

## **GLOBAL CLIMATE RISK INDEX 2006**

WEATHER-RELATED LOSS EVENTS AND THEIR  
IMPACTS ON COUNTRIES IN 2004 AND IN A LONG-  
TERM COMPARISON

Sven Anemüller, Stephan Monreal and Christoph Bals



## Summary

The Global Climate Risk Index 2006 analyses how much countries and country groups have been affected by the impacts of weather-related loss events (storms, floods, droughts etc.). The figures for 2004, the latest available data, as well as those for the past 20 years show that less developed countries are the most affected. Thus, it is very likely that global climate change, which is expected to cause changes in extreme weather events, increasingly threatens many of these countries.

## Imprint

### Authors:

Sven Anemüller, Stephan Monreal and Christoph Bals

### Edited by:

Gerold Kier

### Translation:

Uta Reichling

The authors would like to thank Britta Horstmann, Angelika Wirtz (Munich Re), Dr. Eberhard Faust (Munich Re) and Petra Löw (Munich Re) for their kind support.

### Publisher:

Germanwatch e.V.

Bonn Office

Dr. Werner-Schuster-Haus

Kaiserstr. 201

D-53113 Bonn

Tel. +49 (0)228/60492-0, Fax -19

Internet: <http://www.germanwatch.org>

E-mail: [info@germanwatch.org](mailto:info@germanwatch.org)

Berlin Office

Voßstr. 1

D-10117 Berlin

Tel. +49 (0)30/288 8356-0, Fax -1

July 2006

Purchase order number: 06-2-06

**ISBN 3-9806280-5-1**

This publication is available on the internet at:

**<http://www.germanwatch.org/klak/cri.htm>**

Financially supported by the German Federal Ministry for Economic Cooperation and Development (BMZ).

# Contents

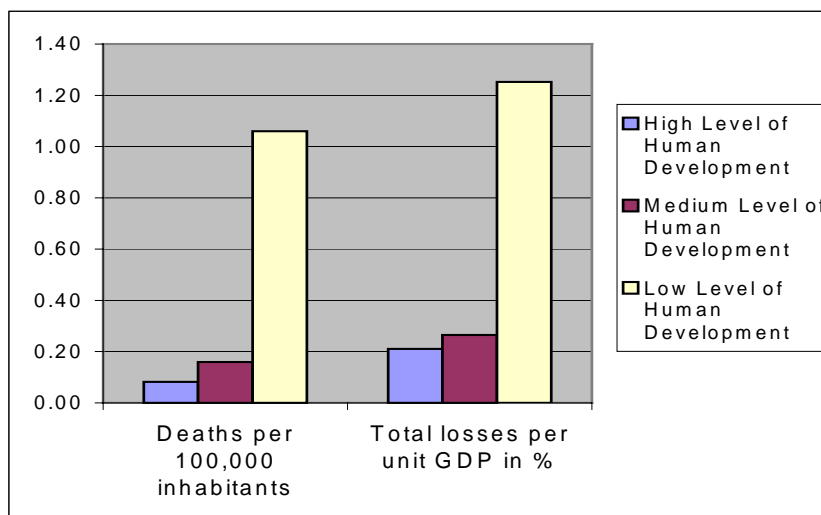
|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Summary .....</b>  | <b>4</b>  |
| <b>2</b> | <b>Introduction and objectives .....</b>  | <b>6</b>  |
| 2.1      | Increasing risks from global warming and extreme weather events .....   | 6         |
| 2.2      | Introductory remarks on contents and methodology .....  | 12        |
| <b>3</b> | <b>Country groups in comparison: Deaths and losses caused by weather-related events in 2004 .....</b>                   | <b>14</b> |
| <b>4</b> | <b>Countries in comparison: Impacts of weather-related events - the Down 10 in 2004 and long-term comparisons .....</b> | <b>16</b> |
| 4.1      | Death toll .....  | 16        |
| 4.2      | Deaths per 100,000 inhabitants.....   | 18        |
| 4.3      | Total losses in million US Dollars (original damages, adjusted for inflation) .....                                     | 20        |
| 4.4      | Total losses in relation to the Gross Domestic Product (GDP).....   | 22        |
| <b>5</b> | <b>The Climate Risk Index as a synthesis of the individual analyses: The 10 most affected countries.....</b>            | <b>24</b> |
| 5.1      | The 10 most affected countries in 2004.....   | 24        |
| 5.2      | The 10 most affected countries in 1995-2004.....  | 25        |
| <b>6</b> | <b>Case study: The Philippines.....</b>   | <b>27</b> |
| 6.1      | Climate trends and hazards .....  | 27        |
| 6.2      | Weather-related loss events on the Philippines 1980-2004 .....  | 29        |
| 6.3      | Adaptation to climate change .....  | 31        |
| 6.4      | Conclusion .....  | 31        |
| <b>7</b> | <b>Literature.....</b>  | <b>32</b> |
| <b>8</b> | <b>Annex .....</b>  | <b>34</b> |

# 1 Summary

The analyses presented here show how much countries have been affected in 2004 by weather-related loss events like hurricanes or floods. They are based on the data of the NatCatSERVICE of Munich Re<sup>1</sup>. The following indicators of affectedness were analysed:

- death toll,
- deaths per 100,000 inhabitants,
- amount of overall losses in US Dollars and
- overall losses in relation to the Gross Domestic Product (GDP).

The indicators are also analysed with regard to their long-term trends by identifying the countries most affected according to the average of annual figures in the past 20 years (separated in two decades). The Climate Risk Index (CRI)<sup>2</sup> is calculated by aggregating the figures for 2004 which are the most current basis of information, and the last decade 1995-2004. This ranking lists the most affected countries, determined by calculating the average rank of a country within all four assessments.



**Fig.: Deaths and losses caused by extreme weather events according to the level of development**

A general observation is that less developed countries are proportionally much more affected by weather-related damage events, as can be seen in the figure above. It shows how country groups according to the Human Development Index<sup>3</sup> are affected. This conclusion is also verified when looking at the ranking of the 10 most affected countries (Down 10), as shown by the Climate Risk Index for 2004 and 1995-2004 (see tables below). Against the background that climate change is expected to lead to more intense weather events in many of the world's regions, especially developing countries face in-

<sup>1</sup> Germanwatch alone is responsible for the presented evaluations, analyses and conclusions.

<sup>2</sup> The Climate Risk Index analyses how countries are affected by weather-related loss events. In the face of climate change and its expected impacts they have to be seen as an indicator for climate risks. Also see the Climate Change Performance Index (CCPI) developed by Germanwatch, which includes an index-based analysis of the emissions levels, the emissions trends as well as the climate protection policy: <http://www.germanwatch.org/ccpi.htm>

<sup>3</sup> The HDI, which is annually calculated by the United Nations Development Programme (UNDP), considers apart from the per capita income the life expectancy and the educational level; see also UNDP 2005.

creasing risks. Floods, storms, heatwaves and other consequences of climate change threaten to undermine slowly achieved progress in development.

Germanwatch will update the Climate Risk Index regularly to watch the future development in this regard and to identify if and where climate change leaves its footprint through extreme weather events.

