Solomon Islands	18.15
7.	Costa Rica	17.38
8.	Cambodia	17.17
9.	Timor-Leste	17.13
10.	El Salvador	16.89
11.	Brunei Darussalam	15.92
12.	Papua New Guinea	15.81
13.	Mauritius	15.39
14.	Nicaragua	15.36
15.	Fiji	13.69

The Netherlands are also ahead of Bangladesh in terms of adaptive capacities: The literacy rate is much higher (Netherlands: 99 percent, Bangladesh: 56 percent), significantly more people enjoy access to education (Netherlands: 99.4 percent, Bangladesh: 48.7 percent), the protection of biodiversity and habitats (index value 84.67 percent) and forest management (index value 95.32 percent) are put significantly more emphasis on in the Netherlands than in Bangladesh (23.57 percent for biodiversity protection and 81.39 percent for forest management).

Hence, only the interaction of high exposure and high vulnerability bears a high risk. Thus, as a rule, high vulnerability values will result in a greater risk, which is shown by the examples of Cambodia and Bangladesh. In terms of exposure, Cambodia is ranked 15th, but owing to vulnerability values of 62.07, its overall risk gives it position 8. The situation for Bangladesh is comparable here. With its exposure ranked at 10 and with relatively high vulnerability values of 63.78, it attains an even higher risk value (rank 5). These examples highlight the influence of vulnerability on a society regarding its potential to sustain considerable harm and damage in the event of natural hazards and climate change.

Exposure to natural hazards

The world map of exposure (Map A, right fold-out page of the cover) shows Southeast Asia, Central America, the Pacific islands and parts of Southeast Europe as global hotspot regions. It gives the population's exposure to the natural hazards of earthquakes, cyclones, floods and droughts and to a rise in sea level of one metre.

Eleven of the 15 most exposed countries are situated in the hotspot regions. Individual countries such as Chile, Japan and the Netherlands are also highly exposed, with Chile and Japan being potentially very strongly affected by earthquakes owing to their geographical location in the immediate proximity of the tectonic plate borders while the greatest threat to the Netherlands is the rise in sea level that has to be reckoned with. The latter also poses a threat to Vanuatu and Tonga, with the two island states additionally being exposed to storms and, especially, earthquakes. For Vanuatu, the model calculations from the PREVIEW data bank (http://preview.grid.unep.ch/) suggest that approx. 37 percent of the population are exposed to an earthquake threat.

Although, for methodological reasons, exposure to sea level rise is only weighted half as strongly as exposure to earthquakes, cyclones and floods, sea level rise does constitute a relevant factor. This also applies in particular to the Small Island Developing States (such as Vanuatu and Tonga) and the countries with a high population concentration in low-lying coastal areas (such as the Netherlands and Bangladesh). Overall, an estimated 13 percent of the global population live in coastal areas lying less than ten meters above sea level (UN-Habitat 2011). This shows that the expected rise in sea level implies a considerable need for adaptation,

The 15 most exposed countries

Rank	Country	Exposure (%)
1.	Vanuatu	63.66
2.	Tonga	55.27
3.	Philippines	52.46
4.	Japan	45.91
5.	Costa Rica	42.61
6.	Brunei Darussalam	41.10
7.	Mauritius	37.35
8.	Guatemala	36.30
9.	El Salvador	32.60
10.	Bangladesh	31.70
11.	Chile	30.95
12.	Netherlands	30.57
13.	Solomon Islands	29.98
14.	Fiji	27.71
15.	Cambodia	27.65

especially also in the regions and countries in which population growth has recently been registered in the low-lying coastal regions. Out of the European countries, in addition to the Netherlands, Greece, Serbia and Albania have also been included in the highest exposure class owing to their exposure to earthquakes and drought.

The 15 most vulnerable countries

Rank	Country	Vulnerability (%)
1.	Eritrea	75.35
2.	Niger	75.17
3.	Chad	74.74
4.	Afghanistan	74.32
5.	Haiti	73.54
6.	Sierra Leone	72.20
7.	Liberia	71.74
8.	Mozambique	71.37
9.	Guinea	71.05
10.	Central African Republic	70.69
11.	Ethiopia	70.21
12.	Mali	69.76
13.	Burundi	69.32
14.	Nigeria	68.70
15.	Togo	68.39

Vulnerability

The global vulnerability hotspot is in Africa, as shown by the vulnerability map (Map B, right fold-out page of the cover), which summarizes the components of susceptibility, the lack of coping capacities and the lack of adaptive capacities. 13 of the world's 15 most vulnerable countries lie in Africa. These countries bear both a very high susceptibility and, partly, very low coping and adaptive capacities. Afghanistan and Haiti complete the table of vulnerability at positions 4 and 5. Additionally, Yemen, Pakistan and Bangladesh, for example, have to be regarded as particularly vulnerable.

In Central America, Guatemala, Honduras and Nicaragua in particular are characterized by a high level of vulnerability. Within Europe, Bosnia and Herzegovina, Albania and Moldavia are the most vulnerable countries, although on a global scale, these countries ought to be regarded more as moderately vulnerable. However, compared to Germany, for example, they do show high values in all three components: higher susceptibility values (for example Bosnia and Herzegovina: 19.47 percent, Germany: 14.63 percent), a greater lack of coping capacities (Bosnia and Herzegovina: 73.88 percent, Germany: 38.58 percent) and lower values for adaptive capacities (Bosnia and Herzegovina: 48.58 percent, Germany: 32.81 percent).

Susceptibility

The countries of the Sahel and in the tropical regions of Africa show a very high level of susceptibility (Map B1, left fold-out page of the cover). This is also reflected in the list of the 15 most susceptible countries worldwide, which, alongside Haiti (position 8) contains 14 African countries. In the cases of Mozambique and Tanzania, the countries at positions 1 and 2, the enormous level of susceptibility is, for example, apparent in the poor values in the area of public infrastructure. In Mozambique,

The 15 most susceptible countries

Rank	Country	Susceptibility (%)
1.	Mozambique	67.63
2.	Tanzania	67.34
3.	Eritrea	66.62
4.	Liberia	65.11
5.	Niger	64.87
6.	Chad	64.69
7.	Madagascar	64.39
8.	Haiti	62.70
9.	Sierra Leone	62.48
10.	Burundi	61.99
11.	Zambia	61.81
12.	Central African Republic	61.52
13.	Ethiopia	58.93
14.	Rwanda	58.47
15.	Zimbabwe	58.45

less than half of the population has access to clean water, and only every fifth individual has access to improved sanitation. In Tanzania, just ten percent of the population has access to improved sanitation. In addition, in both countries, more than three quarters of the population live in extreme poverty, and 38 percent of the population in Mozambique and 34 percent in Tanzania are undernourished.

The international community has to provide special support for Africa, the global hotspot of susceptibility to natural hazards and climate change, with special support to reduce this susceptibility.

However, poverty and poor living conditions have also brought Afghanistan (position 18) and Papua New Guinea (position 34) into the highest susceptibility class. On a European scale, Romania and Moldavia come off worst, for here, not all people, as would be the usual case in the rest of Europe, have access to improved sanitation and clean water. Also, measured in terms of the gross domestic product (GDP) per capita (purchasing power parity), economic performance tends to be poor compared with the rest of Europe, with Moldavia at USD 3,110 a year and Romania at USD 14,287 a year. By comparison, per capita GDP is USD 37,260 a year in Germany.

Lack of coping capacities

The cartographic representation of the lack of coping capacities (Map B2, left fold-out page of the cover) reveals that the countries with low capacities and resources for a disaster event are mainly concentrated in the African continent, with Afghanistan (position 1), Haiti (position 4), Myanmar (position 6), Yemen (position 9) and Iraq (position 10) belonging to the top 15 list of countries with the greatest lack of coping capacities. Almost always, governance indicators are particularly alarming: here, poor values in the area of corruption and governance clearly show that

The 15 countries with the lowest coping capacities

Rank	Country	Lack of coping capacities (%)
1.	Afghanistan	92.07
2.	Chad	91.80
3.	Sudan	91.70
4.	Haiti	90.43
5.	Guinea	90.16
6.	Myanmar	89.82
7.	Burundi	89.53
8.	Central African Republic	89.44
9.	Yemen	88.92
10.	Iraq	88.83
11.	Niger	88.73
12.	Côte d'Ivoire	88.55
13.	Guinea-Bissau	88.48
14.	Ethiopia	88.34
15.	Uganda	88.11

should an extreme natural event occur, the states and governmental institutions have only few functioning capacities of their own owing to a lack of coordinating institutions such as, in Germany, the "Technisches Hilfswerk" (THW – German Federal Agency for Technical Relief) to be able to provide effective help for people in emergencies. Moreover, if a natural hazard occurs, only few people have the opportunity to benefit from well-developed healthcare.

Within Europe, the countries of Albania, Bosnia and Moldavia tend to show poor values for coping capacities, which is partly due to poorer insurance against natural hazards in these countries.

Lack of adaptive capacities

The cartographic representation of the lack of adaptive capacities (Map B3, left fold-out page of the cover) shows clearly recognizable hotspot regions in the Southeast Asian area, with India at the centre, and in West Africa and parts of Central Africa. In addition, two further but smaller hotspot regions can be identified: in East Africa, with Ethiopia and Eritrea, and in the southern part,

The 15 countries with the lowest adaptive capacities

Rank	Country	Lack of adaptive capacities (%)
1.	Afghanistan	74.26
2.	Eritrea	72.68
3.	Niger	71.93
4.	Mali	69.85
5.	Chad	67.74
6.	Haiti	67.48
7.	Mauritania	67.07
8.	Sierra Leone	66.64
9.	Pakistan	65.35
10.	Guinea	64.91
11.	Burkina Faso	64.32
12.	Liberia	64.22
13.	Ethiopia	63.37
14.	Comoros	63.30
15.	Benin	63.00

Madagascar, the Comoros, Mozambique and Lesotho. Haiti and Yemen also show massive problems regarding their adaptive capacities.

In contrast, Thailand, Malaysia and the Philippines are conspicuously positive. Thanks to their favorable scoring in the categories "education and research", "environmental status and ecosystems protection" and "gender parity", the Philippines in particular, which are ranked as high regarding susceptibility and their lack of coping capacities, have attained a quite good result.

The reason why, for example, Eritrea should be the country with the second poorest adaptive capacities can be demonstrated well in a comparison with Iceland: Whereas Iceland can boast a very high literacy rate (99 percent) and really good education participation among the population (95.9 percent), the literacy rate in Eritrea is just 66 percent, and education participation is at only 28 percent. Correspondingly, even with similar exposure to natural hazards and sea level rise, structurally, Eritrea is in a much poorer position to develop adaptive capacities systematically and on a long-term basis, for example through well-trained specialists.

Furthermore, public and private health expenditure highlights the great disparity between the two countries in the area of adaptive capacities. In Iceland, public health expenditure in 2009 amounted to USD 2,546 per capita, and private expenditure to USD 548. In Eritrea, by contrast, a mere USD 6 per capita was spent by the state and USD 7 privately on the area of health. Although, obviously, the healthcare model of the so-called western countries can be questioned, too, these dimensions show the massive differences between the two countries regard present adaptive capacities.

Discussion of results

The calculations and results of the WorldRiskIndex 2012 show that a complex issue can be reduced to an index value, which also means that such an index can be used as a communicating instrument by politics and the public. This was also confirmed by the positive response that the publication of the WorldRiskIndex 2011 met with, which was addressed in more than 450 media reports worldwide. On the other hand, the updates and modifications of the Index described in Chapter 2.2 also show the limits of such a tool. For example, data availability and data quality are crucial to the quality of the Index (Freudenberg 2003, Meyer 2004), too.

Owing to the modification of some indicators, the results of the WorldRiskIndex 2012 cannot directly be compared with all the items of the WorldRiskIndex 2011. For example, for calculating exposure to sea level rise, a new, improved data base has been used giving a better spatial resolution of population data globally. Modifications in the areas of other components, such as the area of environmental status /ecosystems protection, do not allow any direct comparisons with the previous report, either.
The differences in the data situation can be highlighted by comparing the examples of

Bangladesh and the Netherlands. Thanks to the more recent and precise data, a difference in the result of exposure to sea level rise of just under 80,000 people for Bangladesh and half a million people for the Netherlands is obtained. Thus the exposure value rises for both countries (from 27.52 to 31.70 percent for Bangladesh and from 29.24 to 30.57 percent for the Netherlands). Owing to the modifications of the data in the field of environmental protection/ ecosystems protection referred to above, the lack of adaptive capacities for Bangladesh increases by 2.25 percentage points, and for the Netherlands by 3.84 percentage points. This strong increase in exposure cannot be traced back accurately to processes of change in the country but results from a better data situation.

For this reason, great care has to be taken in directly comparing the individual index values with those of the WorldRiskIndex 2011. Nevertheless, bearing these uncertainties and framework conditions in mind, the rankings of last year's and this year's Index may be critically viewed provided that they are related to trends rather than changes in details per country. Generally, according to Freudenberg (2003), it applies that changes in indices over a short or limited period are difficult to interpret since data quality and data relevance will partly differ considerably in the individual indicators. In order to achieve optimum comparability, all indicators would have to have the same data source for all countries, i.e. a uniform year of reference and a uniform method of establishing the data. However, this cannot be put into practice, which is why only an estimate can be made with the data used. Nevertheless, the results of the WorldRiskIndex 2012 show that, as demonstrated by the examples of Bangladesh and the Netherlands, countries with a similarly high level of exposure to natural hazards and climate change impacts can minimize their risk (Netherlands: 8.48 percent and Bangladesh: 20.22 percent) through lower social vulnerability (Netherlands: 27.76 percent, Bangladesh: 63.78 percent).

Generally, a more significant persistence of problems can be observed in the countries of Africa and Southeast Asia. This means that several countries which were already identified as high-risk areas in the WorldRiskReport 2011 have again been ranked high in the WorldRiskReport 2012. More significant changes can only be expected over a longer period of time. In a way, this reflects development cooperation. For development cooperation too, a long-term effort is needed before any progress can be measured on a world scale. In order for these changes to lead to positive results and the risk to decrease for the particularly vulnerable sections of the population, the fateful cycle of environmental destruction, poverty and disaster risk has to be broken by integrated measures at local, national and international level.

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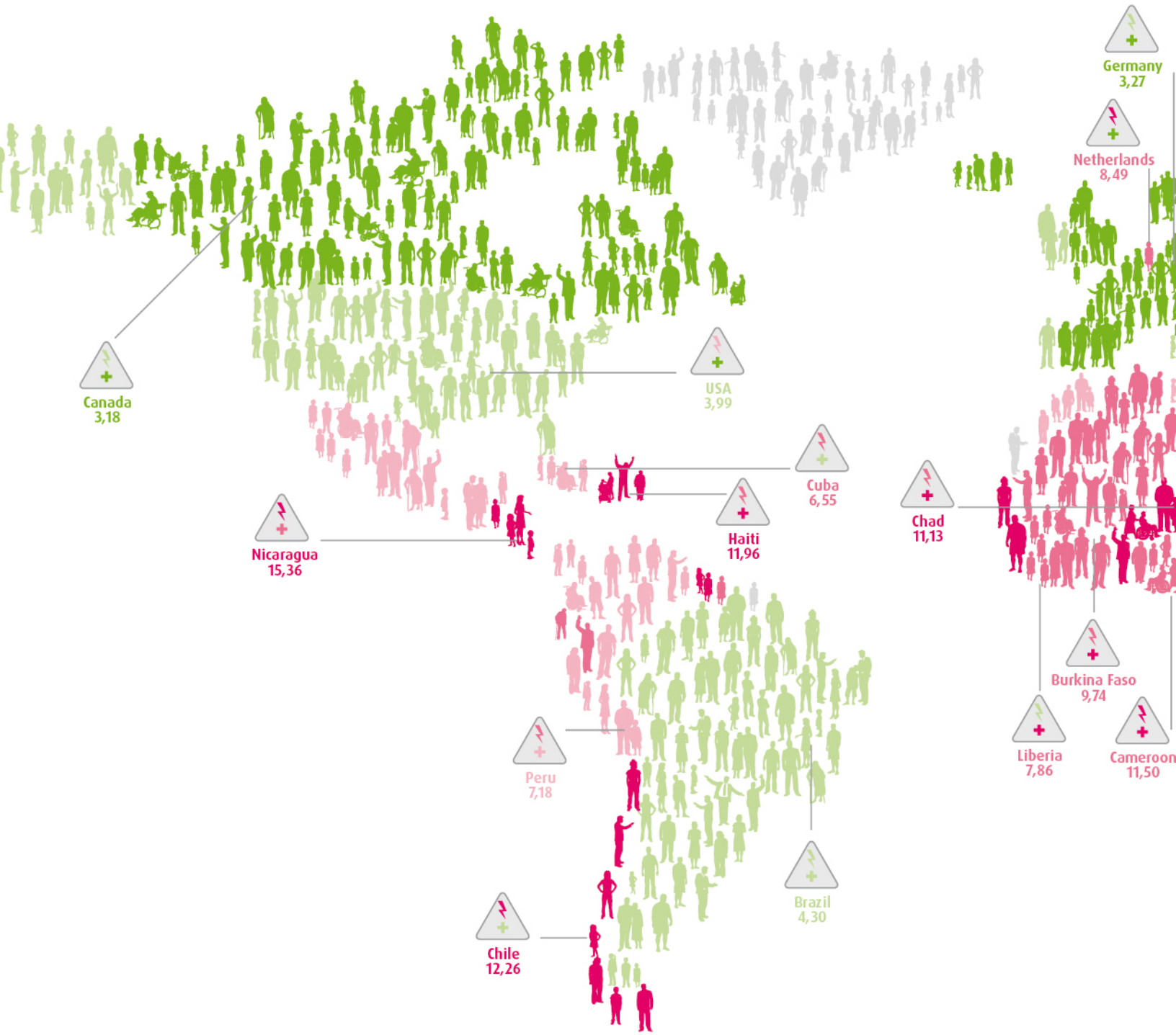
WorldRiskIndex



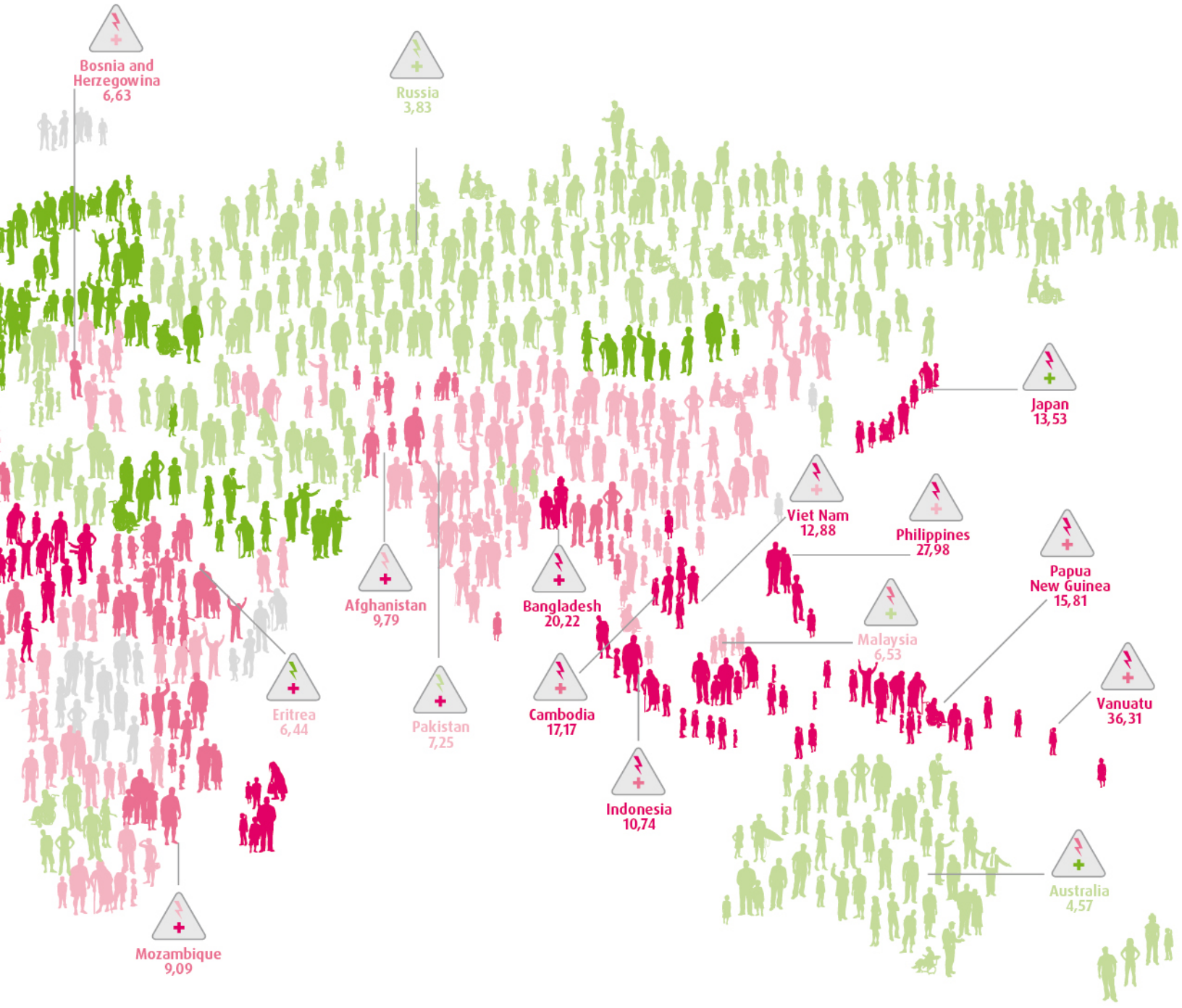
WorldRiskIndex (WRI)	
very low	0,10 – 3,65
low	3,66 – 5,72
medium	5,73 – 7,44
high	7,45 – 10,58
very high	10,59 – 36,31
no data	

Exposure	
very low	0.28 – 9.12
low	9.13 – 11.41
medium	11.42 – 13.85
high	13.86 – 17.45
very high	17.46 – 63.66
no data	

Vulnerability	
very low	26.87 – 36.81
low	36.82 – 46.50
medium	46.51 – 53.35
high	53.36 – 63.43
very high	63.44 – 75.35
no data	

Maximum value 100 %, classification according to the quantile method.