**Tables: The Climate Risk Index (CRI) - the 10 countries most affected by extreme weather events in 2004 and in the period 1995-2004.**

The CRI is calculated as the average rank of each country in the four indicators analysed. (The ranking in the Human Development Index HDI is listed in the right column for comparison only).

**Climate Risk Index 2006 (based on values for 2004):** Somalia as the most affected country has an average rank of 8.50, i.a. with rank 7 in total losses and rank 2 in losses per Gross Domestic Product (GDP). The ranking is particularly dominated by countries that rank low in the HDI.

|    | Country                   | Index value <sup>4</sup> | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank total losses per GDP | For comparison: Rank in HDI 2003 <sup>5</sup> |
|----|---------------------------|--------------------------|-----------------|-------------------------------------|-------------------|---------------------------|---|
| 1  | <b>Somalia</b>            | <b>8.50</b>              | 14              | 11                                  | 7                 | 2                         | -   |
| 2  | <b>Dominican Republic</b> | <b>9.00</b>              | 6               | 5                                   | 14                | 11                        | 95  |
| 3  | <b>Bangladesh</b>         | <b>9.75</b>              | 4               | 20                                  | 5                 | 10                        | 139   |
| 4  | <b>Philippines</b>        | <b>16.75</b>             | 5               | 13                                  | 26                | 23                        | 84  |
| 5  | <b>China</b>              | <b>16.75</b>             | 2               | 48                                  | 3                 | 14                        | 85  |
| 6  | <b>Nepal</b>              | <b>17.00</b>             | 10              | 18                                  | 28                | 12                        | 136   |
| 7  | <b>Madagascar</b>         | <b>17.25</b>             | 8               | 10                                  | 35                | 16                        | 146   |
| 8  | <b>Japan</b>              | <b>18.25</b>             | 11              | 42                                  | 2                 | 18                        | 11  |
| 9  | <b>USA</b>                | <b>18.25</b>             | 7               | 48                                  | 1                 | 17                        | 10  |
| 10 | <b>Bahamas</b>            | <b>20.00</b>             | 51              | 7                                   | 15                | 7                         | 50  |

**Climate Risk Index 1995-2004:** Honduras has been the most affected country in the last decade (1995-2004) with an average rank of 11.00, i.a. with rank 7 in death toll and rank 2 in deaths per 100,000 inhabitants. The figures for some countries are dominated by individual very severe events.

|    | Country                   | Index Value  | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank total losses per GDP | For comparison: Rank in HDI 2003 |
|----|---------------------------|--------------|-----------------|-------------------------------------|-------------------|---------------------------|----------------------------------|
| 1  | <b>Honduras</b>           | <b>11.00</b> | 7               | 2                                   | 25                | 10                        | 116                              |
| 2  | <b>Bangladesh</b>         | <b>17.50</b> | 5               | 34                                  | 14                | 17                        | 139                              |
| 3  | <b>Somalia</b>            | <b>19.00</b> | 20              | 12                                  | 36                | 8                         | -                                |
| 4  | <b>Venezuela</b>          | <b>19.50</b> | 2               | 1                                   | 28                | 47                        | 75                               |
| 5  | <b>Nicaragua</b>          | <b>21.00</b> | 16              | 3                                   | 50                | 15                        | 112                              |
| 6  | <b>Viet Nam</b>           | <b>21.25</b> | 8               | 30                                  | 24                | 23                        | 108                              |
| 7  | <b>Dominican Republic</b> | <b>22.00</b> | 11              | 8                                   | 41                | 28                        | 95                               |
| 8  | <b>France</b>             | <b>24.75</b> | 4               | 11                                  | 5                 | 79                        | 16                               |
| 9  | <b>India</b>              | <b>26.25</b> | 1               | 44                                  | 9                 | 51                        | 127                              |
| 10 | <b>China</b>              | <b>27.50</b> | 3               | 79                                  | 2                 | 26                        | 85                               |

<sup>4</sup> In case of equal index values, the ranking in casualties per 100,000 inhabitants determines the overall ranking.

<sup>5</sup> UNDP 2005

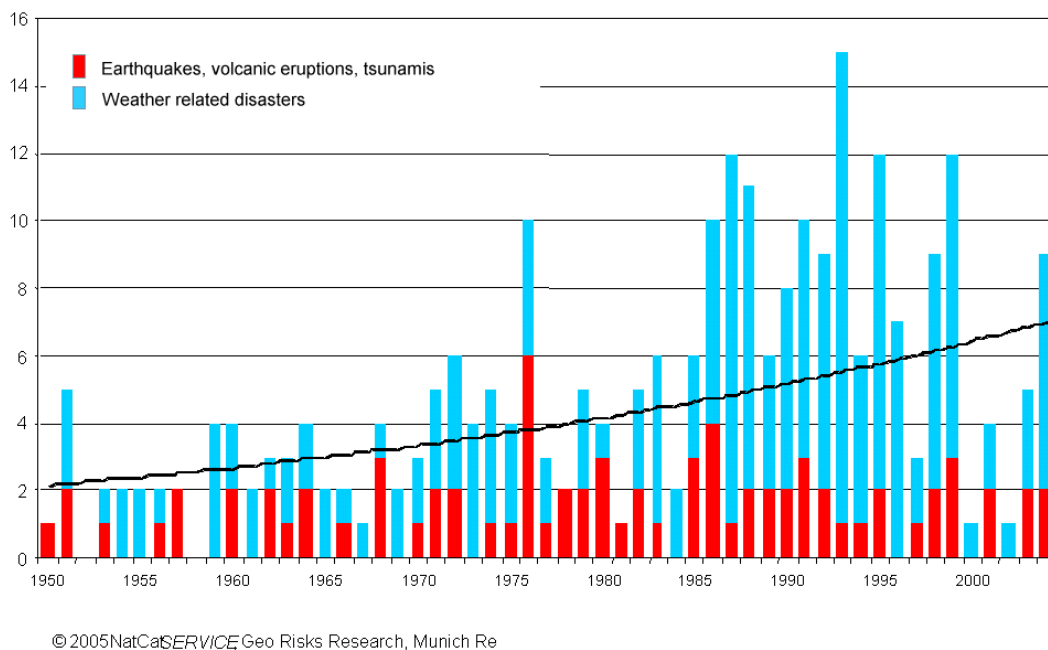
## 2 Introduction and objectives

### 2.1 Increasing risks from global warming and extreme weather events

The year 2005 has clearly shown what kind of devastating impacts extreme weather events can have on the life situation of many people, both in rich and poor countries. Hurricane Katrina caused damages of more than 100 billion dollars in the USA, an unprecedented scale (Munich Re 2006). Central American countries like Mexico and Guatemala have also been ravaged by devastating hurricanes.

In Guatemala alone, more than 800 people died because of hurricane Stan, many are still listed as missing (Wirtz 2006). The hurricane year 2005 has even beaten the records of the season 2004 (Faust 2006). Scientific studies show that the intensity of hurricanes sharply rose since the 1970s.

This development is barely explicable without the influence of climate change (Emanuel 2005, Webster 2005). The number of weather-related great natural catastrophes<sup>6</sup> also increased (see figure 1). Finally, the fact that such phenomena now even occur in regions that had so far not been affected is another indication for a connection between climate change and hurricane activity. In 2004 a hurricane has been registered for the first time ever in the South Atlantic off Brazil (Pezza/Simmonds 2005). In 2005, hurricane Vince developed to be the most easterly and northerly tropical cyclone ever to occur in the Atlantic, advancing into the Canary Islands (Munich Re 2006).