Data: Source UNU-EHS, based on the PREVIEW Global Risk Data Platform, CReSIS, CIESIN and global databases; detailed information at www.WorldRiskReport.org



Country	WRI		
Afghanistan	9.79 %	13.17 %	74.32 %
Australia	4.57 %	15.05 %	30.38 %
Bangladesh	20.22 %	31.70 %	63.78 %
Bosnia a. Herzeg.	6.63 %	14.02 %	47.31 %
Brazil	4.30 %	9.53 %	45.18 %
Burkina Faso	9.74 %	14.32 %	68.00 %
Chile	12.26 %	30.95 %	39.60 %
Germany	3.27 %	11.41 %	28.68 %
Eritrea	6.44 %	8.55 %	75.35 %
Haiti	11.96 %	16.26 %	73.54 %

Land	WRI		
Indonesia	10.74 %	19.36 %	55.48 %
Japan	13.53 %	45.91 %	29.46 %
Cambodia	17.17 %	27.65 %	62.07 %
Cameroon	11.50 %	18.19 %	63.23 %
Canada	3.18 %	10.25 %	31.04 %
Cuba	6.55 %	17.45 %	37.54 %
Liberia	7.86 %	10.96 %	71.74 %
Malaysia	6.53 %	14.60 %	44.74 %
Mozambique	9.09 %	12.73 %	71.37 %
Nicaragua	15.36 %	27.23 %	56.43 %

Land	WRI		
Netherlands	8.49 %	30.57 %	27.76 %
Pakistan	7.25 %	11.36 %	63.86 %
Papua New Guinea	15.81 %	24.94 %	63.38 %
Peru	7.18 %	14.40 %	49.84 %
phili	27.98 %	52.46 %	53.35 %
Russia	3.83 %	9.38 %	40.84 %
Chad	11.13 %	14.89 %	74.74 %
USA	3.99 %	12.25 %	32.57 %
Vanuatu	36.31 %	63.66 %	57.04 %
Viet Nam	12.88 %	25.35 %	50.83 %

= Exposure = Vulnerability

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3. Focus: Environmental degradation and disasters

Hundreds of thousands of trees toppled by a severe hurricane are a visible sign of environmental destruction wrought by a disaster. And flooded coastal villages and washed away beaches whose natural protective belt of mangroves has been chopped down in pursuit of economic interests are, in turn, a sign of the considerably greater risk in the wake of a natural disaster where the natural environment has been destroyed. There is an interactive link between environmental destruction and disasters that many examples can serve to describe. But so far, these insights have been given too little attention by politics and science.

3.1 Environmental degradation as a risk factor

Torsten Welle, Michael W. Beck, Peter Mucke

Intact ecosystems can significantly reduce disaster risk in four ways, corresponding to the components of the World Risk Index.

- Forests and riparian wetlands or coastal ecosystems such as mangroves, coral reefs and sea-grass reduce exposure to natural hazards by acting as natural buffers and protective barriers that thus reduce the impacts of extreme natural events such as landslides or tidal waves.

- When sustainably managed and in good condition, intact ecosystems such as grasslands, forests, rivers or coastal areas can reduce vulnerability. They contribute to nutrition, income and wellbeing. In addition to food, they can also provide medicine and building materials, or they can represent new sources of income, for example via nature-based tourism. Thus they support the livelihoods of inhabitants and supply essential goods.

- Ecosystems can enhance coping capacity in the event of a disaster. For example, if supply lines are severed, food and fresh water can be obtained from the immediate environment when that environment is healthy and intact.

- Ecosystems also directly influence adaptive capacities. When the environment is in good condition, there is a greater diversity of future planning options. For example, in Haiti and other deforested and environmentally degraded areas, the opportunities for diversified strategies for reducing future vulnerability are greatly reduced. It is much easier to manage to reduce future risks when your natural resources currently are viable and intact; your choices simply are greater.

The role of the ecosystems and the link between environmental degradation and the increased impact of disasters were clearly made in the Millennium Ecosystem Assessment (MA) in 2005 particularly with regards to risks from flooding and forest fires. This UN MA study also showed that 60 % of the ecosystems are not being sustainably used or are in a state of ongoing degradation (MA, 2005). The UN Global Assessment Report on Disaster Risk Reduction 2009 identified environmental degradation and the decline of ecosystems as one of the chief factors raising the risk of disasters.

However, scientists have only recently begun to systematically establish the extent to which ecosystems have a direct influence on disaster risk. The Secretariat of the United Nations Office for Disaster Risk Reduction (UNISDR) has applied the ecosystem approach and referred to the role of the environment and its buffering capacities vis-à-vis natural hazards several times in reports. It has called for detailed studies and analyses on an understanding of ecosystems and their influence on the reduction of disaster risks (UNEP/ISDR 2008). Here, there is still a considerable need for research and action.

There are a large number of local and regional studies demonstrating that ecosystem functions and services and their sustainable management have a mitigating effect on disaster risk (PEDRR 2010, Sudmeier-Rieux et al. 2006). For example it is well known that agribusiness increases soil erosion and that deforestation increases risks of landslides (see Chapter 3.3).

As a rule, ecosystem functions are very complex, and the disaster risk is influenced by many factors. At the global level, available data so far allow for restricted statements on the quantitative link between environmental degradation and risk. A correlation has however been established between the frequency of flooding and deforestation (Bradshaw et al. 2007). In Chapter 3.2. of this report, the link between the condition of coastal ecosystems and coastal hazard mitigation through wave attenuation and erosion reduction is examined globally.

There are several reasons why we believe that it is difficult to find global correlations in overall degradation and risk. First we find that the nature of the relationship depends strongly on the respective hazard and habitat type. And second, we believe that the global analysis requires higher resolution data of the type which are so far usually only available from local and regional surveys. Although there is an obvious need for further research in this area, there is widespread scientific evidence showing that the state of the ecosystems has a profound impact on disaster risk.

Increased disaster risk through environmental degradation

There are numerous local- and regional-scale examples of the links between ecosystem condition and disaster risk. For example, the loss of ecosystems, such as the degradation of wetlands and mangroves along river courses, results in increased flooding. This link has been demonstrated along the Mississippi River in the USA. Here, the floodwater storage capacity of the soil has fallen by 80 percent owing to the degradation of forest-covered wetlands along the river through canal building measures, leveling and draining for development purposes (MA 2005, Chapter 16). In combination with severe precipitation, snowmelt and a low level of evaporation, the degradation of alluvial zones along the courses of rivers, river regulation and the sealing of the land enhance surface runoff.
The result is a higher risk of flooding since the ground and the vegetation can no longer absorb the water (Disse and Engel 2001). Furthermore, deforestation and crop farming on slopes also lead to an increase in flood risk since deforestation and agriculture in river catchment areas contribute to increased soil erosion and this in turn raises the sediment load in rivers. This process can result in the silting up of rivers, as has been demonstrated with the examples of the Ganges and the Brahmaputra (Ali 2007).

The link between deforestation and flood risk has also been examined in several studies in experimental hydrological research. Deforestation raises the annual run-off volume and maximum throughflow and reduces the evaporation rate. These properties cause an increased flood risk since the natural buffering capacity of the forest as an ecosystem is lowered (ADPC 2004). Degradation of this kind can lead to a roughly fourfold increase in the extent of flooding in comparison to riparian landscapes with intact, undisturbed vegetation cover (Atta-ur-Rahman and Khan 2011).

Marshes, mangrove forests, corals and sea-grass beds have a direct impact on the disaster risk in coastal areas. For example, the alteration of wetlands in coastal watersheds exacerbated flooding events in Florida and Texas (Brody et al. 2007). In looking at the impacts of cyclones at global level, the areas covered by even semi-altered coastal ecosystems were correlated with lower human mortality (Perez-Maqueo et al. 2007).

The threat of a landslide is increased by severe precipitation, snowmelt, thawing of the ground, tremors due to earthquakes and, last but not least, loss of vegetation through anthropogenic influence (BAFU 2009). Peduzzi (2010) examined the link between

++ 23rd to 29th August 2005 ++ Hurricane Katrina in the USA

Reaching speeds of more than 250 kilometers an hour, Hurricane Katrina at some points built to a category 5 hurricane (the strongest) and hit the Gulf Coast of the USA, especially Florida, Louisiana and Mississippi, as well as Alabama and Georgia. New Orleans was particularly severely affected. Causing more than 1,800 deaths, Hurricane Katrina was one of the five deadliest hurricanes in the history of the USA. Many coastal ecosystems were heavily damaged by Katrina and the follow-up Hurricane Rita, one month later. Louisiana's Chandeleur Islands lost around 85 percent of their surface area; these barrier islands were critical nesting and feeding grounds and their loss directly impacted hundreds of thousands birds from sandwich terns to brown pelicans. Through these storms and through saltwater intrusion inland, more than 570 square kilometers of marshland and coastal forests of the Gulf Coast were lost, which was on top of the already rapid decline of these coastal habitats.

++ 14th to 18th April 2006 ++ Sandstorms in China

The sandstorms are a meteorological phenomenon that occurs in the months of the spring in China. Industrial pollution and an over-cultivation of the soil, deforestation and overgrazing are massively increasing their intensity and their impact.

Owing to the storms, China's deserts grow by up to 10 meters each year, which leads to a loss of fertile soil. Sandstorms also contain toxic harmful substances (sulfur, soot, ash, carbon monoxide) and heavy metals, which can result in an impairment of air, soil and water properties – for instance through acid rain. Additionally, the heavy metals can cause sustained contamination of forage plants for animals as well as their habitats.

landslides and vegetation cover with reference to the earthquake in northern Pakistan in 2005. He used geological data for this purpose (such as remote sensing data like satellite images) from which the vegetation was deduced, digital elevation models, data on active earthquake zones and digital infrastructure data (roads and rivers), and he compiled a regression model. The result was that vegetation can reduce the occurrence of landslides by 15 %, thus representing a significant risk reducing component.

Disasters as a cause of environmental destruction

A number of local and regional studies deal with damage to ecosystems that has been caused by natural events. The state of the environment is examined before and immediately after the event – usually with the aid of remote sensing data, provided that it is available in data banks.

In China, an analysis of surface vegetation was carried out following the earthquake in Wenchuan (with a magnitude of 8.0) in May 2008. Degradation by the earthquake was at 22 percent. One of the phenomena resulting from the earthquake was a large number of landslides. However, after four months, the recovery level of the vegetation was already at almost 100 percent (Liu et al. 2010).

In Thailand, following the tsunami in 2004, the extent of damage to five different forest ecosystems was examined with the aid of high-resolution remote sensing data (Roemer et al. 2010). One aspect revealed here was that in the area examined, 55 percent of the mangrove forests had suffered immediate damage while others, such as tea tree forests, had only suffered a little damage.

Cyclones can cause considerable damage to ecosystems. For example, throughout the Gulf of Mexico, cyclones consistently destroy oyster reefs and beds to the extent that tens of millions of dollars have been spent in the past decade to help revive oyster fishing grounds for small-scale fishing communities. Cyclones have seriously harmed coral reefs throughout the Caribbean, including many of those that are extremely important to communities for tourism and diving.

In Pakistan, damage to the environment caused by flooding was examined. For not only does heavy flooding lead to a loss of livestock and harvests. Erosion processes do lasting harm to the topsoil, strongly affecting the livelihoods of people and resulting in an increase in vulnerability. However, no detailed quantification of damage is available (Atta-ur-Rahman 2011).

The warming of the oceans is already having dramatic effects on reefs and wetlands around the world. When sea surface temperature increases, coral reef ecosystems are badly impacted. In the 1998 El Nino ocean warming events, huge numbers of corals were killed throughout the Indian, Pacific and Caribbean seas. These events are predicted to be much more common in the coming years.

A large number of local and regional surveys demonstrate that the environment directly influences disaster risk. However, further examinations of case studies and country analyses are required to improve our understanding of these processes; further we need better data for comprehensive global correlations. At the same time, it is important to enhance environmental conservation and sustainable environmental management from the local to the global level and actively integrate all these aspects into disaster preparedness.

++ July/August 2010 ++ Flooding in Pakistan

The floods were caused by very heavy monsoon rainfalls and were aggravated by deforestation in the Himalayas. The water masses flooded 20 percent of Pakistan's area, affecting 21 million people.

Food supplies and wide stretches of land used for agricultural purposes were rendered useless. More than 3.2 million hectares, which is just under 16 percent of the cultivable area, were destroyed. The availability of clean drinking water was dramatically reduced.

++ 11th March 2011 ++ Earthquake in Japan

In the course of the Tohuku earthquake and the subsequent Tsunami, 15,860 people were killed, while a further 3,000 were reported lost. The quake hit the Japanese Fukushima Nuclear Power Plant, resulting in a core meltdown and the emission of radioactive material.

This led to a contamination of the air, soil, rivers and lakes, and food (fruit, vegetables, livestock, fish and seafood) for several decades or even centuries.

3.2 Coastal Habitats and Risk Reduction

Michael W. Beck, Christine C. Shepard

The world's coastal zones are changing rapidly and the rate of change is predicted to increase from further coastal development and the impacts of climate change, both of which will dramatically increase the risk potential. Coastal ecosystems and communities are going to be most seriously affected by climate change, through sea level rise and increased intensity and frequency of storms and extreme weather events. Already, the proportion of the world's gross domestic product (GDP) annually exposed to tropical cyclones has increased from 3.6 % in the 1970s to 4.3 % in the first decade of the 2000s (UNISDR 2011).

Coastal and marine habitats, particularly coral reefs and wetlands, are at the front line of these changes and are suffering the greatest damage and destruction. Up to 85% of oyster reefs worldwide have been lost, as well as 30-50% of wetlands (marshes and mangroves) and approximately 20% of coral reefs (Beck et al. 2011). In most cases, the percent loss of these habitats is far greater around population centers. It may reach to the point of functional extinction of these ecosystems. That is, where the most people could benefit from these ecosystems is often where their impacts and loss have been the greatest.

Effectiveness of Natural Solutions

Coastal ecosystems such as wetlands and reefs provide substantial benefits and many advantages for the coastal inhabitants in particular. The loss of these ecosystems affects millions of people, particularly in resource-dependent communities of the tropics. Coral reefs and mangroves are critical to tropical, developing nations. They benefit fisheries, tourism, culture, shoreline stabilization and coastal defense. Their worldwide locations are demonstrated on the double page 38/39.

There is a growing awareness in disaster risk management in coastal regions. Natural conservation solutions, so-called "green solutions", are gaining ground. They take advantage of the natural properties of coastal habitats to mitigate hazards and reduce risk (UNISDR 2011). Interest in green solutions is driven by

+ evidence of ecosystems playing a major role in coastal protection and reducing risks
+ their cost effectiveness
+ the opportunity in some areas to create sustainable livelihood alternatives.

Recent studies show quantitatively that conservation and management of coastal habitats can play a key role in reducing coastal hazards, e.g. through wave attenuation and erosion reduction and can thus reduce the vulnerability of communities. These studies include analyses of all marsh studies globally that measure the benefits of coastlines with marshes as compared to those without for coastal protection. There is also clear evidence that mangroves provide coastal protection benefits in many circumstances in particular for attenuating storm surge, especially with respect to attenuating storm floods (Gedan et al. 2011, Shepard et al. 2011, Zhang et al. 2012).

The second major factor driving interest in natural solutions is their cost efficiency. They can be a cost effective part of hazard mitigation and climate adaptation strategies. Third, natural solutions can

Coastal Defense – "green" and "gray" solutions

The range of solutions for reducing coastal hazards ranges from "green" to "gray" solutions. Green solutions comprise the conservation and restoration of natural coastal ecosystems. Here wetlands and reefs are conserved, replanted or restored to reduce the impacts from waves and erosion on the coastline. There is a growing interest in green solutions – but this is also urgently needed.

Worldwide, gray solutions have been used the most. Here, coastlines are artificially hardened, and gabions and breakwaters made of rock and cement are dumped on shorelines to stabilize them. The development of one gray defense shifts impacts to people downshore, who must then invest in building another artificial defense. Thus more than 22,000 km of the coastal zone in Europe are covered in concrete or asphalt. In the 1990s alone, there was an increase in "hardened" coastline of almost 1,900 kilometers in Europe (Airoldi and Beck 2007).
Gray solutions cause continuous maintenance costs, whereas green solutions are more sustainable and can grow naturally. Mangrove forests, wetlands and coral reefs also offer additional benefits to people including fisheries and livelihoods (e.g., harvest and tourism).

make a valuable contribution to addressing multiple coastal management objectives with which local officials are charged, including natural resource protection and livelihood development. Strategies that aim to enhance the resilience of ecosystems to enable the continued provision of goods and services can be particularly important for communities directly exposed to hazards that depend upon natural resources.

Coral Reefs and Coastal Protection

Here, we focus on coral reefs as an example of the role and importance of coastal habitats for hazard mitigation, because they often form large, robust offshore barriers, because of their proximity to vulnerable settlements and because, while their condition is declining, it is still better than that of many other coastal habitats. Numerous studies show the benefits of coral reefs for coastal protection, in particular for reducing the wave energy and height that impact coastlines (Kenchet al. 2009, Sheppard et al. 2005). In many places, these reefs serve as breakwaters and are the first line of coastal defense for hazards associated with waves, erosion and flooding.

Studies show that coral reefs attenuate and reduce more than 85 per cent of incoming wave energy. The role of reefs as barriers is something that is visually apparent from shore as they break waves (sometimes very large waves) and substantially reduce the energy and height that would otherwise hit the shore far more directly. This wave-breaking effect is something also visible from aerial photos (e.g., Google Earth). From an engineering point of view, some of the most critical features of any barrier whether natural or man-made are height, hardness, and friction. These explain why reefs are so critical; they are huge, hard and structurally complex.
The number of people that potentially benefit from coral reefs is high. As a broad estimate of those that might receive benefits from reefs, we look at how many people and where the benefits might be greatest by assessing the number of people who live in low coastal areas (below 10 meters) near a reef (within 50 kilometers) (see maps on double pages).

These are the 200 million people in villages, towns and cities living near the coast at low elevations who may receive some direct and indirect benefits from reefs. These are also the communities and municipalities that might bear coastal defense or other development costs if reefs are degraded and more artificial barriers and hardened shorelines ("gray" infrastructure) must be developed. From the perspective of risk reduction, many of the most at-risk countries are tropical and coastal, which is where reefs are most abundant.

Coral Reefs and Risk

The value of reefs for providing numerous benefits and reducing disaster risk depends crucially on reef condition. Unfortunately, many reefs are in declining condition. Coral reefs are one of the most well assessed coastal ecosystems and the Reefs at Risk reports provide a well established indicator of global coral reef status based on the indicators "extent of destructive fishing", "extent of coastal development", and "extent of pollution" (Burke et al. 2012). Considerations of the consequences of climate change and its impacts on coral reefs from thermal stress and acidification are not included yet but could be added in future.

For example, in the Caribbean, there have been huge losses of coral reefs and their structural complexity which is critical in considerations of coastal protection. Among the corals that have been lost, most are the staghorn and elkhorn corals, which are complex branching corals that exist in shallower high energy zones on and near reef crests. Their loss can affect both reef height and complexity (i.e., friction), which are

critical parameters from a coastal defense standpoint.

Where reefs are lost and degraded, we can reasonably expect that exposure to wave energy (daily and from storms) will increase and so will the need for investment in solutions (either gray or green) to stabilize shorelines and protect people and property.

Understanding the overlap in social and environmental risk is critical for informing options for action. Some of the nations most at risk are in the western Pacific in Oceania. Moreover, these countries have the greatest overall proportions of their populations in low coastal areas near reefs (28% of the overall population).

The good news is that these are the areas where reefs are in the best shape globally (69% with a low level of degradation). In Oceania, government authorities and non-governmental organizations should focus their efforts on reef conservation near people, because if they were to become degraded, this would have serious consequences for people already often at high risk.

In many other areas, reefs are in worse shape. Government and civil society actors there have to concentrate on better management with the aim of reef recovery, which can have a real influence on reducing hazard risk. Nations throughout the Caribbean have very high exposure to storms and the role of barrier reefs is particularly important there. Asia has by far the greatest number of people (127 million) in low elevations (below ten meters) and near reefs. Here, reef recovery would benefit a particularly large number of people.

The Map of the World on double page 40/41 shows the level of degradation of coral reefs worldwide, the disaster risk in accordance with the WorldRiskIndex and number of people in low, exposed areas near reefs.

Benefits and Limitations of Natural Solutions

The benefits from green solutions are real, but this does not mean that they are a panacea. Indeed, no defense guarantees protection; even the largest and most fortified barriers fail to offer complete protection, as the 2011 tsunami in Japan showed. One problem is that a protective barrier – green or gray – may funnel waters in ways that can increase hazards in other areas. Barriers do not stop water, they merely redirect it. The nature of the protection is dependent on many factors including hazard type (tsunami or storm waves; direction and speed) and structural characteristics (height, width and friction).

The incorporation of natural solutions is imperative given the very high costs to society of engineered, "gray" solutions. Mitigation of coastal hazards has traditionally been undertaken using shoreline hardening and engineered defenses. In many places however, putting up enough artificial defences is impractical, too expensive, and requires on-going maintenance costs. Moreover, such hardening prevents natural change in habitats, thus endangering them, because it prevents the inland migration of coastal ecosystems that get caught in the squeeze between the rising sea and coastal development. Changing approaches (and also the mindsets of decision-makers) to include green infrastructure in the discussion is not simple, and faces strong vested interests of those who earn money by implementing engineered approaches.

Added Risks or New Opportunities: The Choice is Ours

In the Global Assessment Report on Disaster Risk Reduction, the estimated economic loss risk associated with floods and tropical cyclones is increasing worldwide. These risks will likely only get worse with increases in coastal development and with climate change.

A revival of mangroves and reefs

Expertise and success in restoring habitats is increasing. The greatest progress has been made with mangrove forest restoration; the size and scope of reforestation projects has grown rapidly (Spalding et al. 2011). There are also growing efforts in the restoration of oyster reefs and coral reefs. In addition to the ecosystem benefits that these restored habitats provide, the very act of restoration creates employment opportunities as well as a greater environmental awareness. For reefs there have been encouraging developments in the use of semi-natural structures such as reef blocks to help restore the "infrastructure" of coral reefs and oyster reefs. Further 'underwater nurseries' have been developed to help grow corals (e.g., staghorn corals), which can be transplanted to reefs and blocks to quickly re-establish the "living skin" around reefs (Johnson et al. 2011).

Future development that is poorly done will lead to even greater problems and put some of the most vulnerable people at greater risk. Development and conservation do not have to be incompatible; on the contrary, the concept of risk reduction can link environmental, social, and economic goals.

It is well recognized that investments in disaster prevention through sustainable development are cost effective. And it is exactly these sorts of actions which would reduce impacts on ecosystems and thus preserve their benefits for people. Unfortunately, the UNISDR has consistently found that efforts to reduce underlying risk factors account for the least progress in all commitments to risk reduction based on the Hyogo Framework for Action. Moreover, the UNISDR notes that countries rarely appear to work on reducing risk through natural resource management and the incorporation of disaster risk reduction measures into environmental planning. Therefore, governments at the national and multi-national level need to substantially increase their commitment to these preventive plans and measures. Furthermore development organizations and environmental groups need to be comprehensively involved in these issues, which could meet joint goals in sustainable development, risk reduction and the conservation of habitats.

The other major areas of opportunity are in habitat conservation and restoration for risk reduction and other ecosystem benefits (e.g., improvement of livelihoods). Improved management and recovery of existing habitats is the most cost-effective approach for realizing ecosystem benefits to people. This will be no simple task and will be challenging, but the building blocks for these solutions have been laid (see box). Indeed there is some good news when considering the revitalization of coastal habitats in general and for coral reefs in particular. The recovery of some reefs

after the global impacts of coral bleaching from hot water in 1998 is encouraging (corals die and only the white "bleached" calcium carbonate skeleton remains when waters are too hot) (Baker et al. 2008). However, these warm water events will likely increase, and reefs will need to be better managed to reduce sedimentation, pollution, and overfishing so that they can be healthy and resilient to these added climate stresses.

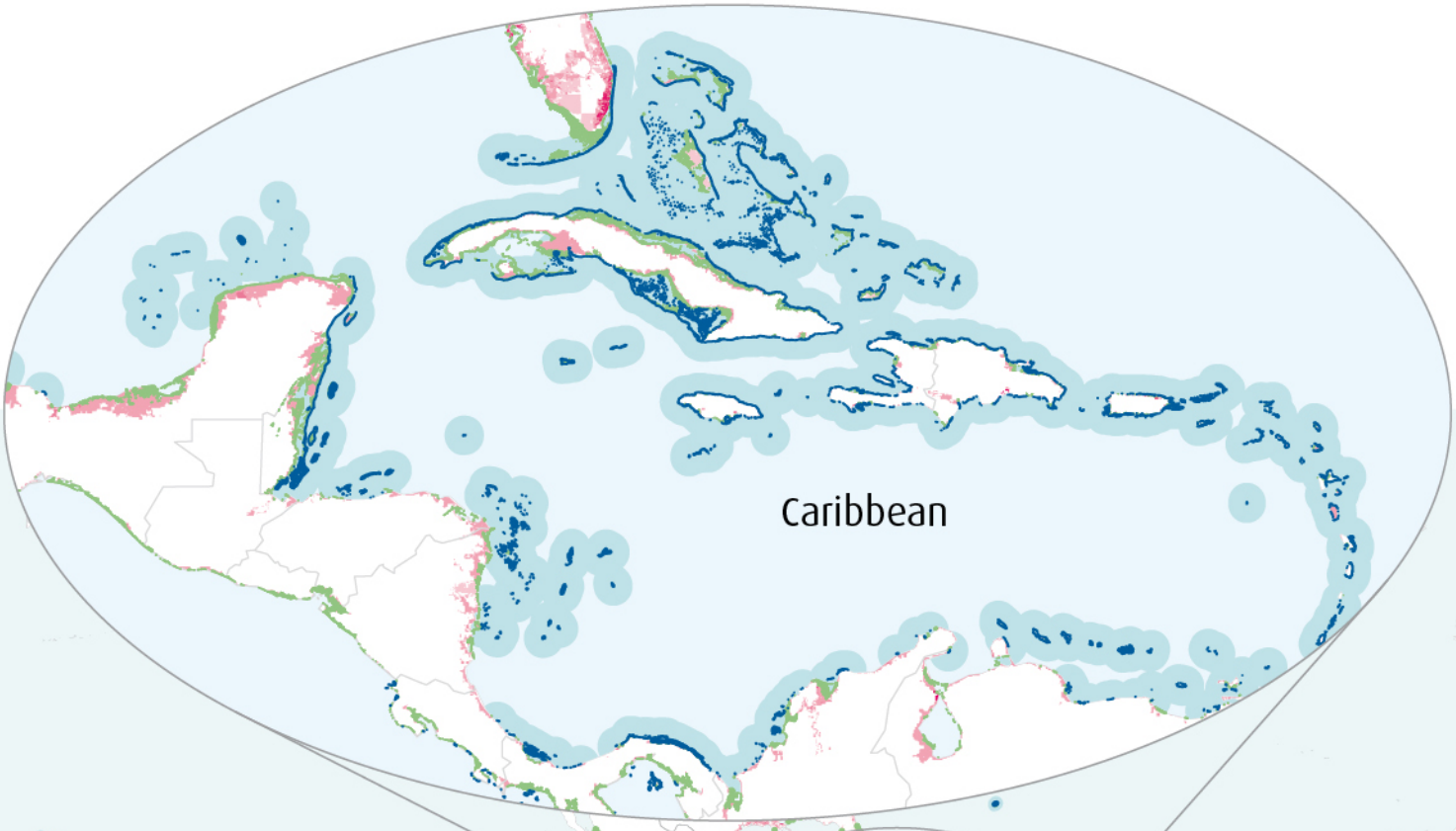
Looking ahead, there will be increasing investments in adaptation aimed at reducing risk to the growing coastal hazards from climate change. These funds will be targeted for developing nations of which the most at-risk are tropical and coastal. If traditional approaches are applied, these funds will mainly go to gray infrastructure (e.g., seawalls, gabions, and breakwaters) unless organizations and agencies across spectrums actively identify the places where conservation and restoration of ecosystems represent particularly good solutions for risk reduction.

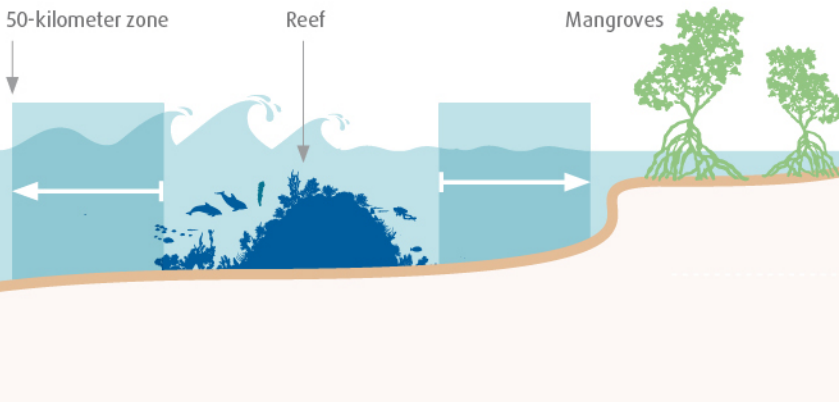
Environmental agencies and non-governmental organizations will have to change the way that they work to focus conservation efforts towards people and particularly those at higher risk. This will mean working less often in more remote areas and much more often where habitats like coral reefs are closest to people.

By prioritizing conservation and restoration of habitats near human communities, we can reduce risks from further habitat loss and, most importantly, focus habitat restoration where it can provide greatest benefits to the most people.

Alliance Development Works

Natural coastal protection





This double page shows the worldwide occurrence of ecosystems and human communities near coasts: reefs and mangroves. Their role and positive effects in a radius of 50 kilometers around the reefs are of special importance where many people live below ten meters above sea level and are therefore especially exposed to marine hazards such as hurricanes, floods and sea level rise. Densely populated coastal areas are emphasized by five shades of red.

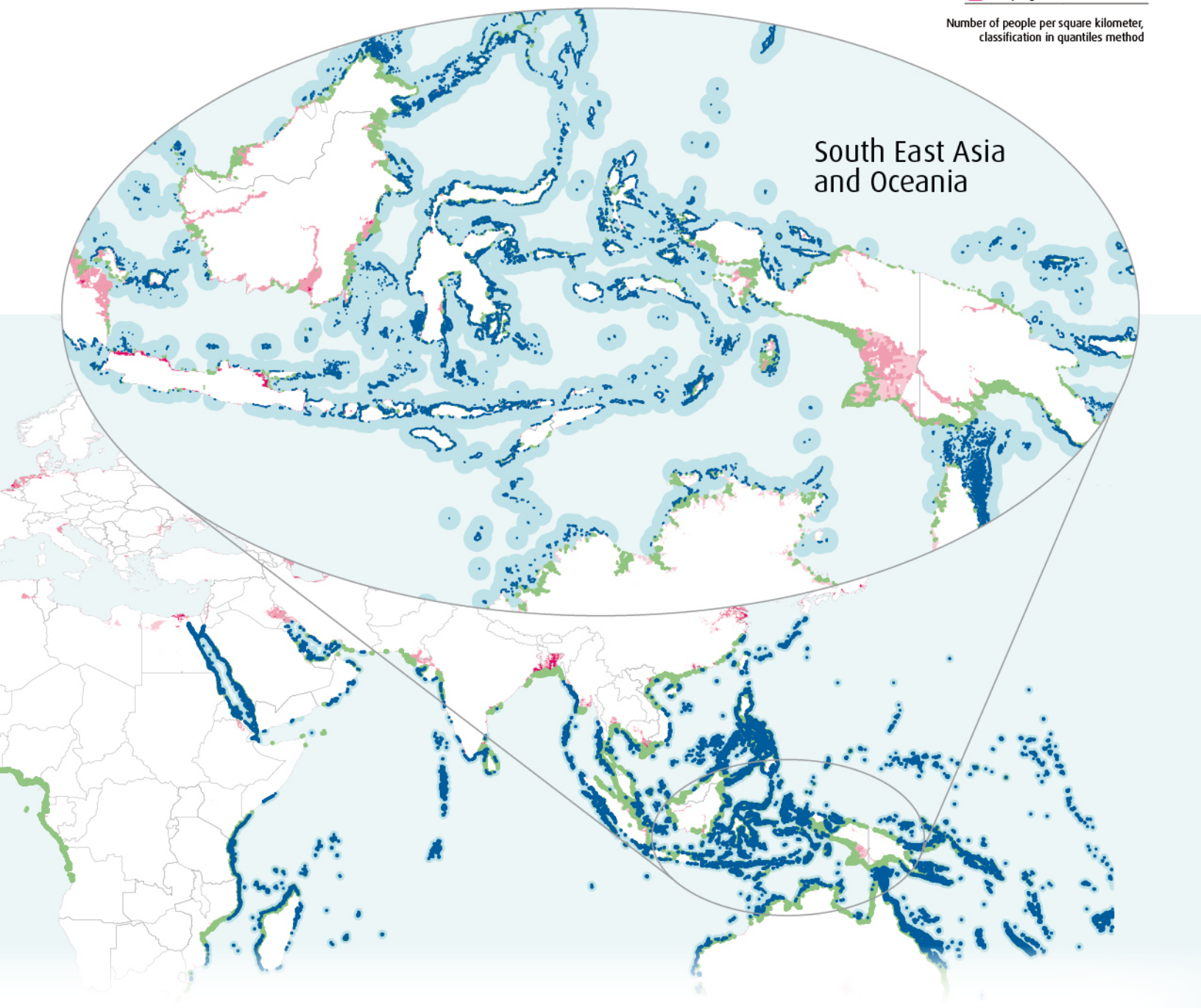
Coastal ecosystems

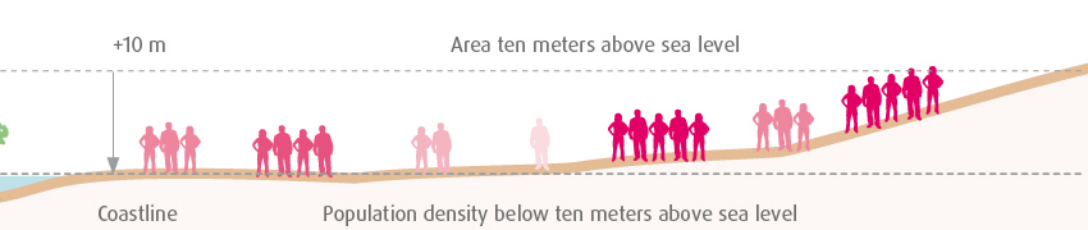
- Mangroves
- Reefs
- 50-kilometer zone around reefs

Population density from 0-10 meters above sea level

very low	< 1
low	1 – 403
medium	404 – 807
high	808 – 1,615
very high	1,616 – 102,969

Number of people per square kilometer, classification in quantiles method





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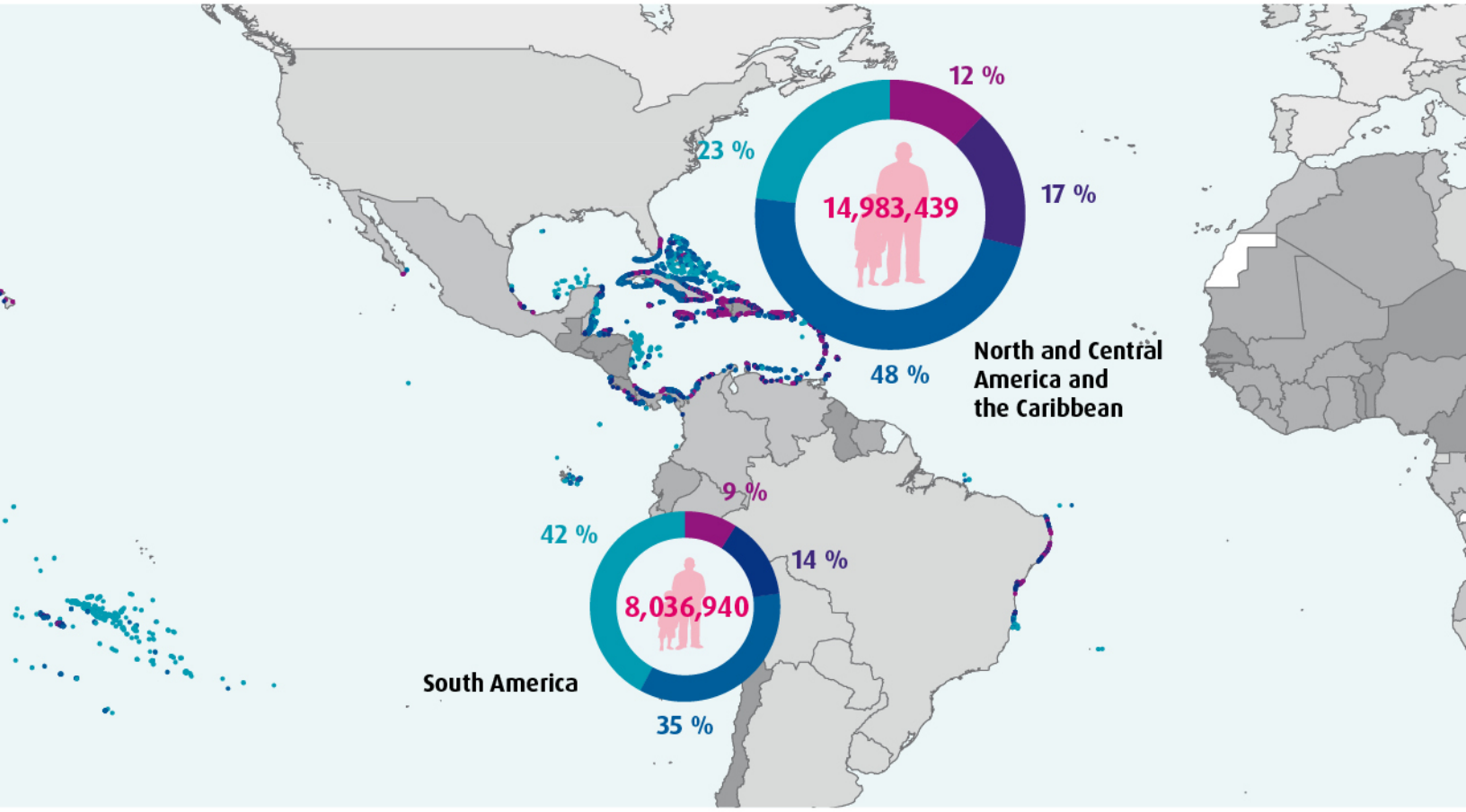
Data: see photo credits on page 69, for details please visit www.network.coastalresilience.org

Alliance Development Works

Brot für die Welt · welt hunger hilfe · terre des hommes · misereor

Reefs at risk, people at risk



Natural coastal protection by intact ecosystems

Coastal forests behind the beach provide protection and shade.