**Fig. 1: Development of the number of great natural catastrophes 1950-2004.**

Compared to the geological events, the weather-related events show a more pronounced trend of increase; this can at least be interpreted as an indication for a possible influence of climate change.

<sup>6</sup> For definition see Munich Re 2006

Climate change is reality and we are already aware of an increasing number of its impacts, others loom. In addition to drastic reductions of greenhouse gas emissions at global level, one question becomes more and more important in the climate debate: which countries will be affected in which way and to which degree by the impacts and which options are there to adapt to the consequences of climate change. Weather events that cause damage play a central role in this context since their formation and their intensity are determined by climate and for this reason, changes in the future are to be expected. Even if the formation of an individual weather event can never be scientifically traced to climate change, the rise in global average temperature undoubtedly influences the probability of occurrence as well as the intensity of such events (see box 1). The increasing intensity of tropical hurricanes over the past 15 years for example shows a tight connection to the simultaneous rise in ocean surface temperature (Faust 2006).

According to the Intergovernmental Panel on Climate Change (IPCC), an increase in risk of floods and droughts is to be expected for many of the world's regions if the concentration of greenhouse gases will continue to increase in the atmosphere (IPCC 2001). Climate scientists have published a number of analyses over the past two years which show an increasingly alarming picture of the impacts of climate change.<sup>7</sup> The knowledge and the statements with regard to various situations of danger now considerably exceed the state described in IPCC 2001 as shown in table 1.

### **Box 1: Extreme weather events and their connection with climate change**

"It is wrong to blame any one event such as [hurricane] Katrina specifically on global warming - and of course it is just as indefensible to blame Katrina on a long-term natural cycle in the climate. Yet this is not the right way to frame the question. ... The situation is analogous to rolling loaded dice: one could, if one was so inclined, construct a set of dice where sixes occur twice as often as normal. But if you were to roll a six using these dice, you could not blame it specifically on the fact that the dice had been loaded. Half of the sixes would have occurred anyway, even with normal dice. Loading the dice simply doubled the odds. In the same manner, while we cannot draw firm conclusions about one single hurricane, we *can* draw some conclusions about hurricanes more generally. In particular, the available scientific evidence indicates that it is likely that global warming will make - and possibly already is making - those hurricanes that form more destructive than they otherwise would have been." Rahmstorf et al. 2005

In addition to this, science increasingly pays attention to risks in the earth system which pose significant threats because of the combination of two attributes. First, as a direct or indirect consequence of temperature increase changes could occur which lead to dangerous socio-economic or climatic impacts on a larger scale. Second, it needs to be taken into account that such a change would not be of linear nature but could trigger a non-linear "tipping" of the system initiating irreversible long-term processes, impacts and feedback effects. With rising temperatures, the risks from climate change and the probability increases that such "tipping points" will be reached. Against this background, an increasing number of politicians, environmental and development NGOs as well as scientists claim to put massive efforts into limiting global warming to 2° C by the end of the century compared to 1860 since beyond this level risks seem to increase rather exponentially than linear (e.g. WBGU 2003; ECF/PIK 2004; CAN 2002; see also IPCC 2001).

---

<sup>7</sup> Schellnhuber 2006

**Table 1: Impacts of global temperature increase and examples for consequences**

According to new scientific evidence, the certainty that the examples described here will occur has even increased in comparison to IPCC 2001. Source: Stern 2006b

| Change  | Region  | Example Consequences   |
|---|---|--|
| More heatwaves  | Continental areas   | Temperatures experienced during the European heatwave of 2003 could be commonplace by the middle of the century and unusually cool by the end of the century |
| Less snow and reduced glacier extent                  | Many northern latitudes and areas that rely on snowmelt for summer water supply (e.g. China, India, Peru)   | Millions more people suffering water shortage in Peru, China and India; unreliable snowfall could make ski resorts less attractive tourist destinations      |
| Sea level rise and increased risk of coastal flooding | Many low-lying areas, including small island states, Western Africa, parts of South East Asia (e.g. Bangladesh)   | 1-m sea level could potentially affect 6 million people in Egypt, 13 million in Bangladesh, and 72 million in China  |
| More intense precipitation events                     | Northern latitudes  | Greater incidence of flooding with increasing weather damages to people, property and their possessions  |
| Drier summers and increasing risk of severe droughts  | Many mid-latitude continental areas, e.g. Mediterranean, Central America, Australia, Southern Africa  | Proportion of years where run-off drops to drought levels could increase by 30% by 2050 in Southern Africa   |
| Increasing ocean acidity                              | Our oceans could become considerably more acidic by the year 2100, probably be lower than has been experienced for hundreds of millennia and, critically, at a rate of change probably 100 times greater than at any time over this period. | Widespread impacts of marine ecosystems and biodiversity, with knock-on effects for local communities dependent on fishing                                   |

For example, the melting of the arctic permafrost might release methane in a dimension that would considerably enhance the global rise in temperature. The possible "tipping over" of the Amazon rainforest might turn this ecosystem into a savanna vegetation and a net source of carbon dioxide by the year 2080. The reason for this transformation might be a self-enhancing effect of three major factors: the dehydration through a disproportionate rise in temperature, the continuing deforestation as well as an expected absence of the natural transport of nutrients through sandstorms from the African Sahelian zone to Brazil in the case of a possible greening of the Sahel.<sup>8</sup>

The various feedback effects might lead to a global warming which is at least twice as high as it is forecasted by today's models with continuing high emissions of greenhouse gases, with temperatures that would be higher than ever before in the past 50 million years (Hadley Centre 2005).

<sup>8</sup> For further information on the transport of nutrients between the Sahel zone and the Amazon see Ridgwell 2002

**Table 2: Potential impacts of rapid climate change, with some estimates of likely global trigger temperatures.**

Source: Stern 2006b; adapted from Schneider/Lane 2006

| Global temperature increase (relative to 2000) | Potential impacts   |
|--|---|
| 2 - 3°C  | <p>Onset of melt of Greenland Ice Sheet, increasing sea levels by 75 cm by 2100 and causing eventual additional sea level rise of 7 m over millennia</p> <p>Collapse of Amazon rainforest, with forest replaced by savannah, leading to significant consequences for biodiversity and human livelihoods</p> <p>Desertification of many world regions with widespread loss of forest and grassland</p> |
| 2 - 5° C                                       | <p>Potential to trigger melting of West Antarctic Ice Sheet, raising sea levels by a further 5 – 6 m for centuries or up to 75 cm by 2100</p> <p>Chance of complete collapse of Thermohaline circulation, cooling Northern Hemisphere by several degrees and changing rainfall patterns</p> <p>Potential release of methane from melting tundra and shallow seas, further accelerating warming</p>    |

A subject that is comparatively new, but might be of extraordinary importance for the most populous region of the world, is the question how the Asian monsoon might alter through climate change. The Indian monsoon brought reliable precipitation in previous years, but this rhythm seems to increasingly falter. Abnormal fluctuations over the past 30 years led to both disastrous famines and devastating floods throughout India. According to a new study implemented by the Potsdam Institute for Climate Impact Research, a strong alleviation as well as an intensification of the precipitation or even a succession of these processes in terms of a "rollercoaster scenario" might be possible (Zickfeld et. al. 2005).