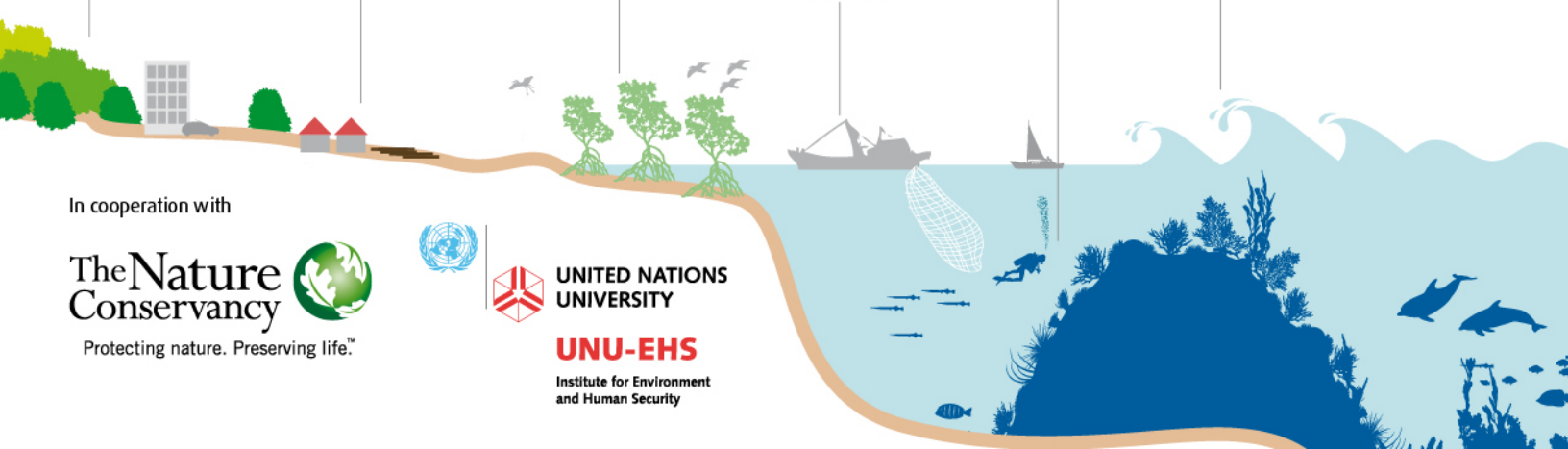
Hotels and houses behind the beach are safer.

Mangrove forests further absorb wave energy and their roots stabilize coasts.

Sustainable management of coastal fisheries: number of boats and nets are balanced with the natural productivity of the fish stock.

Coral reefs help to generate income for the local population from dive tourism.

Reefs significantly absorb wave energy.



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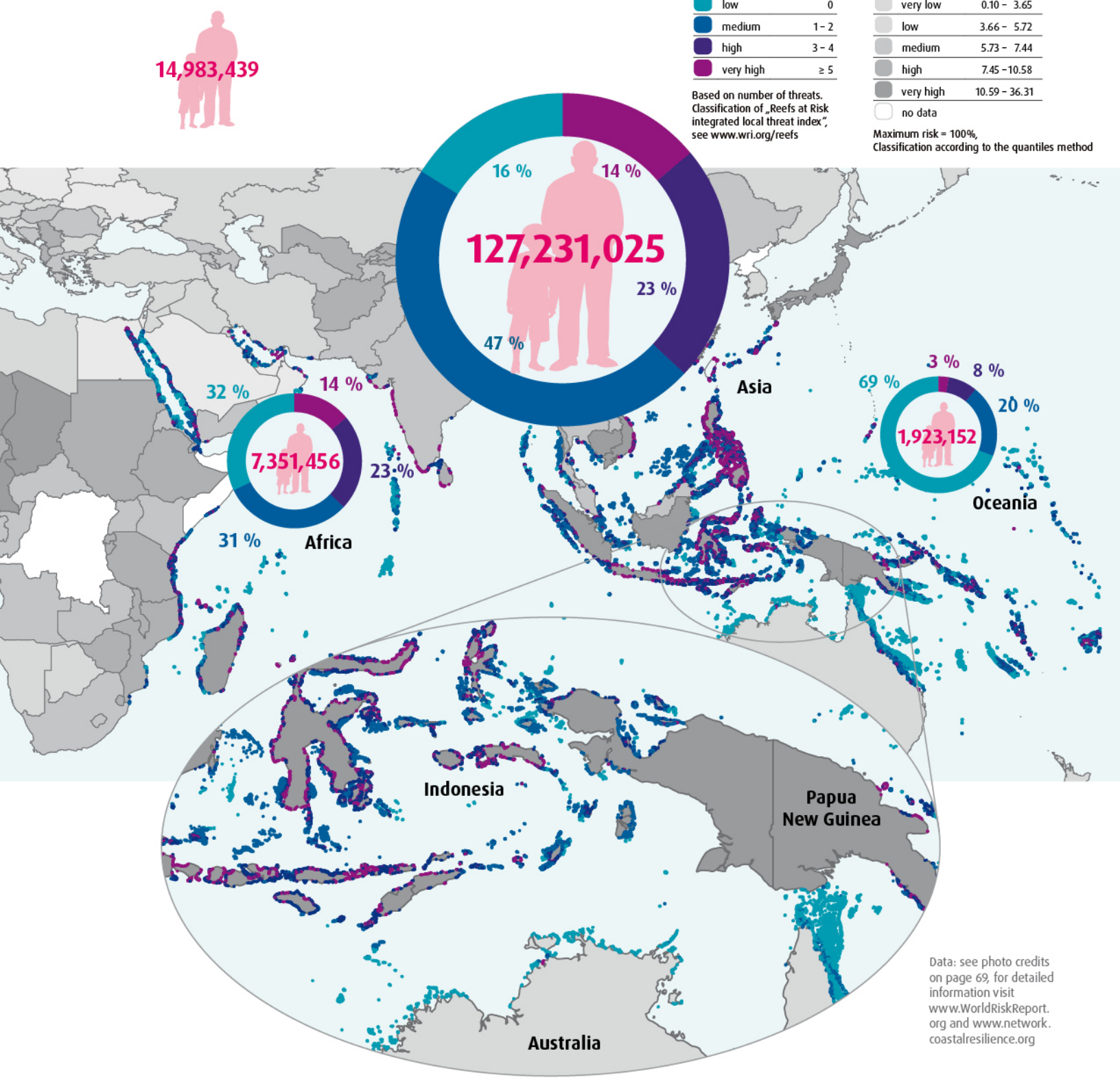

Data: see photo credits on page 69, for detailed information visit www.WorldRiskReport.org and www.network.coastalresilience.org

This double page shows where people and coral reefs are most at risk. The disaster risk is presented in five shades of gray from the WorldRiskIndex. The number in the circles indicates the number of exposed people who may most benefit from reefs on each continent; these are the people living from 0-10m in elevation and within 50km of a reef. As reefs are degraded, these are the people most likely to lose this natural coastal protection and to bear added coastal defense costs. The reefs at risk are indicated in four shades of blue on the map and by risk category (%) by continent in the outer ring of the circles. For example, in Asia, more than 127 million people live at low elevation and within 50 kilometers of a coral reef. But 37 per cent of these reefs are highly or very highly threatened. Declines and losses of these reefs mean that millions of people will lose the many benefits of the coral reef ecosystem.

3.3 Agrofuels, land-grabbing and landslides

Katja Maurer

Crucial experiences are experiences that expose realities one would normally have no access to. For medico international, one such crucial experience was Hurricane Mitch, in Nicaragua. For here, a link between environmental degradation and disaster, between the overexploitation of nature and marginalization, became apparent that ultimately was to cost thousands of people their lives.

In the wake of the hurricane, medico international supported a group of smallholders who had settled on the slopes of the volcano Casita, and whose history illustrates this link. Scattered among several small villages on the slopes, in the shade of the tropical trees and shrubs, they had grown beans and maize and lived largely on a subsistence basis. From León, Nicaragua's second largest city, Casita can be seen in the far distance, towering above the fertile plains. A peaceful scene. Following days of rainfall, the hurricane had broken loose a roughly three-meter wide avalanche of clay from its tip that made its way bit by bit down the slope, turning into a kilometer-wide avalanche of mud. Within a matter of minutes, it buried countless people and destroyed five villages.

The survivors gathered in emergency shelters put up in Posoltega, deeply traumatized by their incomprehensible experience. Children, sons, grandmothers who had just been standing next to them a moment before had been caught by the avalanche in front of their very eyes. Among the people living in the resettlement project that medico was in charge of at the time, there were individuals who had lost up to 50 family members. In a room for workshops in which psychosocial measures are also performed, an exhibition is still on display today with terrible newspaper pictures that show the traumatizing incident. This is how journalist Stephan Hebel described the events at the time: "The village of Rolando Rodriguez had also been situated high up on the mountain. Until Mitch came. When Mitch went, Rolando Rodriguez was lying three, five or even six meters under the mud. Anyone taking a look around here will be walking over dead bodies. To the right and left of the temporary road, bushes and small trees have taken root in the dried volcano soil, as if to provide a merciful green shroud. According to the cold statistics, Mitch killed 2,863 people in Nicaragua, more than 2,500 in the villages on the slopes of Casita."

11,000 killed by landslides

A total of 11,000 people were killed by Hurricane Mitch in Central America in 1998. Most of the deaths were caused by landslides: the peasant families on the slopes of the volcano Casita or the urban poor in the poor districts of the Honduran capital of Tegucigalpa, which are also located on slopes. How can it be possible that in a region in which hurricanes occur every few years, people should be living on slopes on which they are exposed to such predictable hazards?

The slopes of the volcano Casita are a good location to trace back the history of settlements in this region threatened by landslides. In the 1950s, the smallholders were driven away from the fertile plains to the mountain slopes by large-scale plantation management, with cotton grown preferably. Already in those days, this was a result of the global economy. In 1950/51, the world market price of cotton rose by 100 percent, triggering a boom in

cotton production in Nicaragua. Over the next 15 years, the plains, which were inhabited by smallholders and medium-sized farmers, were turned into a large-scale plantation zone. The smallholders and farmers were compulsorily expropriated. Eighty percent of the land suitable for crops in Nicaragua's Pacific Coast zone was turned into cotton plantations.

The dictator's agricultural reforms

A study on agricultural reform and environmental policy in Nicaragua states: "Since the areas needed were not free of settlements or other use, the expansion of cotton-growing caused the loss of the last forest stocks in the Pacific Plains. A new wave of expropriation and displacement of smallholders and farmers caused a decline in staple food production. In the provinces affected most severely, Chinandega and León, the area of cropland for maize-growing was halved between 1950 and 1977, and was reduced by two-thirds for beans. All in all, staple food production in the Pacific region sank by 50 percent. The smallholders became landless seasonal workers, migrated to the city slums or provided reinforcements for the frontera agricola." (Thielen 1988).

The "frontera agricola" (agricultural front) was a dictatorial land reform. The then Nicaraguan dictator Somoza brought tens of thousands of people kept in poverty to the Atlantic Coast and allocated land to them that they were to make fertile with development aid money from the USA. This was a settlement policy driven by a man craving for status that failed after one year because the soils were too poor, the land was exhausted and the people had to move on. They returned to the regions that they had originally come from. Thus the cycle was completed. The former smallholders and farmers from the plains ended up on the slopes of Casita. The ecological disaster that had preceded the hurricane was due to a development model celebrating

Case study: Vietnam

Salty soil in the river delta

Again and again, land is submerged in Vietnam. In 2011, for instance, the full impact of Typhoon "Nesat" hit the country's northern coastal region, flooding the entire area. Cyclones are a familiar phenomenon that people affected in Vietnam have become accustomed to. However, climate change is resulting in an increase in the frequency and intensity of the typhoons. They cause severe flooding, destroy cropland and claim large numbers of human lives. In addition, environmental degradation such as the clearing of protective mangrove forests increases vulnerability towards extreme natural events.

The World Bank ranks Vietnam among the five countries most severely affected by climate change (World Bank Group 2011). The rising sea level is also a result of climate change. It is a serious threat to Vietnam, given the country's coastline of roughly 3,600 kilometers and the large river delta. This applies especially to the coastal province of Thai Binh, as a survey by Australia's "International Centre for Environmental Management" demonstrates (Carew-Reid 2008). This province has 50 kilometers of coast and lies about one to two meters above sea level. Furthermore, Thai Binh is crossed by four major rivers. The rising sea level is resulting in more and more saltwater penetrating the delta areas and making the soil salty. Drinking water gained from the water of the rivers is threatened, too. According to statements by Misereor's partner organization "Centre for Community Socio-Economic and Environmental Development" (CSEED), saltwater is already reaching up to 20 kilometers into the interior of the country.

The population's most important sources of income are rice-growing and shrimp farms. Rice-growing is under a huge threat because the rice paddies are irrigated with freshwater from the rivers. Owing to the soil filling up with salt, there has been a massive decline in rice production. A few years ago, each family was still bringing in 200 to 250 kilograms with each harvest. Today, just 80 to 100 kilograms can be harvested in poor climate conditions and 160 to 180 kilograms in good conditions. But each family requires between 200 and 300 kilograms of rice to earn a living.

Just how severe the impact of anthropogenic environmental degradation can be is demonstrated by the example of the shrimp farms. The excessive use of pesticides and chemical fertilizer destroys the ecosystem, and polluted water enters the natural cycle.

CSEED is addressing this dramatic situation. The primary objectives of this project, which was launched in the summer of 2011, are to secure the population's livelihood and check the impact of climate change. The program targets around 1,200 families in five villages, and local authority staff are also involved. The partner organizes training courses aimed at sensitizing the smallholders towards sustainable methods in agriculture and aquaculture. For example, participants learn how to make compost and get to know other biological fertilizing methods.

The people affected study the consequences of climate change in workshops and learn how they can cope with them and simultaneously contribute to coastal conservation. One example is the development of mangrove forests along the coast that provide effective protection against flooding and soil erosion. CSEED is supporting the families in the reafforestation of mangroves. One aim is also to involve the population directly. The families help with planting, are responsible for looking after the mangroves and their conservation. Radio broadcasts help boost an awareness of the protection that nature offers and reach other people affected. In this manner, forest stocks can be sustainably maintained.

In addition to coastal conservation, treating soil that has been filled with salt is crucial. Supported by Misereor, CSEED is to test salt-tolerant rice varieties and disseminate a technical base for growing these varieties in further training measures. Furthermore, shrimps are to be bred at eco-farms.

large-scale plantations and growth, while regarding the lives of the local people, their social relationships and traditions and their knowledge handed down by generations as negligible. Through slash-and-burn clearing to obtain land and wood for its poor inhabitants, the land on the slopes of the volcano, already threatened by erosion, lost all its stability. The dramatic consequences of this vicious circle of poverty, environmental degradation and disaster have now been etched deeply into the collective memory of the people from the region, as part of recollections that Nicaraguan psychologist Marta Cabrera calls "full of pain in many ways" (Cabrera 2002).

Fertile fallow land

In 1998, at the time of the hurricane disaster, the boom in cotton production had long ceased to be. It had shifted to other regions across the world. The land lay fallow, and through the agricultural reforms under the Sandinista Government, which had toppled the Somoza dictatorship, it had been nationalized or collectivized. The survivors of the Casita disaster occupied the land not under cultivation on the plains. This has resulted in the creation of the village of El Tanque, which now offers almost 1,000 people a place to live and was supported by medico and German Government funding via the Federal Ministry for Economic Cooperation and Development. It was fortunate for the former inhabitants of the Casita slopes for worldwide economic pressure to take a break towards the end of the 1990s.

Thus, in what can almost be described as favorable conditions with hindsight, the self-initiative of the peasant families and integrated support measures ranging from psychosocial support to training and upgrading measures, the establishment of credit funds and much else enabled a village to be set up with social relationships and a more or less sound economic base. The result

is measureable. For unlike many of their neighbors who survived, the inhabitants have not returned to the volcano slopes. They have built up a new home for themselves.

The renaissance of large-scale plantations

It is doubtful whether this could once again meet with success nowadays. For over the last ten years, pressure on land in Central America has been building up enormously. Now, there is hardly any fallow land. Who sells land fetches a good price. For the old development model, the extensive management of cropland with large-scale plantations, has returned. Today, the focus is not on cotton, coffee or bananas – today, plants are in demand yielding products that include agrofuels: sugar and the palm oil tree. Unlike in large-scale plantation management in the 1960s, in which US American agro-corporations like United Fruit played a major role, there are powerful regional companies today, such as the Nicaraguan group Pellas, one of the major sugar cane producers in the region. Or the Widman group in Guatemala. These companies are highly modern enterprises with a department for social marketing, working with state-of-the-art technologies and promising the local population a material share of large-scale cultivation.

They have good reasons to keep an eye on their image, for a huge amount of money is at stake. The palm oil tree and sugar cane are among those agricultural commodities that are booming on the world market and are not affected by any crisis. On the contrary, seeking profitable investment, global capital sees a secure future here given a thirst for energy that it will probably be impossible to quench over the next few years and even decades. Thus "demand for palm oil has risen rapidly over the last few years, and experts are speaking of constant growth rates of around eight percent." (Süddeutsche Zeitung, 26.06.2012). The second largest flotation in 2012 following Facebook is the stock-market launch by Malayan plantation growers Felda Ventures. Palm oil is included not only in agrofuels but also in hygiene articles and in food ranging from potato crisps through deep-freeze pizzas to chocolate bars. And the food industry is just as crisis-proof as gasoline production. For image reasons, many manufacturers use the euphemism "biofuels", although these fuels bear nothing "bio" in the sense of sustainability.

In Central America, the rapid spreading of large-scale plantations has been the dominant economic growth model over the last decade. Guatemalan sociologist Laura Hurtado has noted in a survey that over the last decade, Guatemala has transformed from a food self-sufficient country to a food-importing country. The very food corporations earning profits on the globally available ready-to-use products which are also being imported to Guatemala are either directly or indirectly involved in the spreading of the large-scale plantations with their socially and environmentally harmful impacts (Hurtado 2008).

Destruction of the ecosystem

The National Institute of Statistics in Guatemala has compiled a detailed list of expansions of land under cultivation. Between 2003 and 2011, the cultivation of palm oil trees has grown from 31,000 to approximately 100,000 hectares, and according to the survey by Hurtado, the cultivation area for sugar from 188,000 in 2003 to almost 260,000 hectares in 2007, with a tendency to rise still further. Hurtado notes that the production and processing of the palm oil plant and of sugar cane is in the hands of a small number of enterprises, further aggravating the concentration of land under cultivation. The result is: "These processes are leading to a displacement of rural communities, fundamentally changing areas that used to be producers of staple foods, destroying forest areas and generating earth movements through large-scale drain-

age drying up moorland, lagoons and other sources of water." Ultimately, it is argued, this process will result in "the destruction of the ecosystem and the loss of biodiversity."

However, there is far more damage to the environment. The large-scale plantations exhaust cropland, rendering it useless for a long time. The pesticides applied are harmful both to humans and to the environment. Frequently, they cause widespread contamination of the groundwater that lasts for years. One of the diseases that puts a severe strain on both the people and the poor health systems in these countries is chronic kidney insufficiency. The frequency of these symptoms is characteristic in Nicaragua and the other countries of Central America In comparison to countries without sugar cane cultivation. The displacement of the rural population results in a shift of the agricultural border. If they do not migrate to the cities or even leave the country, they try their luck in regions that are not yet under cultivation, which leads to further environmental degradation and above all increases the vulnerability of the population forced to migrate.

Here, we come full circle. The danger of disasters caused by environmental degradation, such as the one that occurred on the slopes of the volcano Casita, being repeated at any time has been growing considerably owing to large-scale plantations. For there is one promise that the enterprises make again and again but do not keep: the promise of modernization, development and secure living conditions, also for the poor. Unlike in Brazil, where the government has at least distributed surplus agribusiness profits among the marginalized slum inhabitants in the context of its social programs, none of this is happening in the countries of Central America.

The governments almost exclusively impose indirect taxes. The large-scale enterprises, which usually belong to the established oligarchy, pay virtually no tax. In this sense, the Central American countries continue to be "banana republics" – now under the control of the national oligarchies.

Forced displacement in the Polochic Valley

One example of the companies' action in close cooperation with the state, and above all military, structures in Guatemala is the forced displacement of 14 communities in the Polochic Valley, in the District of Alta Verapaz, in March 2011. Hundreds of police, troops and private security staff drove out thousands of inhabitants, demolishing their houses and burning up the harvest under the pretext that the residents had illegally acquired the land. The backdrop of this is the massive spread of sugar cane cultivation in the valley by Guatemalan companies, in cooperation with the powerful Nicaraguan Pellas group. According to a report in the newspaper "Prensa Libre" of the 01.02.2012, the company invested around USD 18 million in the expansion of the area under cultivation in 2011 and was also planning this for 2012. Then there are loans totaling more than USD 50 million that have been provided by the Inter-American Development Bank.

But things are not quite as simple as they used to be when dictatorial regimes were holding a grip on Central America and giving the oligarchs a free hand. The dispute over the Polochic Valley has become a symbol of resistance against the exploitative development model. In March 2012, the smallholders marched hundreds of kilometers and managed to wring initial concessions from the Government in Guatemala City. The Inter-American Commission for Human Rights sided with the 14 communities that had been displaced using force. Guatemalan civil society organizations provided lawyers in order to represent the interests of the peasants, who were of indigenous origin. Here, they refer

Case study: Burkina Faso

Using stone walls and robust trees to combat erosion

Already for the third time in a decade, the people in the Sahel are threatened with acute hunger. The reason for the food crisis is a lack of rainfall and the severe decline in crop yield that it has brought about. That people in the Sahel should be so vulnerable to drought is also due to massive environmental degradation caused by excessively intensive land use. For as a rule, a poor peasant family can only till 1.5 hectares of cropland, whereas a rich peasant family using oxen can manage up to three hectares. Most of the peasants have to make very intensive use of their land and are unable to maintain the fallow periods that are vital for the soil to regenerate.

The result is a decline in vegetation or even its complete disappearance, precipitation draining off fast and directly on the surface, water shortage, soil erosion or soil filling with sand and sand carried by the wind destroying infrastructure. The land becomes infertile and barren, and what is known as desertification sets in. A dramatic vicious cycle is triggered, with ever less fertile land being available that necessitates a more and more intensive use of the still existing fertile land, the result being that here too, the degradation process takes over more and more rapidly.

Welthungerhilfe has already been working together with its partners to combat desertification in the Sahel for years. Thanks to an appropriate and sustainable use of the water and soil resources, the environmental situation is improving. For example, in Burkina Faso, in cooperation with the organizations "Association Zood Nooma", "Association de Développement Sougri Nooma" and "Association Lutte contre la Désertification", soil and water retaining measures are being carried out together with the peasants. In all, these measures reach a total of 1.3 million inhabitants in the four provinces of Bam, Sanmantenga, Ganzourgou and Oubritenga.
Here too, a high population density, the excessive use of cropland and pastureland and the decline in annual precipitation levels – in combination with more frequent heavy rain – have led to an erosion of land used for farming. Fertility has declined, and ever larger areas of cropland have to be cultivated to attain the same yields. These areas are gained by clear-cutting the savannah, which additionally robs the soils of their natural protection – the onset of the disastrous cycle of desertification.

The consultants from the partner organizations and so-called village trainers train the peasants in constructing and maintaining mechanical and biological erosion protection systems. The peasants join forces to build stone walls and smaller dams, and they plant them with the robust and drought-resistant Jatropha trees and shrubs. Held back by the stone walls, strong rainfall only drains off slowly from the fields, and small erosion channels and holes see to it that water uptake by the soil is improved. In this manner, the groundwater reserves are replenished. Planting the walls also reduces erosion and has a favorable effect on the microclimate.

Village committees are established in order to develop this process sustainably. Finance required for necessary investments is also raised by the communities themselves. The dissemination of soil conservation methods is performed chiefly via multipliers from village groups who train other farmer organizations. The partner organizations are ready to provide any advice needed. The project has already shown success during the food crisis in the Sahel. Many of the peasants benefiting from the Welthungerhilfe project have had better harvests and are thus less vulnerable to the drought.

to international legal standards that cannot simply be ignored by the government and the enterprises. Such disputes over the expansion of land under cultivation are happening in many places in Guatemala. Often, they already start with resistance against the extension of infrastructure projects such as the "Franja Transversal" highway. Not without reason, the population fear that together with the highway, large-scale plantations will be entering the scene, and that they will see a return of the military, who were involved in a systematic extermination of the indigenous population in the civil war of the 1980s.

Alternative growth models

This may look like the hopeless struggle of the weavers against the machines. But it could also bear similarities with the doubts that citizens in Germany have about infrastructural models robbing them of sleep. The humble life of the peasants in Guatemala may not be an idyll. But the villagers are aware of the threats to life and limb that migrating and the urban slums bear. The Latin American debates over alternatives to the exploitative growth model, to the overexploitation of nature and the environment, which also consider indigenous concepts of how nature should be treated and how people should relate to it, are fueling these disputes in a new manner. It is not without reason that relief and human rights organizations such as medico international are supporting the actors in these debates. The Nicaraguan village of El Tanque is an example of an integrated model in harmony with nature and the local population that reduces people's vulnerability in the context of environmental degradation. However, one village cannot stop the global market and its possible impacts harming the environment. So it is essential for aid aiming to take preventive measures against disasters to participate in the quest for alternatives to the prevalent growth models.

3.4 Environmental degradation, poverty and disaster risk on the international development agenda

Jens Martens

The link between environmental degradation, poverty and disaster risk has already been a subject of debate since the 1970s. However, the political discourses over the topic frequently progressed independently of one another. Greater political attention has been given to the relationships since the UN Conference on Sustainable Development 2012 ("Rio+20"). Disaster risk reduction has become one of the emerging issues on the "Rio+20" agenda.

However, in this area too, the governments failed to agree on substantial political and financial commitments in Rio de Janeiro in June 2012. They merely emphasized their willingness to step up their cooperation in the context of a new international agreement on disaster risk reduction.

The present agreement, the Hyogo Framework for Action, expires in 2015, and the preparations for a renegotiation have already started. The challenge over the next three years will be to turn this topic into an integral element of international negotiations on environment and development.

Disaster risk and the discourse on sustainability – a brief look back

The Brundtland Commission already pointed out the links between environmental degradation, disasters, poverty and development in its 1987 report, "Our Common Future" (United Nations 1987), noting that as early as the 1970s, six times as many people had died owing to disasters resulting from extreme natural events as in the previous decade. To a growing extent, droughts and floods had been caused by deforestation and overcultivation of soils. The victims had first and foremost been impoverished groups of the population in Asia, Latin America and, in particular, Africa.

The governments responded to the devastating drought and flood disasters of the 1970s and 1980s by proclaiming 1990–1999 the International Decade for Natural Disaster Reduction (IDNDR), from which the International Strategy for Disaster Reduction (ISDR) subsequently emerged (www.unisdr.org). Marking halftime in the decade, with the adoption of the Yokohama Strategy and the 1994 Plan of Action for a Safe World, the governments put a stronger emphasis on the socio-economic factors of disasters. The Strategy also related to the results of the first UN Conference on Environment and Development, which had been held in Rio de Janeiro two years before.

In its extensive results, the 1992 Rio Conference also focused on the growing danger of disasters owing to extreme natural events. Agenda 21, the Rio Conference plan of action, addresses the issues of disaster preparedness and risk reduction in various contexts. Reference made to disasters caused by industry is particularly noteworthy. (UN 1992, Chap. 7, para. 57):

"... there is an urgent need to address the prevention and reduction of man-made

Case study: Peru

Applying traditional knowledge to cope with the consequences of climate change

A study by the "Tyndall Centre for Climate Change Research" refers to Peru as the third country most severely affected by climate-conditioned change (Andersen et. al 2009). It is regularly exposed to extreme weather events with grave consequences, above all flooding, landslides, drought and cold snaps. The number of disasters increased six-fold between 1990 and 2000. According to the national council on environmental issues, seven out of ten of these disasters were climate-conditioned – and it has to be feared that climate change, which is also directly related to anthropogenic environmental degradation, is going to further exacerbate the situation. The coast and the highlands are particularly affected by climate-conditioned disasters.

The coastal region is regularly stricken by the "El Niño" phenomenon, which involves heavy rainfall as well as considerable dryness. The 1997/1998 "Niño" resulted in damage amounting to 3.5 billion US dollars. This corresponds to roughly 4.5 percent of the Gross Domestic Product (Rosenberger 2007).

Climate change is posing new challenges: The rainy season, which used to last from November to April, has been shortened to the months from January to March. The streams that are important for irrigation in agriculture carry less water, and there is an unusual extent of hail as well as increased pest infestation in the country's more low-lying regions. Warming is evident especially at higher altitudes, and coincides with a marked shrinking of glaciers. "The area of the Peruvian Andes covered with ice diminished by 27 percent between 1970 and 2003," the Peruvian water authority announced (Der Standard 2009). The massive decline in water reserves that this caused as well as cold snaps and droughts are threatening the livelihoods of the local population. And this is occurring at a time when every second Peruvian is already living in poverty.

The growing intensity of solar radiation, which is leading to fields drying up, given simultaneously sinking groundwater levels, presents a further problem. Rainfall sets in at a later

stage, but then it comes as cloudbursts resulting in flooding that washes away the harvest and fertile soil. Crop failure is causing supply bottlenecks, and there is a growing threat of malnutrition. Smallholders who are no longer to able to feed their families adequately work as day laborers in plantations or in the cities.

The people of Peru have been familiar with difficult and changing living conditions for thousands of years. They have responded to this by breeding plant varieties adapted to the climate and practicing specialized cultivating methods in the mountain regions. Peru can still boast around 3,000 potato varieties that are adapted to the different climate and soil conditions. But for decades, ministries and international seed corporations have been calling for new, higher yielding varieties that have been optimized in laboratories, which is why many farmers are opting for the novelties. However, their growth depends much more strongly on additional input such as fertilizer and pesticides as well as a steady climate. If neither of these factors is guaranteed, the yields of the smallholders will decline drastically, and they will run into debt.

This is why terre des hommes has been supporting local organizations such as the association Bartolome Aripaylla (ABA) in the community of Quispillaqta with cultivating traditional varieties since the mid-1980s. This enables the smallholders to feed their families. In addition, as a rule, cultivating such varieties is environmentally friendly and healthy. In the community of Quispillaqta, near Ayacucho, ABA is helping to run seed fairs with financial support from terre des hommes. The adoption of Indio knowledge in the school curricula is being promoted. More than 6,500 peasant families as well as the city of Ayacucho with its 150.000 inhabitants are benefiting from the reafforestation of 481 hectares of new forest, soil conservation measures, the community maintenance of 1,600 water springs and the digging of 73 ponds.

disasters and/or disasters caused by, inter alia, industries, unsafe nuclear power generation and toxic wastes …"

In contrast, the relationships between disaster risk reduction and more comprehensive strategies for sustainable development were still receiving too little attention at the first Rio Conference. This was to change ten years later, at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002. In its final declaration, the governments describe a crisis scenario of growing environmental degradation and more and more frequent disasters owing to extreme natural events (Johannesburg Declaration on Sustainable Development). Setting out from this, they formulated a package of measures to reduce disaster risk and agreed to enhance the role of the United Nations Office for Disaster Risk Reduction (UNISDR) and step up its financing.

Three years later, at the World Conference on Disaster Reduction in Kobe, Japan, the general mission of the Johannesburg Summit was translated into a comprehensive ten-year action program that still represents the international key document in the field of disaster risk reduction today. In the Hyogo Framework for Action 2005–2015, the governments formulated the following strategic goals (UNISDR 2005, para. 12):

+ A more effective integration of disaster risk considerations into politics, planning and program development for sustainable development at all levels, with particular attention being given to the prevention or mitigation of disasters as well as being prepared for the occurrence of disasters and vulnerability reduction.

+ Developing and strengthening institutions, mechanisms and capacities at all levels, especially the community level, to systematically build resilience to "natural disasters".

+ The systematic integration of risk reduction approaches into the fleshing out and implementation of programs for emergency relief, coping and rehabilitation in the areas affected.

Thus the governments laid down the foundations for an integration of measures to reduce disaster risk into more comprehensive sustainable development strategies. However, progress made since then has remained limited. In the run-up to the "Rio+20" Conference, the United Nations noted in a Background Paper (UN DESA 2011): "Despite some progress, the implementation is still not sufficient given the fact that the world's exposure to natural hazards is growing faster than its vulnerability to these can be reduced. Effective implementation of the internationally agreed goals on disaster preparedness and resilience requires a cross-ministerial, multi-stakeholder and multi-hazard approach and there is still a long way to go to achieve this."

Disaster risk reduction as a Rio+20 Conference topic

Originally, no provisions had been made for disaster risk reduction as a topic on the agenda of the Rio+20 Conference. Rio+20 was to focus chiefly on two issues: the Green Economy in the context of sustainable development and poverty reduction and the institutional framework for sustainable development (UN 2009). But in the course of the preparation process for the Rio+20, the topic gained significance. The United Nations adopted "disaster readiness" in the list of seven priority areas of activity that were to be given special attention at Rio+20 (www.un.org/en/sustainablefuture).

In its report published end January 2012, the High-level Panel on Global Sustainability appointed by UN Secretary General Ban Ki-moon already addressed the target of enhancing the resilience of societies, also to natural events, in its title, "Resilient People, Resilient Planet" (UN Secretary-General's High Level Panel on Global Sustainability 2012). Especially with a view to the necessary adaptations to climate change, measures to reduce the risk of disasters were needed. The Panel noted (ibid., Item 134): "Disaster risk reduction is about much more than just emergency management – on the contrary, to be fully effective it must be integrated into all sectors of development and cover both measures to avoid disasters and measures to mitigate damage when they do occur."

As a conclusion from this, the Panel addressed three recommendations to the governments that were above all aimed at developing programs to cope with the social and economic impacts of disasters, compile regional vulnerability assessments and preventive strategies and increase finance for measures to reduce the risk of disasters.

The governments took up the topic in the preparatory process for the Rio+20 Conference in different ways. The Japanese Government has traditionally been particularly active in its efforts to reduce disaster risks ensuing from extreme natural events (Government of Japan 2011). In the run-up to Rio, it demanded that disaster risk reduction become one of the central pillars in national sustainable development policies. The Hyogo Framework for Action, which ends in 2015, the target year for the Millennium Development Goals (MDGs, see Box on page 61), ought to be replaced with a new agreement that needed to form an integral element of the post-2015 development agenda. This was aimed at ensuring a "mainstreaming of disaster risk reduction into development policies" (Government of Japan 2011).

Flanking Japan's activities, a group of "Friends of Disaster Risk Reduction" formed in the United Nations as a political lobby in the run-up to the Rio+20 Conference. It

was headed jointly by Australia, Indonesia, Norway and Peru. Its other members were Denmark, Ecuador, Mexico, Morocco, Mozambique, the Philippines, New Zealand, Switzerland and Timor Leste. Whereas large parts of the Conference were characterized by a confrontation between the classical negotiating blocs from the industrialized and developing countries, this group formed one of the few cross-bloc coalitions. In a joint statement, it stressed the urgent need for a reduction of the social, economic and ecological impacts of disasters caused by extreme natural events. With a view to the Outcome Document of the Rio+20 Conference, the group announced (Friends of Disaster Risk Reduction 2012):

"We call for strong and strategic language (…) that recognises disaster risk reduction as fundamental to achieving sustainable development and places it at the heart of the future development agenda."

In the positions held by the key negotiating actors of the Rio+20 Conference, the Group of 77 (G77), the European Union (EU) and the USA, this topic played a less prominent role:

+ The EU only mentioned "natural disasters" in the context of preserving coral reefs and the future range of tasks to be assigned to an upgraded UN Environmental Program (UNEP) (EU 2011, Chap. II, para. 70 and Chap. III, para. 21).

+ The USA argued the case for improved disaster preparedness and response, especially in the context of promoting sustainable cities and creating new, "green" jobs (United States 2011).

+ In its statement, the G77 only made general references to the corresponding passages in the Implementation Plan of Johannesburg, professed its "deep concerns" over the growing number and intensity of "natural disasters" and their long-term negative social, economic and ecological consequences, and stressed the obvious relationship between sustainable development, poverty reduction, climate change and disaster risk reduction (G77 2011, para. 15).

In the negotiations on the Outcome Document of the Rio+20 Conference, no grave controversies arose over the chapter on disaster risk reduction, unlike, for example, with the topics "Green Economy" and UNEP reform. However, Rio+20 failed to achieve a translation of the general appeals for better cooperation, coordination and financing of activities to reduce the risk of disasters into a concrete package of measures. This is obviously intended to be reserved for the further discussion process on the post-2015 development agenda and the follow-up agreement for the Hyogo Framework for Action.

In the Outcome Document of the Rio+20 Conference, the governments mainly focused on the following general statements (cf. Box):

+ Disaster risk reduction is to be integrated into the future development programs at all levels.

+ Early warning systems and risk assessment are to be improved, and international cooperation is to be stepped up in this sector.

+ The mutual relationships between disaster risk reduction and long-term development planning are to be considered in the context of comprehensive and better coordinated strategies.

+ A gender perspective is to be considered in all phases of disaster management.

Case study: Indonesia

Lowering the disaster risk with training

The island state of Indonesia is particularly strongly exposed to extreme weather events and comes 28th in the list of the most strongly exposed countries in the 2012 WorldRiskIndex. These forces of nature are a hazard to human lives, are destroying the environment and, moreover, are threatening local and national development initiatives. In addition to earthquakes and volcano eruptions owing to the country's location along the geological fault of the Pacific, it is above all climate change that has been leading to a dangerous increase in the frequency and intensity of extreme weather events. Environmental degradation is raising the population's vulnerability towards natural hazards. Especially the poor are affected.

Together with Diakonie Katastrophenhilfe, Brot für die Welt is campaigning for these people: in West Java, where the rising sea level and the filling up of soil with salt owing to seawater flowing in are threatening people's livelihoods, and in South Sulawesi, where clear-cutting for the development of cocoa plantations is raising the threat of landslides.

Together with partner organizations and the local population Brot für die Welt conducted risk analyses early in 2010, at the beginning of the project, which is scheduled for ten years. The inhabitants of South Sulawi identified the neglect of reafforestation by the authorities as the reason for the landslides that destroyed their fields and houses. They addressed the local authorities with demands for reafforestation and the establishment of forest conservation zones. The inhabitants of the villages in West Java were initially unable to do anything about seawater penetrating their wells and fields. However, in workshops, they learnt how to use new irrigation methods and no longer obtain their drinking water from the well but from springs lying at a higher level.