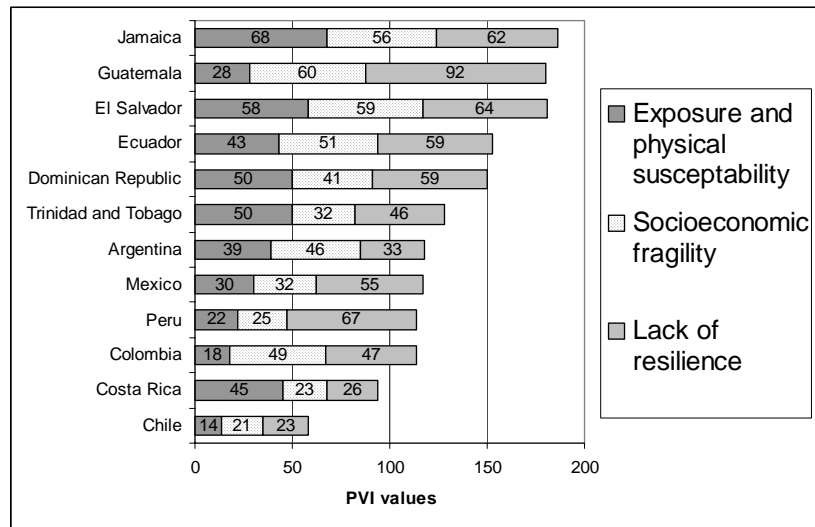
Already today it is known that comparatively minor changes of 10 % in either direction of the monsoon's average precipitation can cause devastating droughts or floods. A weak summer monsoon for example can lead to crop collapses and a lack of food among the rural population - for two thirds of the 1.1 billion Indian inhabitants (Stern 2006a).

### **Country specific conditions determine vulnerability towards disasters**

Undoubtedly every country has not only different climatic conditions, but also different economic and social characteristics. The complex interplay of the different factors such as population growth, income, development level etc. characterises the vulnerability of a country or a population group in the face of the extreme weather events considered here.<sup>9</sup> A lot of scientific research has been carried out to identify and understand the principal factors constituting vulnerability with regard to disaster risks in general, not only weather- or climate-related risks. Some projects have put many efforts into developing sets of indicators and indices.

For example, in a programme of the Inter-American Development Bank (IDB) inter alia a Prevalent Vulnerability Index (PVI) was developed and later applied to a number of countries in Latin America (Cardona et al. 2004). This PVI is built on three factors, a) exposure and physical susceptibility, b) socioeconomic fragility and c) lack of resilience. The higher the overall value the higher the vulnerability.

<sup>9</sup> See Brauch 2005 for a wide-ranging analysis of the term "vulnerability"



**Fig. 2: The Prevalent Vulnerability Index (PVI) applied for 12 Latin American countries**

Source: Cardona et al. 2004

A project carried out by Columbia University and the World Bank developed world maps of disaster hotspots showing where the risk of mortality and economic losses due to hazards of natural origin are greatest (see Dilley et al. 2005). This assessment thus focuses foremost on risks as a product of hazard frequency and consequence.

Finally, the United Nations Development Programme (UNDP) has been working on a Disaster Reduction Index (DRI) in order to help frame efforts how to better anticipate, manage and reduce disaster risks. The DRI "measures the relative vulnerability of countries to three key natural hazards - earthquake, tropical cyclone and flood - and identifies development factors that contribute to risk, and shows in quantitative terms, just how the effects of disasters can be either reduced or exacerbated by policy choices." (UNDP 2004)

Carreño et al. in a forthcoming publication pay special attention to the question how progress in disaster reduction can be assessed which could help to identify those measures that are most effective to reduce the impacts from disasters (Carreño et al. 2006).

A recent publication by Munich Re analysed the vulnerability of megacities, so as to give practical advice to reduce vulnerability in particularly important areas where a large number of people and huge material values concentrate (Munich Re 2005).

According to the Third Assessment Report of the IPCC, "populations in developing countries are generally expected to be exposed to relatively high risks of adverse impacts of climate change [...]. The exposures and low capacity to adapt combine to make populations in developing countries generally more vulnerable than populations in developed countries" (IPCC 2001: 77).

In the face of the considerably dangerous situation posed by climate change and its impacts, an analysis of the past can provide an important indication for the question which countries are especially vulnerable towards extreme weather events, already under today's climatic conditions or in the face of climatic changes which are already under way. The consideration of socio-economic variables in comparison to damages and fatalities caused by weather events - as done in the present analysis - does not allow an exact measurement of vulnerability, but at least an estimation (Brauch 2005). It is likely that most of the countries identified as extraordinarily affected in this analysis will also become particularly endangered in the future through climate change.

Despite any historical analysis, a deterministic projection of the past into the future, however, is not appropriate. For one thing, the statistical past only partly reflects the altered probability of occurrence of damage events due to climate change. Besides, new phenomena can arise for states or regions (see above). Not least do the people also have various measures of adaptation at their disposal. To implement them effectively, however, depends on many factors that determine the overall extent of vulnerability.

However, a too drastic change of the global and regional climatic conditions - likely impacts have already been described in this study - can exceed the adaptive capacity of whole nations. In order to manage the unavoidable, and to avoid the unmanageable in face of climate change both adaptation to the unavoidable consequences and mitigation of greenhouse gas emissions pushing global warming beyond critical thresholds must be pursued.

**Prime objective of the Climate Risk Index: sensitization of public and media**

Extreme weather events play an important role in the public discussion about climate change since they often receive high attention by the media and the general public. But often the discussion only highlights the absolute figures and records of losses and deaths and thus lacks differentiating between countries' differing conditions such as countries' level of development, number of inhabitants etc. when hit by such events.

**Against this background, Germanwatch developed the Global Climate Risk Index to periodically sensitize the general public and the media to the impacts of extreme weather events, their relation to climate change, and to call for a differentiated discussion about the consequences. In addition, we intend to promote the debate about options that could be taken to reduce the adverse impacts, especially on less developed countries.**

**More particularly, the analyses presented here are to show, for both the year 2004 and the past 20 years, respectively:**

- **how intensively countries and country groups have been affected by weather events;**
- **deaths and losses in relation to country-specific conditions;**
- **how intensively especially the less developed countries are affected by the impacts;**
- **what are options to be taken to prepare for, and reduce the risks from climate-related extreme events?**

It has been highlighted and analysed by different actors that many successful initiatives exist to prepare for such disasters (see e.g. UNDP 2002; PAHO 2006). The secretariat of the United Framework Convention on Climate Change, for example, provides an overview of local coping strategies for adaptation to climate change. Many of these are related to extreme weather events (UNFCCC 2006).<sup>10</sup> Using the example of the **Philippines**, the development of climate and weather events as well as possible measures of adaptation in one country will be considered more specifically.

This is the first time that this analysis is published in the present way, with the impacts of the year 2004 and the last two decades. Germanwatch will update and advance these analyses regularly to watch if and how climate change leaves its footprint through extreme weather events in the future and also to present options how countries prepare for the risks.