The aid programs directly assess more than 2,000 people each in the areas. Several times as many local people benefit indirectly, around 40,000 people in West Java and just under 20,000 people in South Sulawesi. The training programs were developed holistically for the population and for multipliers such as non-governmental organizations and local authorities. In this manner, the people affected learn what to do in a disaster event and familiarize themselves with measures to prevent damage through erosion and crop failure as well as methods to adapt agriculture and households in the threatened areas. This also includes generating and using regenerative energies (solar panels instead of kerosene lamps, biogas instead of wood firing, using hydropower).

Three major goals are being pursued with these projects:

+ **Adapting peasant lives and livelihoods to the changed conditions**

This includes research and training programs on organic farming, the rehabilitation of irrigation and drainage channels, the reafforestation of mangrove forests, the construction of community composting plants, the introduction of new species and varieties, especially regarding coffee and cocoa, and the introduction of organic kitchen gardens for self-supply and marketing.

+ **Empowering the population**

The setting up of peasant self-help groups, training in constructive conflict resolution (for conflict events in land use) and in disaster prevention, the establishment of community committees and the development of community-focused risk and emergency management prepare the population for extreme natural events and enable them to claim their rights.

+ **People's climate protection**

Research and development of alternative energy solutions as well as lobbying activities for the integration of climate protection measures into local and regional/national budget plans enhance the population's contribution to climate protection.

Integrating these local projects into a larger reference frame and communicating at regional and national as well as international level gives due consideration to the global significance that the threat posed by climate change has. But the chief actor is, and will continue to be, the local population making an effort to achieve safe and sustainable living conditions in their villages and regions.

Next steps towards the Post-2015 Development Agenda

The relationship between environmental degradation, poverty and disaster risk has received more attention in the context of the Rio+20 Conference. Australian Foreign Secretary Bob Carr already referred to an "unprecedented international momentum to reduce disaster risk" (Friends of Disaster Risk Reduction 2012) in the UN General Assembly in April 2012. In the following three years, it will be crucial to translate the political appeals formulated in the Rio+20 process into practical action in a Hyogo follow-up agreement.

The follow-up process after the Rio+20 Conference and the debates over the future of the MDGs and the post-2015 development agenda offer the opportunity to systematically consider the topic of "disaster risks" in these contexts. At the same time, the specific debates on this topic will continue to be held in the responsible international bodies and at special thematic conferences. Thus, over the next three years, there are going to be at least four parallel discussion and negation strands at global level:

+ The debates on a post-Hyogo agreement are going to reach an initial climax with the forth session of the Global Platform for Disaster Risk Reduction in Geneva, in May 2013. At the third World Conference on Disaster Reduction 2015 in Japan, they are to lead to the adoption of a follow-up agreement for the Hyogo Framework for Action.

+ Thanks to the appointment of a High-level Panel for the Post-2015 Development Agenda by UN Secretary General Ban Ki-moon in July 2012, the discussions over the future of the MDGs have gained momentum. The report by this Panel is to provide the basis for the next (and expected to be the last) "MDG Summit" of the UN General Assembly in fall 2013. The resolutions are to be put into concrete terms in the subsequent two years in order for the future UN development agenda to be passed at a further summit meeting in 2015.

+ As a result of the Rio+20 Conference, the UN General Assembly is to appoint a 30-member working group of government representatives in fall 2012 that is to develop a proposal for a future set of universal "Sustainable Development Goals" within a year's time. With specific targets and indicators, the new set of goals is to form a core element of the Post-2015 Development Agenda.

+ In the international climate negotiations, the governments committed themselves in the Durban Platform in December 2012 to negotiate a new climate agreement by 2015 that is also to include measures aimed at reducing the risk of disasters

Thus all these processes are to culminate in 2015. By then, the central challenge will be to systematically integrate these processes. The aim has to be to really turn disaster risk reduction into an integral element of a post-2015 development agenda.

Excerpt from the Final Document of the "Rio+20" Conference: „The future we want"

Disaster risk reduction

186. We reaffirm our commitment to the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters and call for States, the United Nations system, the international financial institutions, subregional, regional and international organizations and civil society to accelerate implementation of the Framework and the achievement of its goals. We call for disaster risk reduction and the building of resilience to disasters to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication, and, as appropriate, to be integrated into policies, plans, programmes and budgets at all levels and considered within relevant future frameworks. We invite governments at all levels as well as relevant subregional, regional and international organizations to commit to adequate, timely and predictable resources for disaster risk reduction in order to enhance the resilience of cities and communities to disasters, according to their own circumstances and capacities.

187. We recognize the importance of early warning systems as part of effective disaster risk reduction at all levels in order to reduce economic and social damages, including the loss of human life, and in this regard encourage States to integrate such systems into their national disaster risk reduction strategies and plans. We encourage donors and the international community to enhance international cooperation in support of disaster risk reduction in developing countries, as appropriate, through technical assistance, technology transfer as mutually agreed, capacity-building and training programmes.

We further recognize the importance of comprehensive hazard and risk assessments, and knowledge- and information- sharing, including reliable geospatial information. We commit to undertake and strengthen in a timely manner risk assessment and disaster risk reduction instruments.

188. We stress the importance of stronger interlinkages among disaster risk reduction, recovery and long-term development planning, and call for more coordinated and comprehensive strategies that integrate disaster risk reduction and climate change adaptation considerations into public and private investment, decision-making and the planning of humanitarian and development actions, in order to reduce risk, increase resilience and provide a smoother transition between relief, recovery and development. In this regard, we recognize the need to integrate a gender perspective into the design and implementation of all phases of disaster risk management.

189. We call for all relevant stakeholders, including Governments, international, regional and subregional organizations, the private sector and civil society, to take appropriate and effective measures, taking into account the three dimensions of sustainable development, including through strengthening coordination and cooperation to reduce exposure to risk for the protection of people, and infrastructure and other national assets, from the impact of disasters, in line with the Hyogo Framework for Action and any post-2015 framework for disaster risk reduction.

(United Nations General Assembly 2012)

4. Disaster risk reduction – a key element of global sustainability policy

Peter Mucke, Jens Martens, Katrin Radtke

Political awareness of the relationships between environmental degradation, poverty and disaster risks has grown in the context of the UN Summit on Sustainable Development ("Rio+20"). It was urgently necessary for this to happen, for to a growing extent, disasters are being aggravated by intrusions of human beings into nature such as the overcultivation of land, deforestation and clear-cutting of coastal vegetation, the destruction of coral reefs or river regulation. With progressive climate change, the disaster risk is set to further increase. The threat of uncontrollable new technologies (such as in the context of "geo-engineering") and an insistence upon highly risky obsolete technologies (such as nuclear power) are additionally exacerbating the risk of disasters.

Not only do large-scale disasters cause immense human suffering, they also create massive costs for the economy. Within next to no time, they can wipe out years of progress in development. Thus the reduction of disasters is both a moral imperative and an economic necessity. It is a basic precondition for sustainable development and requires greater coordinated action from the local to the global level.

In the past, disaster prevention and immediate disaster relief was often treated in isolation from longer-term strategies for sustainable development. Even today, this is reflected in separate political responsibilities and institutional competences. A growing number of governments and civil society organizations have learned lessons from the deficits in coherence and coordination and are now calling for activities to reduce disaster risk to be fully integrated into more comprehensive strategies and policies of sustainable development. The Rio+20 process has provided a political forum for these demands.

In the coming three years, it will be crucial to translate the political demands made there into practical action, agree a follow-up agreement for the anti-disaster program of Hyogo and adopt its disaster risk reduction strategies as an integral element of the new, Post-2015 Development Agenda and the climate negotiations.

Alliance Development Works demands that any Post-Hyogo Agreement should be based on four general goals that are oriented on the four components of the WorldRiskIndex:

1. Reducing the threat of extreme natural events:
In order to eliminate the root causes of growing disaster risks, there is a particular need for effective measures to mitigate climate change and counter the degradation of soils and vegetation.

2. Reducing structural vulnerability:
This above all calls for improvements in the social and economic living conditions of vulnerable people. Measures here comprise combating poverty and hunger and reducing income disparities.

3. Raising the capacities to cope with disasters:
This includes strengthening public institutions and developing social security systems, but also the stepping up of disaster preparedness and early warning.

4. Improving measures to adapt to disaster risks:
These comprise investments in more resilient infrastructure and ecosystems as well as improvements in education and research and equal participation of people threatened by disasters in political decision-making processes.

On the basis of this general set of goals, elements for the Post-Hyogo Agreement and the new Development Agenda that the governments ought to resolve include:

+ Realizing a human right to disaster preparedness:
The basic rights of people in the event of a disaster are, inter alia, governed by the Universal Declaration of Human Rights (particularly Articles 3 and 25) and the International Covenant on Economic, Social and Cultural Rights (the Social Pact). The principles of the 1992 Rio Declaration and the Millennium Declaration of 2000 – in particular the polluter principle (with regard to responsibility for climate change), the principle of common but differentiated responsibilities as well as the solidarity principle – are quite clear: People affected by disasters have a right to support, and disaster risk reduction is not merely a humanitarian challenge for governments but also a human rights obligation.

+ Improving the disaster information base:
Sufficient information is of essential importance to preventing and coping with disasters. For this reason, governments ought to systematically make risk assessments, establish threat potentials, compile contingency plans and calculate the costs of possible disasters ex ante. Also, all private enterprises potentially affected by disasters ought to be obliged to conduct corresponding risk assessments. This applies in particular prior to the introduction of new, as yet untested technologies that could have a massive ecological impact, such as forms of "geo-engineering". All this information ought to be provided to the public free of charge. In the event of a disaster, it is also important for the public and the media to be supplied with comprehensive and immediate information. An independent checking of information has to be ensured.

+ Ensuring equal participation:
In order to enhance adaptability to environmental change and raise coping capacities in the event of a disaster, the people affected have to be comprehensively integrated into the political decision-making processes at community and national level, with equal participation of women being ensured. This also applies to the coordination and allocation of disaster relief. Here, the basis for decision-making includes gender studies and statistics that can be broken down according to gender, too.

+ Setting standards to make infrastructure disaster-proof:
In order to reduce vulnerability to disasters and reduce the extent of potential harm and damage, physical infrastructure in the respective regions has to be made disaster-proof. One precondition for this is adequate construction and safety standards for buildings, bridges, roads, etc. Complying with them has to be systematically monitored in the countries at risk, and should the need arise, it has to be financially supported via the

Terms used in the Post-2015 Development Agenda

Millennium Development Goals

In 2000, the heads of states and governments from more than 150 countries adopted the United Nations Millennium Declaration. One of the items it contained was a set of internationally agreed development goals that were to subsequently become referred to as the "Millennium Development Goals" (MDGs) and act as a guiding concept in international development politics. With them, the discourse on development focused on addressing the most extreme forms of poverty and hunger and on basic social provisions for the population, especially in the fields of primary education, health and water supply. Most of the MDGs are linked to clear quantitative, and therefore verifiable, objectives that are to be reached by 2015. Together with what are now 21 sub-targets and 60 indicators, the eight MDGs form an important reference frame for poverty reduction and development. However, they also bear severe shortcomings, for the structural framework conditions of development remain just as much in the dark in the MDG catalogue as the ecological dimension of development does. Neither do human rights, democracy or good governance play any substantial role. Finally, the modes of consumption and production of the industrialized countries, with their grave consequences regarding climate change and the increase in the risk of disasters, are not addressed in the MDGs. At the 2010 "MDG Summit", the governments commissioned the UN Secretary General with the task of developing proposals on the future of the MDGs and the United Nations Development Agenda after 2015. Since then, intensive debates have started on the Post-2015 Development Agenda. In parallel, at the

Rio+20 Summit, the governments resolved to formulate universal Sustainable Development Goals (SDGs). As yet, it remains unclear how this process is to be combined with the discussions over the Post-2015 Development Agenda. The Outcome Document of Rio merely states that the processes are to develop in a "coordinated and coherent" manner.

Hyogo Framework for Action

The Hyogo Framework for Action (HFA) was the central outcome of the second World Conference on Disaster Reduction in Kobe, in 2005 (UNISDR 2005). It was signed by 168 member states. The HFA is a ten-year plan aimed basically at substantially reducing losses resulting from extreme natural events. The HFA defines five priorities for action that are to contribute to disaster risk reduction: 1. Ensuring that disaster risk reduction becomes a national priority and a strong institutional basis for implementation is established. 2. Identifying, monitoring and assessing the respective disaster risk. 3. Supporting early warning. 4. Taking advantage of knowledge, innovation and education to develop a culture of security and resilience at all levels. 5. Reducing the risk factors behind disasters and strengthening disaster preparedness in order to enable an effective response at all levels. Thus the HFA is the first plan to describe processes in detail that are necessary in the various sectors to reduce disaster risk. The implementation of the HFA is being coordinated by the Secretariat of the United Nations International Strategy for Disaster Reduction (UNISDR), which regularly reports on progress made in putting the plan into practice.

Rio Conference 1992

The UN Conference on Environment and Development", (UNCED) in Rio de Janeiro is regarded as a milestone in the international discussion on sustainable development. At the time, this meeting, which is also referred to as the "Earth Summit", was the largest international conference in human history. The official results of the Earth Summit were the Rio Declaration on Environment and Development, the Agenda 21, the conventions on climate change and biological diversity negotiated in the run-up to the Conference and a forest declaration containing principles of forest management and forest conservation.

public budget and international development cooperation.

+ Integrating disaster risk reduction in development planning:
All sustainable development strategies ought to serve the goal of reducing the risk of disasters, too. This applies both to the countries immediately exposed to extreme natural events and those indirectly influencing hazards via their policies (for example their climate policies). There are items to set out from in all policy areas. For example, consistent measures to protect the climate and the prevention of an overexploitation of forests and soil erosion can reduce the hazard potential. Public investment in rural development, the preservation of ecosystems and sustainable urban development can reduce structural susceptibility to disasters. Improving government disaster preparedness, the setting up of public early warning systems, an across-the-board development of the public health system and the establishment of social security systems raise capacities to cope with disasters.

+ Sufficient finance for disaster risk reduction:
Disaster risk reduction is not free of charge. But increasing investment in disaster preparedness saves a multiple of costs arising for coping and rehabilitation once a disaster has set in. Greater public investment in disaster preparedness therefore also makes sense for the economy as a whole. This applies to the public budgets of the countries affected, which ought to provide more finance for disaster risk reduction. But it also applies to international development cooperation. For here too, given the need for emergency relief and rehabilitation support after a disaster has set in, each euro spent in projects on disaster preparedness will save higher costs. Moreover, financial support is not merely a charity issue but is also one of economic reason – as well as being a human rights and international law obligation. For not only is it the extraterritorial duty of states to provide support. It generally applies that,

in accordance with the "polluter pays principle", those countries are held liable for harm and damage that have caused it. First and foremost, in the case of aggravated disasters (flooding, droughts, etc.) caused by climate change, these tend to be the traditional industrialized countries.

+ Strategically and institutionally enhancing policy coherence:
Reducing disaster risk is a cross-sectoral task for politics to address. At international level, this has to imply that this task is considered in all debates on global sustainability and the new, Post-2015 Development Agenda. That at least a few modest steps into this direction have been made at the Rio+20 Summit is a positive signal. However, the European Union in particular ought to give this topic higher political priority in the ongoing and future international negotiations than it has done so far. Above all, the governments ought to see to it that disaster risk reduction is established in the agenda of the new High Level Political Forum for Sustainable Development. But at national level too, this topic ought to be integrated into the respective sustainability strategies. To enhance policy coherence, attention also ought to be given to overcome the institutional separating of development cooperation and disaster relief/humanitarian aid into different ministries – as is the case in Germany, for example.

+ Including disaster risk reduction in the future set of global sustainability goals:
In order to make disaster preparedness and coping with disasters an integral element of a Post-2015 Development Agenda, it would make sense to consider the issue in a future set of global sustainability goals, too. Although a large number of potential goals, for example in the field of poverty eradication, reducing income disparities and limiting per capita CO2 emissions, also implicitly serve the reduction of vulnerability and hazards, they ought to be supplemented by specific

In its core, the Rio Declaration stresses the holistic character of development by combining environmental, social and economic goals, as well as social participation and democracy. One of the chief causes of global problems has been seen in the unsustainable production and consumption patterns in the rich countries. It is from this that the principle of common but differentiated responsibilities, established in the Rio Declaration, follows for the preservation of the Earth's ecosystems. In this principle, the industrialized countries acknowledged for the first time "the responsibility that they bear in the international pursuit to sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command" (Rio Declaration, Principle 7). This principle is also of considerable importance in the debate on disaster risk reduction.

Climate negotiations and the Kyoto Protocol

The climate negotiations at international level are also of considerable importance to disaster risk reduction. The chief basis is the UN Framework Convention on Climate Change, which the United Nations adopted in 1992. Concrete measures are negotiated in particular in the context of the annual Conference of Parties (COP) by the current 194 states party to the convention.

The valid contractual basis is the so-called Kyoto Protocol of 1997. One of the items that the states party to this Protocol agreed in the Japanese city of Kyoto was to reduce the emissions of six of the most important greenhouse gases by 2012. Intensive discussions have been held on a follow-up agreement and further commitment periods in

the context of the ongoing climate negotiations, recently at COP 17 in Durban end 2011.

The agreement reached there that the community of states negotiate a new agreement by 2015 that would then enter force by 2020 at the latest is expected to lead the way forward. The next stage on this route is the Climate Summit in Qatar from 26th November to 7th December 2012 (COP 18), which will be a yardstick for the seriousness of the further negotiation process. However, the schedule, extent and distribution of greenhouse gas reductions, especially between the emerging economies and the industrialized countries, continue to be controversial. These items are to be settled in Qatar.

The goal of the negotiation has to be to lower global warming to below two degrees Celsius (compared to the level before the beginning of industrialization). For this is the only way in which negative impacts of climate change can be checked according to the present level of knowledge. However, the current developments in global emissions, forest degradation and consumption and production patterns in industry and agriculture suggest that there will be cause to fear a rise in temperature of four to six degrees Celsius by the end of the century.

It was also decided to compile a "Review" in Durban with the aid of which the currently agreed climate protection goals and the implementation strategies of the respective countries are to be assessed by 2015, particularly from the angle of whether they are appropriate to state-of-the-art insights in climatology.

Essential scientific foundations for these consultations will be provided by the Fifth Assessment Report of the International Panel on Climate Change (IPCC), scheduled to be published as three Report sections in 2013 and 2014. The crucial question here is whether the Assessment Report will give new impetus to scientific impulses for the negotiations.

targets for disaster preparedness and coping with disasters. For example, such targets could relate to the setting up of national early warning systems and the conducting of risk assessments, financing disaster preparedness and disaster relief and the systematic introduction of disaster-proof building regulations. Whereas the framework for global sustainability goals ought apply universally, the specific sub-targets should be adapted to the local conditions and defined by the population living there.

The follow-up process after the Rio+20 Summit, the international climate negotiations and the increasingly intensive debates on the future of the Millennium Development Goals (MDGs) and the Post-2015 Development Agenda offer an opportunity to also systematically consider the topic of "disaster risks" in these contexts.

In the following three years, it will be crucial to demonstrate the will professed again and again to overcome a sector-related "silo mentality" and systematically interlink the various negotiation and discussion processes. The aim has to be to really turn disaster risk reduction into an integral element of the new Development Agenda.

Country	WRI	Rank
Afghanistan	9.79 %	40.
Albania	9.96 %	38.
Algeria	8.15 %	56.
Angola	6.56 %	88.
Argentina	3.80 %	133.
Armenia	7.04 %	79.
Australia	4.57 %	117.
Austria	3.75 %	135.
Azerbaijan	6.10 %	98.
Bahamas	4.17 %	125.
Bahrain	1.81 %	166.
Bangladesh	20.22 %	5.
Barbados	1.15 %	171.
Belarus	3.32 %	145.
Belgium	3.48 %	142.
Belize	6.63 %	86.
Benin	11.42 %	27.
Bhutan	8.17 %	55.
Bolivia	5.13 %	110.
Bosnia and Herzeg.	6.63 %	86.
Botswana	5.21 %	109.
Brazil	4.30 %	124.
Brunei Darussalam	15.92 %	11.
Bulgaria	4.56 %	118.
Burkina Faso	9.74 %	41.
Burma	9.15 %	42.
Burundi	10.49 %	36.
Cambodia	17.17 %	8.
Cameroon	11.50 %	26.
Canada	3.18 %	150.
Cape Verde	10.88 %	32.
Central African Rep.	6.64 %	85.
Chad	11.13 %	28.
Chile	12.26 %	19.
China	7.05 %	78.
Colombia	6.89 %	81.
Comoros	7.45 %	68.
Congo	7.38 %	71.
Costa Rica	17.38 %	7.
Côte d'Ivoire	9.00 %	44.
Croatia	4.35 %	123.
Cuba	6.55 %	89.
Cyprus	2.81 %	152.
Czech Republic	3.67 %	138.
Denmark	3.09 %	151.
Djibouti	9.96 %	37.
Dominican Republic	11.63 %	25.
Ecuador	7.94 %	58.
Egypt	2.33 %	161.
El Salvador	16.89 %	10.
Equatorial Guinea	4.47 %	121.
Eritrea	6.44 %	92.
Estonia	2.50 %	159.
Ethiopia	7.81 %	62.
Fiji	13.69 %	15.
Finland	2.24 %	163.
France	2.78 %	153.
Gabon	6.20 %	96.
Gambia	11.84 %	23.
Georgia	6.75 %	84.
Germany	3.27 %	146.
Ghana	8.85 %	45.
Greece	7.35 %	72.
Grenada	1.46 %	169.
Guatemala	20.75 %	4.
Guinea	8.55 %	49.
Guinea-Bissau	13.34 %	17.
Guyana	11.77 %	24.
Haiti	11.96 %	21.
Honduras	11.02 %	30.
Hungary	5.87 %	102.
Iceland	1.53 %	168.
India	7.28 %	73.
Indonesia	10.74 %	33.
Iran	4.98 %	112.
Iraq	4.95 %	113.
Ireland	4.50 %	120.
Israel	2.43 %	160.
Italy	4.82 %	116.
Jamaica	12.15 %	20.
Japan	13.53 %	16.
Jordan	4.90 %	114.
Kazakhstan	3.87 %	128.
Kenya	6.96 %	80.
Kiribati	1.78 %	167.
Korea, Republic of	4.89 %	115.
Kuwait	3.71 %	136.
Kyrgyzstan	8.50 %	50.
Lao P. D. Rep.	5.73 %	103.
Latvia	3.51 %	141.
Lebanon	5.10 %	111.
Lesotho	7.22 %	75.
Liberia	7.86 %	60.
Libyan Arab Jam.	3.80 %	133.
Lithuania	3.23 %	148.
Luxembourg	2.65 %	155.
Madagascar	10.96 %	31.
Malawi	8.18 %	54.
Malaysia	6.53 %	91.
Mali	8.76 %	46.
Malta	0.61 %	172.
Mauritania	8.43 %	52.
Mauritius	15.39 %	13.
Mexico	6.39 %	94.
Mongolia	3.24 %	147.
Morocco	7.21 %	76.
Mozambique	9.09 %	43.
Namibia	5.72 %	104.
Nepal	5.69 %	105.
Netherlands	8.49 %	51.
New Zealand	4.44 %	122.
Nicaragua	15.36 %	14.
Niger	11.93 %	22.
Nigeria	8.28 %	53.
Norway	2.31 %	162.
Oman	2.72 %	154.
Pakistan	7.25 %	74.
Panama	7.69 %	64.
Papua New Guinea	15.81 %	12.
Paraguay	3.84 %	129.
Peru	7.18 %	77.
Philippines	27.98 %	3.
Poland	3.53 %	140.
Portugal	3.82 %	131.
Qatar	0.10 %	173.
Rep. of Moldova	5.23 %	108.
Romania	6.78 %	82.
Russia	3.83 %	130.
Rwanda	7.60 %	67.
Samoa	4.51 %	119.
S. Tome a. Principe	3.40 %	143.
Saudi Arabia	1.31 %	170.
Senegal	11.08 %	29.
Serbia	7.67 %	66.
Seychelles	2.60 %	156.
Sierra Leone	10.58 %	35.
Singapore	2.54 %	158.
Slovakia	3.69 %	137.
Slovenia	3.81 %	132.
Solomon Islands	18.15 %	6.
South Africa	5.90 %	100.
Spain	3.40 %	143.
Sri Lanka	7.79 %	63.
Sudan	7.88 %	59.
Suriname	8.62 %	48.
Swaziland	7.84 %	61.
Sweden	2.15 %	164.
Switzerland	2.59 %	157.
Syrian Arab Republic	5.68 %	106.
Tajikistan	7.40 %	70.
Thailand	6.44 %	92.
Rep. of Macedonia	6.25 %	95.
Timor-Leste	17.13 %	9.
Togo	10.64 %	34.
Tonga	28.62 %	2.
Trinidad a. Tobago	7.68 %	65.
Tunisia	5.90 %	100.
Turkey	5.68 %	106.
Turkmenistan	6.55 %	89.
Uganda	6.75 %	83.
Ukraine	3.19 %	149.
Uni. Arab Emirates	2.07 %	165.
United Kingdom	3.65 %	139.
U. Rep. o. Tanzania	8.11 %	57.
United States o. A.	3.99 %	127.
Uruguay	4.12 %	126.
Uzbekistan	8.71 %	47.
Vanuatu	36.31 %	1.
Venezuela	6.13 %	97.
Viet Nam	12.88 %	18.
Yemen	5.98 %	99.
Zambia	7.44 %	69.
Zimbabwe	9.87 %	39.

Countries not listed in the WorldRiskIndex

- Andorra
- Antigua and Barbuda
- Dem. People's Republic of Korea
- Democratic Republic of the Congo
- Dominica
- Federated States of Micronesia
- Liechtenstein
- Maldives
- Marshall Islands
- Monaco
- Montenegro
- Nauru
- Palau
- San Marino
- Somalia
- St. Kitts and Nevis
- St. Lucia
- St. Vincent and the Grenadines
- Tuvalu

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
1.	Vanuatu	36.31 %	63.66 %	57.04 %	34.17 %	81.19 %	55.78 %
2.	Tonga	28.62 %	55.27 %	51.78 %	27.91 %	81.31 %	46.11 %
3.	Philippines	27.98 %	52.46 %	53.35 %	33.92 %	83.09 %	43.03 %
4.	Guatemala	20.75 %	36.30 %	57.16 %	37.28 %	81.18 %	53.04 %
5.	Bangladesh	20.22 %	31.70 %	63.78 %	43.47 %	86.84 %	61.03 %
6.	Solomon Islands	18.15 %	29.98 %	60.55 %	43.96 %	84.26 %	53.42 %
7.	Costa Rica	17.38 %	42.61 %	40.80 %	21.59 %	65.63 %	35.19 %
8.	Cambodia	17.17 %	27.65 %	62.07 %	45.93 %	86.68 %	53.61 %
9.	Timor-Leste	17.13 %	25.73 %	66.59 %	52.88 %	87.58 %	59.32 %
10.	El Salvador	16.89 %	32.60 %	51.82 %	28.92 %	76.71 %	49.82 %
11.	Brunei Darussalam	15.92 %	41.10 %	38.72 %	14.57 %	65.66 %	35.94 %
12.	Papua New Guinea	15.81 %	24.94 %	63.38 %	49.03 %	84.85 %	56.27 %
13.	Mauritius	15.39 %	37.35 %	41.21 %	18.99 %	62.04 %	42.60 %
14.	Nicaragua	15.36 %	27.23 %	56.43 %	38.41 %	82.68 %	48.21 %
15.	Fiji	13.69 %	27.71 %	49.40 %	26.19 %	75.32 %	46.67 %
16.	Japan	13.53 %	45.91 %	29.46 %	16.52 %	36.31 %	35.56 %
17.	Guinea-Bissau	13.34 %	19.65 %	67.88 %	55.49 %	88.48 %	59.68 %
18.	Viet Nam	12.88 %	25.35 %	50.83 %	29.20 %	76.73 %	46.56 %
19.	Chile	12.26 %	30.95 %	39.60 %	20.95 %	57.84 %	40.01 %
20.	Jamaica	12.15 %	25.82 %	47.06 %	26.49 %	72.49 %	42.21 %
21.	Haiti	11.96 %	16.26 %	73.54 %	62.70 %	90.43 %	67.48 %
22.	Niger	11.93 %	15.87 %	75.17 %	64.87 %	88.73 %	71.93 %
23.	Gambia	11.84 %	19.29 %	61.41 %	44.40 %	82.19 %	57.63 %
24.	Guyana	11.77 %	22.90 %	51.40 %	29.25 %	79.79 %	45.16 %
25.	Dominican Republic	11.63 %	23.14 %	50.23 %	30.00 %	75.74 %	44.96 %
26.	Cameroon	11.50 %	18.19 %	63.23 %	45.57 %	85.10 %	59.01 %
27.	Benin	11.42 %	17.06 %	66.93 %	53.91 %	83.88 %	63.00 %
28.	Chad	11.13 %	14.89 %	74.74 %	64.69 %	91.80 %	67.74 %
29.	Senegal	11.08 %	17.57 %	63.07 %	46.97 %	82.47 %	59.76 %
30.	Honduras	11.02 %	20.01 %	55.09 %	36.19 %	81.68 %	47.40 %
31.	Madagascar	10.96 %	16.03 %	68.37 %	64.39 %	83.07 %	57.66 %
32.	Cape Verde	10.88 %	20.26 %	53.72 %	36.13 %	70.64 %	54.39 %
33.	Indonesia	10.74 %	19.36 %	55.48 %	35.45 %	82.16 %	48.83 %
34.	Togo	10.64 %	15.56 %	68.39 %	56.15 %	86.52 %	62.51 %
35.	Sierra Leone	10.58 %	14.65 %	72.20 %	62.48 %	87.48 %	66.64 %
36.	Burundi	10.49 %	15.13 %	69.32 %	61.99 %	89.53 %	56.44 %
37.	Djibouti	9.96 %	16.34 %	60.98 %	40.34 %	82.94 %	59.66 %
38.	Albania	9.96 %	21.25 %	46.89 %	20.73 %	74.67 %	45.26 %
39.	Zimbabwe	9.87 %	14.96 %	65.97 %	58.45 %	87.74 %	51.73 %
40.	Afghanistan	9.79 %	13.17 %	74.32 %	56.63 %	92.07 %	74.26 %
41.	Burkina Faso	9.74 %	14.32 %	68.00 %	54.81 %	84.86 %	64.32 %
42.	Burma	9.15 %	14.87 %	61.57 %	36.70 %	89.82 %	58.18 %
43.	Mozambique	9.09 %	12.73 %	71.37 %	67.63 %	84.91 %	61.58 %
44.	Côte d'Ivoire	9.00 %	13.67 %	65.84 %	47.34 %	88.55 %	61.64 %
45.	Ghana	8.85 %	14.48 %	61.12 %	47.12 %	79.06 %	57.16 %
46.	Mali	8.76 %	12.55 %	69.76 %	56.57 %	82.87 %	69.85 %
47.	Uzbekistan	8.71 %	16.18 %	53.84 %	32.33 %	77.85 %	51.35 %
48.	Suriname	8.62 %	18.12 %	47.60 %	30.01 %	73.27 %	39.53 %
49.	Guinea	8.55 %	12.03 %	71.05 %	58.08 %	90.16 %	64.91 %
50.	Kyrgyzstan	8.50 %	16.63 %	51.10 %	27.54 %	77.79 %	47.98 %
51.	Netherlands	8.49 %	30.57 %	27.76 %	13.89 %	39.14 %	30.26 %
52.	Mauritania	8.43 %	12.47 %	67.55 %	49.04 %	86.54 %	67.07 %
53.	Nigeria	8.28 %	12.06 %	68.70 %	55.46 %	88.00 %	62.63 %
54.	Malawi	8.18 %	12.34 %	66.25 %	56.28 %	85.31 %	57.15 %
55.	Bhutan	8.17 %	14.81 %	55.14 %	35.06 %	77.31 %	53.05 %
56.	Algeria	8.15 %	15.82 %	51.48 %	22.50 %	78.46 %	53.48 %
57.	United Republic of Tanzania	8.11 %	12.01 %	67.52 %	67.34 %	83.49 %	51.73 %
58.	Ecuador	7.94 %	16.15 %	49.19 %	26.80 %	76.93 %	43.85 %

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
59.	Sudan	7.88 %	11.86 %	66.45 %	52.44 %	91.70 %	55.22 %
60.	Liberia	7.86 %	10.96 %	71.74 %	65.11 %	85.88 %	64.22 %
61.	Swaziland	7.84 %	12.76 %	61.41 %	47.48 %	82.07 %	54.69 %
62.	Ethiopia	7.81 %	11.12 %	70.21 %	58.93 %	88.34 %	63.37 %
63.	Sri Lanka	7.79 %	14.79 %	52.67 %	28.28 %	80.45 %	49.29 %
64.	Panama	7.69 %	16.45 %	46.74 %	29.46 %	68.89 %	41.86 %
65.	Trinidad and Tobago	7.68 %	17.54 %	43.77 %	18.87 %	70.58 %	41.88 %
66.	Serbia	7.67 %	18.05 %	42.52 %	18.77 %	68.33 %	40.46 %
67.	Rwanda	7.60 %	11.98 %	63.43 %	58.47 %	80.26 %	51.54 %
68.	Comoros	7.45 %	10.97 %	67.91 %	56.70 %	83.73 %	63.30 %
69.	Zambia	7.44 %	11.37 %	65.46 %	61.81 %	81.26 %	53.31 %
70.	Tajikistan	7.40 %	12.98 %	56.99 %	37.25 %	76.31 %	57.42 %
71.	Congo	7.38 %	11.65 %	63.37 %	52.14 %	86.41 %	51.54 %
72.	Greece	7.35 %	21.11 %	34.83 %	16.55 %	52.27 %	35.67 %
73.	India	7.28 %	11.94 %	60.95 %	40.88 %	81.78 %	60.18 %
74.	Pakistan	7.25 %	11.36 %	63.86 %	38.84 %	87.39 %	65.35 %
75.	Lesotho	7.22 %	11.40 %	63.33 %	50.87 %	81.83 %	57.30 %
76.	Morocco	7.21 %	13.25 %	54.45 %	29.07 %	76.42 %	57.86 %
77.	Peru	7.18 %	14.40 %	49.84 %	30.81 %	74.93 %	43.77 %
78.	China	7.05 %	14.43 %	48.83 %	28.58 %	71.53 %	46.39 %
79.	Armenia	7.04 %	14.51 %	48.49 %	24.02 %	70.95 %	50.51 %
80.	Kenya	6.96 %	10.69 %	65.09 %	52.90 %	86.56 %	55.80 %
81.	Colombia	6.89 %	13.84 %	49.80 %	29.73 %	76.89 %	42.76 %
82.	Romania	6.78 %	15.77 %	42.99 %	22.06 %	63.95 %	42.95 %
83.	Uganda	6.75 %	10.16 %	66.43 %	56.61 %	88.11 %	54.59 %
84.	Georgia	6.75 %	14.69 %	45.94 %	24.17 %	65.46 %	48.18 %
85.	Central African Republic	6.64 %	9.39 %	70.69 %	61.52 %	89.44 %	61.12 %
86.	Bosnia and Herzegovina	6.63 %	14.02 %	47.31 %	19.47 %	73.88 %	48.58 %
87.	Belize	6.63 %	13.31 %	49.81 %	28.16 %	74.31 %	46.94 %
88.	Angola	6.56 %	10.18 %	64.45 %	56.15 %	85.28 %	51.91 %
89.	Cuba	6.55 %	17.45 %	37.54 %	19.20 %	58.95 %	34.48 %
90.	Turkmenistan	6.55 %	13.19 %	49.65 %	24.02 %	76.23 %	48.71 %
91.	Malaysia	6.53 %	14.60 %	44.74 %	20.87 %	70.30 %	43.04 %
92.	Thailand	6.44 %	13.70 %	47.03 %	21.96 %	76.42 %	42.72 %
92.	Eritrea	6.44 %	8.55 %	75.35 %	66.62 %	86.76 %	72.68 %
94.	Mexico	6.39 %	13.84 %	46.15 %	23.75 %	71.59 %	43.12 %
95.	The former Yugoslav Republic of Macedonia	6.25 %	14.38 %	43.47 %	20.66 %	66.13 %	43.63 %
96.	Gabon	6.20 %	11.95 %	51.90 %	33.01 %	81.54 %	41.14 %
97.	Venezuela	6.13 %	13.15 %	46.62 %	23.44 %	74.59 %	41.84 %
98.	Azerbaijan	6.10 %	13.16 %	46.34 %	22.86 %	67.61 %	48.54 %
99.	Yemen	5.98 %	9.04 %	66.13 %	47.89 %	88.92 %	61.58 %
100.	Tunisia	5.90 %	12.45 %	47.38 %	22.52 %	72.15 %	47.46 %
100.	South Africa	5.90 %	12.08 %	48.83 %	31.36 %	69.85 %	45.26 %
102.	Hungary	5.87 %	15.61 %	37.61 %	16.18 %	55.28 %	41.38 %
103.	Lao People's Dem. Republic	5.73 %	9.55 %	60.03 %	43.34 %	85.60 %	51.14 %
104.	Namibia	5.72 %	10.41 %	54.96 %	46.26 %	72.11 %	46.51 %
105.	Nepal	5.69 %	9.16 %	62.19 %	48.06 %	82.74 %	55.76 %
106.	Syrian Arab Republic	5.68 %	10.56 %	53.81 %	27.35 %	80.19 %	53.88 %
106.	Turkey	5.68 %	12.25 %	46.35 %	19.80 %	69.87 %	49.40 %
108.	Republic of Moldova	5.23 %	11.11 %	47.06 %	23.53 %	70.83 %	46.83 %
109.	Botswana	5.21 %	10.55 %	49.40 %	31.97 %	68.77 %	47.46 %
110.	Bolivia	5.13 %	8.98 %	57.13 %	43.63 %	80.34 %	47.43 %
111.	Lebanon	5.10 %	11.14 %	45.75 %	20.40 %	70.20 %	46.64 %
112.	Iran (Islamic Republic of)	4.98 %	10.19 %	48.85 %	18.36 %	79.75 %	48.43 %
113.	Iraq	4.95 %	8.08 %	61.20 %	37.49 %	88.83 %	57.27 %
114.	Jordan	4.90 %	10.53 %	46.50 %	24.38 %	68.85 %	46.28 %
115.	Korea, Republic of	4.89 %	14.89 %	32.84 %	14.37 %	45.61 %	38.54 %