---

<sup>10</sup> For available research papers on adaptation issues, see e.g.: <http://www.climateadaptation.net/papers.html>

## 2.2 *Introductory remarks on contents and methodology*

The evaluations presented here are based on the worldwide accepted data of the NatCat-SERVICE of Munich Re's Geo Risks Research of the past 20 years.<sup>11</sup>

It includes "all loss events concerning natural hazards which have resulted in substantial material or human losses" (Munich Re 2003: 6).

Munich Re registers the number of loss events, the death toll, the insured losses as well as the total losses for the world's countries. The latter two indicators are denominated in million dollars (original values, adjusted for inflation).

The present analyses only cover the weather-related event classes of the Munich Re data: a) storms, b) floods and c) extreme temperature events and mass movements (droughts, cold spells etc.).<sup>12</sup> Geology-related events like earthquakes, volcanic eruptions or tsunamis, for which data are also available, are not considered important in this context since they do not depend on the weather and are therefore not to be seen in the context of climate change. The various categories within the weather-related events have been combined for reasons of simplified manageability of the large data collection. In addition to this, the country-specific evaluation is considered more important here than the evaluation by types of events. In the case of extremely devastating events it is mentioned if it had been a flood, a storm or some other type of event. It also has to be noted that the impacts on a country usually are not distributed equally over the whole country and the whole range of social groups. Especially in large countries like China or India the impacts may concentrate on one region. But since relevant data on a sub-national level is much more difficult to assess, these analyses concentrate on the national level.

In **chapter 3** the data for the year 2004 are evaluated according to the country groups<sup>13</sup> defined by the per capita income. Relative figures are additionally analysed in the context of the country groups according to the Human Development Index (HDI) of the United Nations Development Programme (UNDP).

In **chapter 4**, country-specific analyses are carried out for the four indicators "total death toll", "deaths per 100,000 inhabitants", "total losses" as well as "total losses in relation to the Gross Domestic Product (GDP)" with the objective of identifying the 10 most affected countries in 2004 as well as over the past two decades (1985-1994 and 1995-2004; based on annual average figures). The term **Down 10** is applied to the ten countries most affected in any indicator since a negative consequence is attributed to the highest rank, in contrast to the term "Top 10". A distinction of insured/uninsured losses has not been made, since no or only marginal insured damages have been registered for the majority of events, especially in developing countries. The long-term comparison is to help the judgement of possible trends: for example, if the year 2004 has only been an anomaly for one specific country, if there are clear long-term improvements etc.

Mortality and economic losses also play a major role in elaborate assessments of disaster risk undertaken by relevant international organisations, such as the UNDP Disaster Risk Index (UNDP 2004) or the Natural Disaster Hotspot Global Risk Analysis of Columbia University and the World Bank (Dilley et al. 2005). This fact supports the application of these indicators in the analyses presented in this document.

---

<sup>11</sup> Germanwatch alone is responsible for the presented evaluations, analyses and conclusions.

<sup>12</sup> In addition to the NatCatSERVICE of Munich Re it should be referred to the extensive data and analyses of the Centre for Research on the Epidemiology of Disasters (CRED) in Belgium (Guha-Sapir et al. 2004).

<sup>13</sup> The Worldbank makes the following sub-division according to the annual per capita income (in USD): low income, \$825 or less; lower middle income, \$826 - \$3,255; upper middle income, \$3,256 - \$10,065; and high income, \$10,066 or more; see World Bank Data/Country Classification: <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>

In **chapter 5**, the Climate Risk Index (CRI) of the overall most affected countries is then calculated for 2004 and 1995-2004. The analysis is based on the average rank of each country in the four indicators analysed which are thus weighted equally. The calculation of relative figures is an important supplement to the absolute figures since it puts the country-specific data of losses and deaths in relation to the real conditions within the countries. It is for example evident that a damage of 1 billion dollars has a far smaller economic impact on a rich country like the USA than for one of the poorest countries in the world like Nepal. This is underpinned by the relative evaluations. For this, the general data of the United Nations Statistics Division (UN 2006) and the World Bank have been consulted (World Bank 2006). Where published data had not been available in individual cases, they have been found in other sources or approximately calculated. This has especially been the case for data on the Gross Domestic Product (GDP) of very small countries. In few individual cases the data are based on estimations. The ranking of the Down10, however, has not been considerably influenced by this. It is important to point out that the average figures have been influenced in some individual cases by extraordinarily severe events. This is, for example, the case for the extremely high average of fatalities in the period of 1985-1994 in Bangladesh or in the period of 1995-2004 in Venezuela. In Venezuela there has been a catastrophic flood in 1999 with more than 30,000 deaths, and apart from that hardly any other event took place. Where catastrophes like this one distort the overall result to such an extent it is pointed out in the text since it is only partially visible in the figures presented.

**Chapter 6** finally examines the example of the Philippines more specifically. Weather risks and possible measures of adaptation - future ones but also already taken ones - are enormous challenges for this South-East Asian country.

### **Box 2: Overview of the evaluated indicators**

#### **Evaluated indicators:**

- Total death toll
- Deaths per 100,000 inhabitants
- Total losses in USD (original figures, adjusted for inflation)
- Total losses per unit GDP in %

#### **Evaluated period of time:**

- 1985-2004

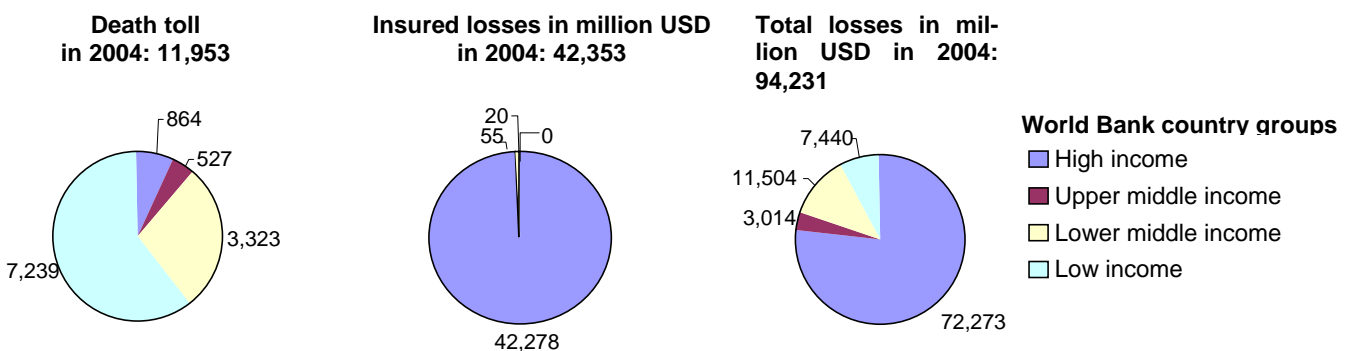
### 3 Country groups in comparison: Deaths and losses caused by weather-related events in 2004

In order to analyse if a general conclusion regarding the relationship between material wealth and affectedness by extreme weather events can be made, a series of analyses has been performed differentiated by country groups. According to the World Bank standards, the world's countries have been divided into four levels of per capita income and for each country group absolute (fig. 3) and relative (fig. 4) indicators of how it has been affected have been calculated.