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
116.	Italy	4.82 %	13.85 %	34.78 %	16.05 %	54.84 %	33.44 %
117.	Australia	4.57 %	15.05 %	30.38 %	14.39 %	41.87 %	34.88 %
118.	Bulgaria	4.56 %	11.66 %	39.11 %	16.90 %	59.31 %	41.11 %
119.	Samoa	4.51 %	9.10 %	49.58 %	27.91 %	73.83 %	47.00 %
120.	Ireland	4.50 %	14.74 %	30.54 %	14.98 %	42.26 %	34.38 %
121.	Equatorial Guinea	4.47 %	8.22 %	54.37 %	26.40 %	85.65 %	51.06 %
122.	New Zealand	4.44 %	15.44 %	28.77 %	16.13 %	39.79 %	30.39 %
123.	Croatia	4.35 %	11.53 %	37.73 %	17.16 %	59.65 %	36.39 %
124.	Brazil	4.30 %	9.53 %	45.18 %	25.31 %	68.39 %	41.83 %
125.	Bahamas	4.17 %	10.71 %	38.99 %	17.27 %	57.10 %	42.59 %
126.	Uruguay	4.12 %	11.10 %	37.06 %	20.69 %	51.31 %	39.19 %
127.	United States	3.99 %	12.25 %	32.57 %	16.67 %	48.48 %	32.55 %
128.	Kazakhstan	3.87 %	9.11 %	42.47 %	18.53 %	62.22 %	46.66 %
129.	Paraguay	3.84 %	7.03 %	54.56 %	32.92 %	79.63 %	51.14 %
130.	Russia	3.83 %	9.38 %	40.84 %	21.25 %	59.70 %	41.58 %
131.	Portugal	3.82 %	10.93 %	34.99 %	17.15 %	48.80 %	39.01 %
132.	Slovenia	3.81 %	11.59 %	32.86 %	14.23 %	51.36 %	33.00 %
133.	Argentina	3.80 %	9.55 %	39.82 %	22.06 %	61.56 %	35.84 %
133.	Libyan Arab Jamahiriya	3.80 %	7.80 %	48.70 %	24.27 %	72.45 %	49.38 %
135.	Austria	3.75 %	13.60 %	27.54 %	13.63 %	35.75 %	33.25 %
136.	Kuwait	3.71 %	9.04 %	41.03 %	13.27 %	65.98 %	43.84 %
137.	Slovakia	3.69 %	10.21 %	36.13 %	13.82 %	56.98 %	37.58 %
138.	Czech Republic	3.67 %	10.82 %	33.96 %	14.33 %	51.85 %	35.71 %
139.	United Kingdom	3.65 %	11.60 %	31.49 %	15.53 %	46.40 %	32.53 %
140.	Poland	3.53 %	9.79 %	36.05 %	17.23 %	55.45 %	35.48 %
141.	Latvia	3.51 %	9.26 %	37.94 %	20.98 %	58.05 %	34.81 %
142.	Belgium	3.48 %	11.66 %	29.88 %	14.91 %	42.89 %	31.84 %
143.	Spain	3.40 %	10.23 %	33.28 %	15.07 %	50.87 %	33.91 %
143.	Sao Tome and Principe	3.40 %	5.81 %	58.55 %	46.17 %	77.52 %	51.96 %
145.	Belarus	3.32 %	8.46 %	39.31 %	16.85 %	60.56 %	40.50 %
146.	Germany	3.27 %	11.41 %	28.68 %	14.63 %	38.59 %	32.82 %
147.	Mongolia	3.24 %	6.52 %	49.66 %	34.42 %	68.56 %	46.02 %
148.	Lithuania	3.23 %	8.88 %	36.40 %	20.39 %	53.17 %	35.64 %
149.	Ukraine	3.19 %	7.50 %	42.56 %	19.30 %	63.44 %	44.95 %
150.	Canada	3.18 %	10.25 %	31.04 %	14.29 %	45.06 %	33.77 %
151.	Denmark	3.09 %	10.87 %	28.42 %	14.30 %	39.09 %	31.89 %
152.	Cyprus	2.81 %	7.44 %	37.72 %	14.00 %	57.99 %	41.17 %
153.	France	2.78 %	9.25 %	30.05 %	15.39 %	42.25 %	32.50 %
154.	Oman	2.72 %	6.41 %	42.48 %	17.60 %	63.19 %	46.65 %
155.	Luxembourg	2.65 %	9.12 %	29.11 %	11.59 %	40.51 %	35.22 %
156.	Seychelles	2.60 %	5.99 %	43.46 %	20.88 %	63.92 %	45.57 %
157.	Switzerland	2.59 %	9.56 %	27.14 %	13.99 %	36.93 %	30.51 %
158.	Singapore	2.54 %	7.82 %	32.47 %	14.11 %	47.10 %	36.19 %
159.	Estonia	2.50 %	7.23 %	34.62 %	17.83 %	52.12 %	33.90 %
160.	Israel	2.43 %	6.41 %	37.88 %	18.49 %	56.82 %	38.33 %
161.	Egypt	2.33 %	4.72 %	49.38 %	22.00 %	76.55 %	49.57 %
162.	Norway	2.31 %	8.58 %	26.87 %	13.75 %	37.98 %	28.87 %
163.	Finland	2.24 %	8.19 %	27.41 %	14.62 %	37.81 %	29.79 %
164.	Sweden	2.15 %	7.97 %	27.01 %	14.32 %	36.85 %	29.86 %
165.	United Arab Emirates	2.07 %	5.93 %	34.84 %	10.54 %	56.36 %	37.61 %
166.	Bahrain	1.81 %	4.27 %	42.44 %	13.55 %	64.19 %	49.57 %
167.	Kiribati	1.78 %	3.05 %	58.32 %	42.22 %	82.43 %	50.31 %
168.	Iceland	1.53 %	5.67 %	26.98 %	14.34 %	39.16 %	27.45 %
169.	Grenada	1.46 %	3.13 %	46.64 %	25.32 %	69.89 %	44.70 %
170.	Saudi Arabia	1.31 %	2.93 %	44.53 %	17.93 %	70.89 %	44.78 %
171.	Barbados	1.15 %	3.46 %	33.08 %	15.36 %	48.53 %	35.36 %
172.	Malta	0.61 %	1.65 %	36.81 %	14.29 %	53.52 %	42.62 %
173.	Qatar	0.10 %	0.28 %	36.18 %	9.61 %	55.40 %	43.54 %

ADPC (2004): Environmental Degradation and Disaster Risk. Prepared for the Embassy of Sweden/Sida Bangkok. http://www.adpc.net/

Ali, A. M. S (2007): September 2004 flood event in South-western Bangladesh: a study of its nature, causes, human perception and adjustments to a new hazard. Nat Hazards 40:89–111.

Atta-ur-Rahman & Khan, A. (2011): Analysis of flood causes and associated socio-economic damages in the Hindukush region. IN: Nat Hazards 59:1239–1260

BAFU (Bundesamt für Gefährdung) (2009): Rutschungen Ursachen: Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation UVEK.

Baker, A.C., P.W. Glynn, B. Riegl. 2008. Climate change and coral reef bleaching: An ecological assessment of long-term impacts, recovery trends and future outlook. Estuarine, Coastal and Shelf Science 80(4): 435-471.

Beck MW, et al. (2011) Oyster reefs at risk and recommendations for conservation, restoration, and management. Bioscience 61:107-116.

Birkmann, J., P. Buckle, J. Jaeger, M. Pelling, N. Setiadi, M. Garschagen, N. Fernando, and J. Kropp (2010): Extreme events and disasters: A window of opportunity for change? Analysis of changes, formal and informal responses after mega disasters. Natural Hazards, 55(3), 637-669.

Birkmann, J., Welle, T., Krause, D., Wolfertz, J., Catalina Suarez, D. and Neysa Setiadi (2011): WorldRiskIndex: Concept and Results. In: WorldRiskReport 2011. Alliance Development Works, 13-42, ISBN 978-3-9814495-1-8

Bradshaw, C. J. A., Sodhi, N. S., Peh, K. S.-H. & Brook, B. W. (2007): Global Evidence that deforestation amplifies flood risk and severity in the developing world. In: Global Change Biology 13, 1-17.

Brody SD, Highfield WE, Ryu HC, Spanel-Weber L (2007) Examining the relationship between wetland alteration and watershed flooding in Texas and Florida. Natural Hazards 40: 413–428.

Burke, L., Reytar, K., Spalding, M., and Perry, A. L., 2012, Reefs at Risk Revisited. World Resources Institute, Washington D.C.

Cabrera, Martha (2002): Nicaragua – Vivimos y sobrevivimos en un país multiduelos. Envío, Ausgabe 249, Dezember 2002.

Center for Remote Sensing of Ice Sheets (CRESIS), University of Kansas: Sea Level Rise Maps. Abrufbar unter: https://www.cresis.ku.edu/data/sea-level-rise-maps

Center for International Earth Science Information Network (CIESIN), Columbia University; International Food Policy Research Institute (IFPRI); The World Bank; and Centro Internacional de Agricultura Tropical (CIAT). (2012): Global Rural-Urban Mapping Project (GRUMP): Population Count Grid for 2010 (alpha). Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC), Columbia University.

Center for International Earth Science Information Network (CIESIN) & Ciat (Centro Internacional de Agricultura Tropical)(2005): Gridded Population of the World Version 3 (GPWv3). Population Density Grids. Socioeconomic Data and Applications Center (SEDAC). Columbia University, Palisades, NY.

Disse, M. and Engel, H. (2001): Flood Events in the Rhine Basin: Genesis, Influences and Mitigation. In: Natural Hazards 23: 271–290.

Emerson, J.W., A. Hsu, M.A. Levy, A. de Sherbinin, V. Mara, D.C. Esty, and M. Jaiteh. 2012. (2012): Environmental Performance Index and Pilot Trend Environmental Performance Index. New Haven: Yale Center for Environmental Law and Policy.

ETC Group (2010): Geopiracy. The Case against Geoengineering. Ottawa. www.etcgroup.org/upload/publication/pdf_file/ETC_geopiracy_4web.pdf

EU (2011): Contribution by the European Union and its Member States to the UN Department of Economic and Social Affairs. Brüssel. www.uncsd2012.org/rio20/index.php?page=view&type=510&nr=240&menu=20

Freudenberg, M. (2003), "Composite Indicators of Country Performance: A Critical Assessment", OECD Science, Technology and Industry Working Papers, 2003/16, OECD Publishing.

Friends of Disaster Risk Reduction (2012): Joint Statement on the Occasion of the President of the Unite Nations General Assembly Interactive Thematic Debate on Disaster Risk Reduction. Delivered by Bob Carr, Minister for Foreign Affairs, Australia. www.unny.mission.gov.au/unny/120412_drr.html

G77 (2011): Submission by the Group of 77 and China for the compilation document of the United Nations Conference on Sustainable Development (RIO+20). New York. www.uncsd2012.org/rio20/content/documents/399UNCSD%20RIO-%20complete%20submission-final.pdf

Gedan KB, Kirwan ML, Wolanski E, Barbier EB, & Silliman BR (2011) The present and future role of coastal wetland vegetation in protecting shorelines: answering recent challenges to the paradigm. Climatic Change 106:7-29.

Government of Japan (2011): Input to the Rio+20 Outcome Document. Tokio. www.uncsd2012.org/rio20/content/documents/113Japan.pdf

Hurtado, Laura (2008): La plantaciones para agrocombustibles y la pérdida de tierras para la producción de alimentos en Guatemala. Guatemala-Stadt.

IGES (2012): Issues Brief 2: Building Resilience and Reducing Risk from Natural Disasters: Essentials of 21st Century Sustainable Development. Hayama. http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=3538

IPCC (2012a): Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Summary for Policymakers. Cambridge/New York. http://ipcc-wg2.gov/SREX/images/uploads/SREX-SPMbrocure_FINAL.pdf

IPCC (2012b): Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D.

Johnson, M.E., C. Lustic, E. Bartels, I.B. Baums, D.S. Gilliam, L. Larson, D. Lirman, M.W. Miller, K. Nedimyer., and S. Schopmeyer. 2011. Caribbean Acropora Restoration Guide: Best Practices for Propagation and Population Enhancement. The Nature Conservancy, Arlington, VA. 54p.

Kench PS, Brander RW, Parnell KE, & O'Callaghan JM (2009) Seasonal variations in wave characteristics around a coral reef island, South Maalhosmadulu atoll, Maldives. Marine Geology 262(1-4):116-129.

Martens, Jens (2012): Rio + 20. Die UN-Konferenz für nachhaltige Entwicklung 2012. Hintergründe – Konflikte – Perspektiven. Bonn/Osnabrück: Global Policy Forum Europe/terre des hommes. www.globalpolicy.org/images/pdfs/GPFEurope/Rio20_Report.pdf

Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

Mitchell, Tom/Wilkinson, Emily (2012): Disaster risk management in post-2015 policy frameworks: Forging a more resilient future. London: ODI (ODI Briefing Paper 75, June 2012).

Lavell, A., M. Oppenheimer, C. Diop, J. Hess, R. Lempert, J. Li, R. Muir-Wood, and S. Myeong (2012): Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 25-64.

Liu, Y., Liu, R. & Ge, Q. (2010): Evaluating the vegetation destruction and recovery of Wenchuan earthquake using MODIS data. In: Nat Hazards 54:851–862

Meyer, W. (2004): Indikatorenentwicklung. Eine praxisorientierte Einführung (2.Auflage). CEval-Arbeitspapiere 10, Centrum für Evaluation. Saarbrücken.

Millennium Ecosystem Assessment (2005): Ecosystems and human well-being: current state and trends: findings of the Condition and Trends Working Group.

PEDRR (2010): Demonstrating the Role of Ecosystem-based Management for Disaster Risk Reduction. Partnership for Environment and Disaster Risk Reduction.

Peduzzi (2010): Landslides and vegetation cover in the 2005 North Pakistan earthquake: a GIS and statistical quantitative approach. IN: Nat. Hazards Earth Syst. Sci., 10, 623–640.

Peduzzi, P., Dao, H., Herold, C. & F. Mouton (2009): Assessing global exposure and vulnerability towards natural hazards: the Disaster Risk Index. In: Natural Hazards and Earth System Sciences 9, S. 1149-1159.

Perez-Maqueo O, Intralawan A, Martínez ML (2007): Coastal disasters from the perspective of ecological economics. Ecological Economics 63: 273–284.

PREVIEW: Global Risk Data Platform. Database. http://preview.grid.unep.ch

Roemer, H., Kaiser, G.,Sterr, H. & Ludwig,R. (2010): Using remote sensing to assess tsunami-induced impacts on coastal forest ecosystems at the Andaman Sea coast of Thailand. In: Nat. Hazards Earth Syst. Sci., 10, 729–745.

Shepard C, Crain C, & Beck MW (2011) The protective role of coastal marshes: a systematic review and metaanalysis. PLoS One 6(11): e27374. http://bit.ly/vfAHvT

Sheppard C, Dixon DJ, Gourlay M, Sheppard A, & Payet R (2005) Coral mortality increases wave energy reaching shores protected by reef flats in the Seychelles. Estuar Coast Shelf S 64:223-234

Spalding, M, Kainuma, M. and Collins, L. 2010. World Atlas of Mangroves. Earthscan, LondonUNISDR (2011) Global assessment report on disaster risk reduction revealing risk, redefining development (UN, NY).

Sudmeier-Rieux, K., H. Masundire, A. Rizvi and S. Rietbergen (eds). (2006): Ecosystems, Livelihoods and Disasters: An integrated approach to disaster risk management. IUCN, Gland, Switzerland and Cambridge, UK. x + 58 pp.

Thielen, Helmut (1988): Nicaragua – Entwicklung der Agrarreform und Umweltpolitik seit 1979. Fort Lauderdale.

UN (2009): Implementation of Agenda 21, the Programme for the Further Implementation of Agenda 21 and the outcomes of the World Summit on Sustainable Development. Resolution adopted by the General Assembly. New York (UN Dok. A/RES/64/236, vom 24. Dezember 2009).

UN (1992): Agenda 21. New York. (UN Dok. A/CONF.151/26, Band I.) www.un.org/Depts/german/conf/agenda21/agenda_21.pdf

UN DESA (2011): Issues Brief 8: Disaster Risk Reduction and Resilience Building. New York. www.uncsd2012.org/rio20/index.php?page=view&type=400&nr=225&menu=45

UN Secretary-General's High Level Panel on Global Sustainability (2012): Resilient People, Resilient Planet. A Future Worth Choosing. New York. www.un.org/gsp

UNISDR (2005): Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. Geneva. http://bit.ly/iyPyfR.

UNISDR (2012): Towards a Post-2015 Framework for Disaster Risk Reduction. Geneva. www.unisdr.org/files/25129_towardsapost2015frameworkfordisaste.pdf

United Nations (1987): Our common future. Report of the World Commission on Environment and Development. http://www.un-documents.net/our-common-future.pdf

United Nations General Assembly (2012): The future we want. New York. http://daccess-dds-ny.un.org/doc/UNDOC/LTD/N12/436/88/PDF/N1243688.pdf?OpenElement

United States (2011): Sustainable Development for the Next Twenty Years. United States Views on Rio+20. Submission to the United Nations on November 1, 2011. Washington, D.C. www.uncsd2012.org/rio20/content/documents/37011-11-01%20US%20Submission%20Rio%2020%20Nov%201(1).pdf

UN-Habitat (United Nations Human Settlements Programme) (2011): Cities and Climate Change: Policy Directions. Global Report on Human Settlements 2011. Abridged Edition. (Earthscan) London, Washington.

Zhang, K., H. Liu, Y. Li, H. Xu, J. Shen, J. Rhome, T. J. Smith III. 2012. The role of mangroves in attenuating storm surges. Estuarine, Coastal and Shelf Science 102-103: 11e23.

Publisher:
Bündnis Entwicklung Hilft (Alliance Development Works),
In charge of publishing: Peter Mucke

Concept and implementation:
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Lars Jeschonnek, MediaCompany

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Naldo Gruden, MediaCompany

Translation:
Mike Gardner

Cooperation partners:
United Nations University, Institute for Environment and
Human Security (UNU-EHS), Bonn
The Nature Conservancy, Arlington, supported by the
Pew Marine Fellowship Program

ISBN 978-3-9814495-0-3

**With the kind assistance of
Stiftung Umwelt und Entwicklung
Nordrhein-Westfalen**

Photo credits:
Map on pages 38/39: Data on coral reefs: World Resources Institute (2011): Reefs at Risk Revisited; on the mangroves: Spalding, M., Kainuma, M. and Collins, L. (2010): World Atlas of Mangroves. ISME. And: Global Digital Elevation Model (ETOPO2): National Geophysical Data Center (NGDC); on population density: Global Rural-Urban Mapping Project (GRUMP): Urban Extents Data Collection. Alpha Version. Center for International Earth Science Information Network (CIESIN), Columbia University, detailed information at: www.network.coastalresilience.org

Map on pages 40/41: World Resources Institute (2011); Data on coral reefs: Reefs at Risk Revisited; on population density: Global Rural-Urban Mapping Project (GRUMP): Urban Extents Data Collection. Alpha Version. Center for International Earth Science Information Network (CIESIN), Columbia University, detailed information at www.network.coastalresilience.org; on the WorldRiskIndex: source: UNU-EHS, based on PREVIEW Global Risk Data Platform, CreSIS, CIESIN and global data banks, detailed information at: www.WorldRiskReport.org

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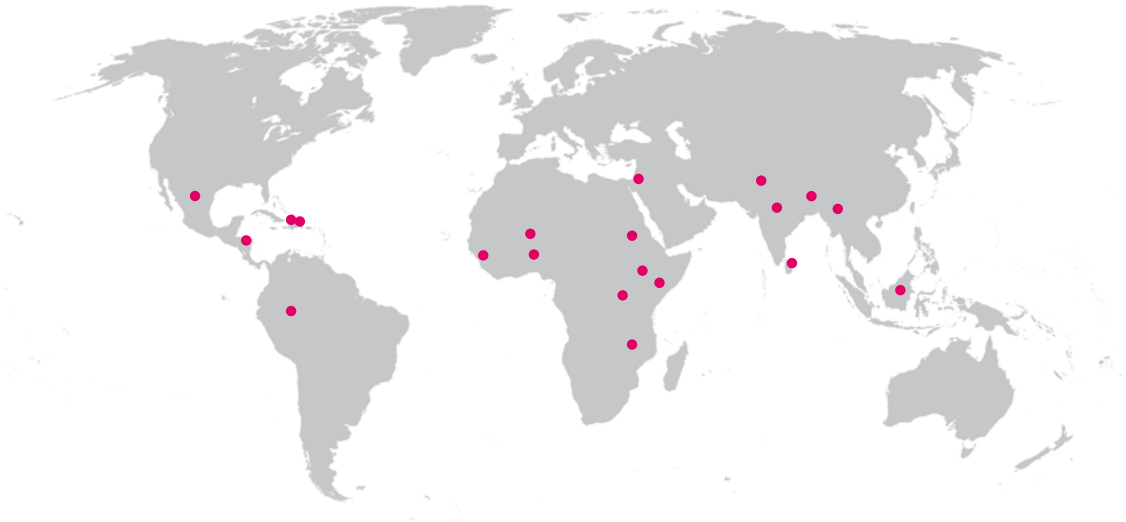
Printing:
könitzers druck + medien, Berlin

Online:
The detailed scientific description as well as further information and tables can be consulted and downloaded from www.WorldRiskReport.org



Publisher:

Bündnis Entwicklung Hilft
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ISBN 978-3-9814495-0-3

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