The following observations and conclusions have arisen from that:

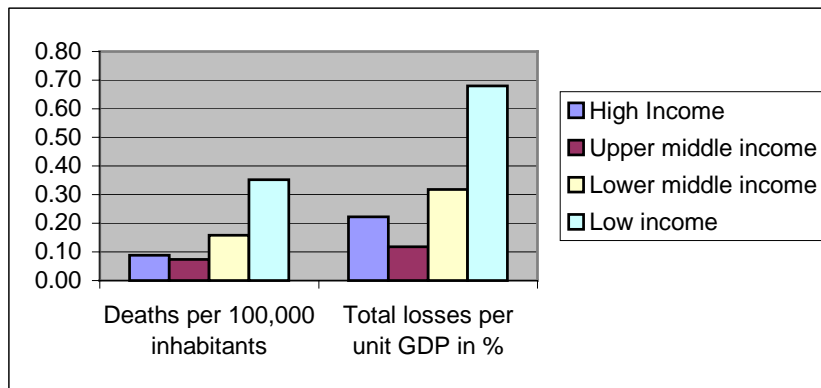
- The richer countries are worst hit financially, both with regard to economic and insured damages.
- In the case of the total economic damages, the distribution, however, is clearly different from the insured damages since the general level of insurance is clearly lower in poorer countries, as shown by data of Munich Re elsewhere (Munich Re 2004).
- In poorer countries an exceptionally large number of people die because of the impacts of weather-related events.
- While the relative figures for fatalities confirm the conclusions drawn from the absolute figures, the relative figures for losses show a different picture than the absolute losses: according to this indicator, the most affected countries are those with the lowest per capita income (fig. 4). This tendency becomes even more evident when the grouping of the countries is made according to the Human Development Index (HDI) (fig. 5). The HDI is based on a more differentiated approach to record the countries' state of development than a pure balancing of the per capita income.<sup>14</sup>

These results underline the thesis that reducing the risks of disasters from extreme weather events is a crucial component when striving for the achievement of the Millennium Development Goals (MDGs) (see also UNDP 2004).



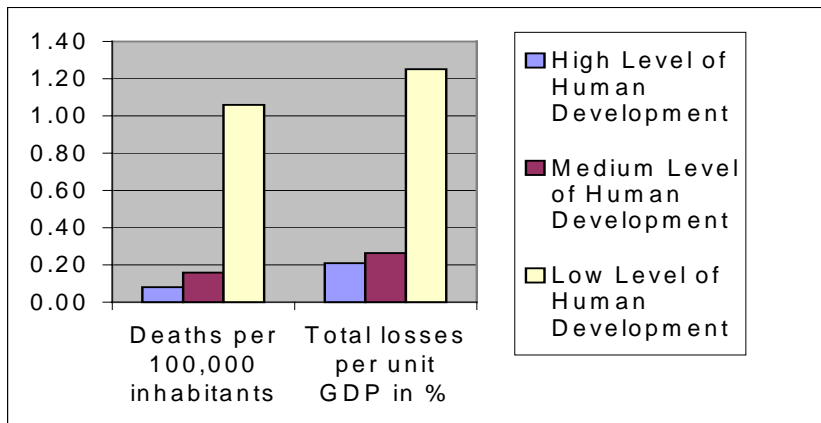
**Fig. 3: Deaths and losses caused by weather events by country group in 2004**

<sup>14</sup> The HDI, which is annually calculated by the United Nations Development Programme (UNDP), considers apart from the per capita income the life expectancy and the educational level; see also UNDP 2005.



**Fig. 4: Relative affectedness with respect to deaths and losses caused by weather events in 2004 by country group based on income.**

The chart shows that the countries with lower per capita income are much more affected.



**Fig. 5: Relative figures for deaths and losses caused by weather events in 2004 for country groups defined on the basis of the Human Development Index (HDI).**

The chart shows that countries with a low level of development are much more affected.

## 4 Countries in comparison: Impacts of weather-related events - the Down 10 in 2004 and long-term comparisons

### 4.1 Death toll

The country with the highest death toll caused by weather-related events in 2004 is Haiti, the fatalities were caused by storms and floods (see table 3). Relatively big, heavily populated countries like China, India and Bangladesh follow. With regard to the fatalities caused by weather events, non-industrialised countries are clearly the most affected, the USA being the only industrialised country in the Down 10. By comparing the values for 2004 with those for the previous year or with long-term analyses it becomes clear that 2004 has been a particularly "bad" year for Haiti or Madagascar. China and Bangladesh, on the other hand, do not contrast much from their long-term average. In China, however, the average numbers of deaths have, despite a population growth, clearly declined compared to the first decade. It may be assumed that the economic boom and targeted measures of poverty reduction have done their bit for a reduction of the vulnerability towards extreme weather.

**Table 3: The 10 countries with the highest death tolls caused by weather-related loss events in 2004 as well as a comparison with the previous year and the long-term average.**

| Rank 2004 (2003) | Country            | Death toll |       | Annual average |           | Deaths per event |      |           |           |
|------------------|--------------------|------------|-------|----------------|-----------|------------------|------|-----------|-----------|
|                  |                    | 2004       | 2003  | 1995-2004      | 1985-1994 | 2004             | 2003 | 1995-2004 | 1985-1994 |
| 1 (29)           | Haiti              | 3,463      | 72    | 382            | 208       | 1,154            | 24   | 201       | 297       |
| 2 (6)            | China              | 1,328      | 1,078 | 1,782          | 2,691     | 78               | 54   | 71        | 131       |
| 3 (3)            | India              | 1,115      | 4,405 | 4,402          | 2,019     | 186              | 245  | 265       | 151       |
| 4 (5)            | Bangladesh         | 1,112      | 1,212 | 812            | 16,553    | 111              | 110  | 67        | 1,562     |
| 5 (9)            | Philippines        | 1,012      | 346   | 497            | 1,032     | 92               | 27   | 44        | 90        |
| 6 (44)           | Dominican Republic | 445        | 22    | 399            | 9         | 148              | 5    | 235       | 7         |
| 7 (11)           | USA                | 299        | 322   | 372            | 283       | 3                | 4    | 3         | 4         |
| 8 (22)           | Madagascar         | 266        | 86    | 84             | 53        | 89               | 21   | 47        | 33        |
| 9 (91)           | Myanmar            | 220        | 0     | 226            | 7         | 220              | 0    | 323       | 12        |
| 10 (13)          | Nepal              | 212        | 308   | 325            | 241       | 53               | 154  | 53        | 134       |

The analysis of the deaths per event provides an indication for the population's vulnerability towards weather events. In Haiti the average in 2004 is very high attributable to two extremely devastating events. The figures of Bangladesh in the decade of 1985-1994

are characterised by a flood event that caused nearly 140,000 fatalities in 1991. The following years could have been characterised by catastrophes of similar dimensions, if there hadn't been effective catastrophe prevention programs. It needs to be added for the USA that the events in 2005 - Hurricane Katrina alone caused more than 1,300 fatalities - that are not mentioned here will cause a significant rise in the figures in future analyses. For Germany, 23 deaths have been registered for 2004 which puts it in rank 39.

### Ten year series

It is noticeable that specific countries appear both among the Down 10 in 2004 and in the two decades, namely Bangladesh, China, India and the Philippines (see table 4). Especially India stands out with its clear increase. Particularly in the last decade the Down 10 table is characterised by extraordinary extreme events. The majority of fatalities in France, Germany and Italy can be traced back to the hot summer of 2003 that caused around 15,000 deaths in France alone. In the context of this study a relevant fact is that there is established scientific indication that the probability of occurrence of such a heat wave in the heart of Europe has been substantially increased through man-made climate change (Stott et al. 2004). This also broke the clear "dominance" of the developing countries, but is so far to be regarded as an exception. The figures of fatalities and losses, however, might also increase in the industrialised countries in the future.

The high figures for Venezuela (1995-2004), Mozambique and Bangladesh (1985-1994) have also been caused by extremely devastating events. In 1999, around 30,000 people died in Venezuela because of floods, in 1985 a long period of drought caused around 100,000 fatalities in Mozambique.

**Table 4: Long-term average of deaths caused by weather-related damage events.**

| 1995-2004 |             |       | 1985-1994 |             |        |
|-----------|-------------|-------|-----------|-------------|--------|
| 1         | India       | 4,402 | 1         | Bangladesh  | 16,553 |
| 2         | Venezuela   | 3,007 | 2         | Mozambique  | 10,039 |
| 3         | China       | 1,782 | 3         | China       | 2,691  |
| 4         | France      | 1,521 | 4         | India       | 2,019  |
| 5         | Bangladesh  | 812   | 5         | Philippines | 1,032  |
| 6         | Germany     | 728   | 6         | Sudan       | 803    |
| 7         | Honduras    | 578   | 7         | Pakistan    | 484    |
| 8         | Viet Nam    | 497   | 8         | Viet Nam    | 457    |
| 9         | Philippines | 497   | 9         | USA         | 283    |
| 10        | Italy       | 445   | 10        | Afghanistan | 273    |

## 4.2 Deaths per 100,000 inhabitants

The calculation of the deaths per 100,000 inhabitants helps to evaluate the impact of the death toll more realistically (see table 5). Because for countries that are heavily populated, absolute death tolls can be expected to be higher compared to less populated ones - if comparable weather risks exist. Thus, countries like China, India and Bangladesh do not appear here anymore; instead, apart from Djibouti, only island states are present in the list, namely extremely small islands that are clearly more exposed to weather events and face them more unprotected (apart from Madagascar where, however, it could not be checked whether the events claimed most of the casualties on the main island or on the smaller ones that belong to Madagascar). Niue is an extreme example in the statistical sense since there has only been one fatality, the country, however, only has around 2,000 inhabitants. Also in this relative analysis of 2004 Haiti is extraordinarily strongly affected.

This can also be seen in comparison with the long-term average figures. The figures for the Dominican Republic, Madagascar and Somalia reveal the same picture. According to this indicator, around half of the countries had practically not been affected in the previous year. For Germany a value of 0.03 arises which puts the country on rank 84.

**Table 5: Down 10 of the most affected countries according to the relative death toll in 2004**

The table shows the values rounded off to one digit, while the calculation was made for two digits behind the decimal point (e.g., in the column Deaths per 100,000 inhabitants / 2004, The Seychelles have a value of 3.52, while the Bahamas have 3.47).

| Rank<br>2004<br>(2003) <sup>15</sup> | Country                     | Deaths per 100,000<br>inhabitants |      | Annual average of deaths per<br>100,000 inhabitants |           |
|--------------------------------------|-----------------------------|-----------------------------------|------|---|-----------|
|                                      |                             | 2004                              | 2003 | 1995-2004   | 1985-1994 |
| 1 (89)                               | Niue                        | 46.4                              | 0    | 5.0*  | 0         |
| 2 (15)                               | Haiti                       | 40.3                              | 0.8  | 4.8   | 3.2       |
| 3 (89)                               | Grenada                     | 36.9                              | 0    | 3.8   | 0         |
| 4 (89)                               | Djibouti                    | 9.8                               | 0    | 1.1   | 2.5       |
| 5 (28)                               | Dominican Republic          | 5.0                               | 0.2  | 4.8   | 0.1       |
| 6 (89)                               | Seychelles                  | 3.5                               | 0    | 0.4   | 0.7       |
| 7 (89)                               | Bahamas                     | 3.5                               | 0    | 0.5   | 0         |
| 8 (89)                               | Northern Mariana<br>Islands | 2.5                               | 0    | 0.3   | 1.2*      |
| 9 (89)                               | Cayman Islands              | 2.3                               | 0    | 1.2   | 0         |
| 10 (18)                              | Madagascar                  | 1.5                               | 0.5  | 0.5   | 0.5       |

\* estimation

<sup>15</sup> In case of equal values, the countries are ranked equally.

### Ten year series

The average values for the last two decades differ clearly from each other (see table 6). For one thing, extremely devastating events affect the balance in this case, just like in the evaluation of the absolute death tolls. This especially applies to Venezuela (1995-2004) as well as Mozambique and Bangladesh (1985-1994), even if Bangladesh is ravaged by weather catastrophes more regularly. Also France only appears because of the hot summer of 2003. For another thing, relatively low populated countries appear like Niue, Micronesia, the Solomon Islands or Vanuatu that all have less than 1 million inhabitants. Furthermore noticeable is the regional dominance of Central America and the Caribbean over the past 10 years. With Honduras, Nicaragua, Haiti, the Dominican Republic, Grenada as well as Antigua and Barbuda six countries of this region alone are part of the Down 10. A regional Human Development Report identified the vulnerability to extreme weather events as one challenge for improving human development which underlines these results (UNDP 2003).

Haiti is the only country appearing in the tables of both decades. The fact that it is constantly strongly affected can be regarded as evidence for the big vulnerability of this extremely poor country, ranked 153 in the Human Development Index analyses. However, the question needs to be raised if catastrophe prevention has been neglected in face of the known hazards.

**Table 6: Long-term average of deaths per 100,000 inhabitants caused by weather-related loss events.**

| 1995-2004 |                     |      | 1985-1994 |                 |      |
|-----------|---------------------|------|-----------|-----------------|------|
| 1         | Venezuela           | 12.5 | 1         | Mozambique      | 70.3 |
| 2         | Honduras            | 9.1  | 2         | Bangladesh      | 15.3 |
| 3         | Nicaragua           | 5.9  | 3         | Solomon Islands | 9.8  |
| 4         | Micronesia          | 5.7  | 4         | Guinea-Bissau   | 5.9  |
| 5         | Papua New Guinea    | 5.2  | 5         | Vanuatu         | 4.5  |
| 6         | Niue*               | 5.0  | 6         | Haiti           | 3.2  |
| 7         | Haiti               | 4.8  | 7         | Sudan           | 3.2  |
| 8         | Dominican Republic  | 4.8  | 8         | Djibouti        | 2.5  |
| 9         | Grenada             | 3.8  | 9         | Greece          | 2.1  |
| 10        | Antigua and Barbuda | 2.8  | 10        | Samoa           | 2.0  |

\*estimation

### 4.3 Total losses in million US Dollars (original damages, adjusted for inflation)

The analysis of total losses (see table 7) also shows a combination of constants as well as exceptions. While the USA, China, Germany and India constantly record high damages, 2004 has been an extreme year for countries like the Cayman Islands, the Seychelles, Kenya and Somalia.

Japan has also been strongly affected in 2004. The year 2003, on the other hand, has been a "benign" year for this country, as the comparison with the average values of the decades shows. In the case of the Cayman Islands, however, it needs to be added that in comparison with countries like Bangladesh or Kenya, a relatively high amount of damage had been insured, around 50 %, which relativises the actual importance of the damages.

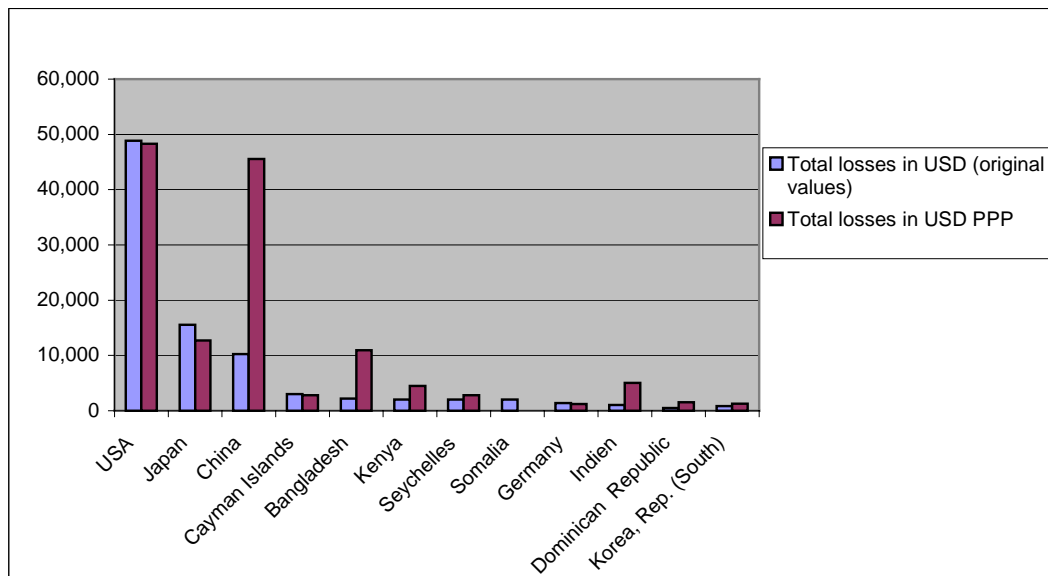
**Table 7: The Down 10 of the most affected countries in 2004 according to the total losses (original values, adjusted for inflation), including the long-term analysis.**

| Rank 2004 (2003) <sup>16</sup> | Country        | Total losses in million USD |        | Annual average |           | Losses per event |      |           |           |
|--------------------------------|----------------|-----------------------------|--------|----------------|-----------|------------------|------|-----------|-----------|
|                                |                | 2004                        | 2003   | 1995-2004      | 1985-1994 | 2004             | 2003 | 1995-2004 | 1985-1994 |
| 1 (1)                          | USA            | 48,824                      | 19,890 | 20,014         | 15,099    | 509              | 240  | 204       | 231       |
| 2 (20)                         | Japan          | 15,537                      | 260    | 3,100          | 2,505     | 914              | 43   | 263       | 261       |
| 3 (2)                          | China          | 10,238                      | 10,671 | 11,376         | 5,608     | 569              | 534  | 451       | 274       |
| 4 (108)                        | Cayman Islands | 3,000                       | 0      | 304            | 2         | 3,000            | 0    | 608       | 25        |
| 5 (43)                         | Bangladesh     | 2,203                       | 9      | 880            | 913       | 220              | 0.8  | 72        | 86        |
| 6 (69)                         | Kenya          | 2,001                       | 0.5    | 204            | 1         | 667              | 0.2  | 71        | 0,6       |
| 7 (108)                        | Seychelles     | 2,000                       | 0      | 200            | 0.1       | 2,000            | 0    | 1,000     | 0.4       |
| 7 (77)                         | Somalia        | 2,000                       | 0.2    | 202            | 2         | 2,000            | 0.1  | 92        | 2         |
| 9 (5)                          | Germany        | 1,366                       | 2,288  | 2,449          | 933       | 59               | 95   | 111       | 49        |
| 10 (8)                         | India          | 1,013                       | 637    | 1,291          | 1,479     | 169              | 35   | 78        | 111       |

Another meaningful evaluation is the calculation of damages in purchasing power parities (PPP)<sup>17</sup> which shows a clearer image of their economic importance (Fig. 6). The total losses in countries like China (now on rank 2), Bangladesh, India, Kenya and the Seychelles are clearly upgraded by this, while those of Japan and the Cayman Islands decrease. The Dominican Republic and South Korea appear as new entries in the Down10 according to this analysis. The USA stay on rank 1 with a slight increase. In the case of Somalia, no data with regard to purchasing power parities could be calculated. In the case of Germany, the value slightly decreases to 1,207 million dollars, which makes the country fall out of the Down 10 in this analysis.

<sup>16</sup> In case of equal values, the countries are ranked equally.

<sup>17</sup> Purchasing power parities are exchange rates that enable a comparison of the GDP that considers the differences in prices between countries.



**Fig. 6: Total losses in US dollars (original values and according to purchasing power parities).**

The calculation of losses according to purchasing power parities shows that poorer countries like China, Bangladesh or Kenya are considerably stronger affected than suggested by the mere values in US dollars.

### Ten year series

The analysis over the decades shows that the USA, China and Japan recorded the highest amount of average losses caused by weather-related events both over the past ten years and in the period between 1985 and 1994 (see table 8). All in all, seven of the most affected countries appear in both periods of time, so there is a certain constancy. As expected, the tables are dominated by countries that due to their big economical potential hold greater values that can be damaged. In the first decade, five of the seven (formerly) major economic powers (G7)<sup>18</sup> appear in the table, between 1985 and 1994 even all seven. The extent of damage shows a clear trend. In those countries appearing in both tables, apart from India, the values for the past ten years are clearly higher, despite the values' adjustment for inflation.

**Table 8: Long-term annual average of the total losses in million dollars (original values, adjusted for inflation).**

| 1995-2004 |                          |        | 1985-1994 |               |        |
|-----------|--------------------------|--------|-----------|---------------|--------|
| 1         | USA                      | 20,014 | 1         | USA           | 15,099 |
| 2         | China                    | 11,376 | 2         | China         | 5,608  |
| 3         | Japan                    | 3,100  | 3         | Japan         | 2,505  |
| 4         | Germany                  | 2,449  | 4         | India         | 1,479  |
| 5         | France                   | 2,137  | 5         | Great Britain | 1,282  |
| 6         | Korea, Dem. Rep. (North) | 1,742  | 6         | Italy         | 1,237  |
| 7         | Italy                    | 1,740  | 7         | France        | 997    |
| 8         | Korea, Rep. (South)      | 1,545  | 8         | Germany       | 933    |
| 9         | India                    | 1,291  | 9         | Canada        | 928    |
| 10        | Spain                    | 1,155  | 10        | Bangladesh    | 913    |

<sup>18</sup> By now China is the fourth largest economic power, but not a member of the G7.

#### 4.4 Total losses in relation to the Gross Domestic Product (GDP)

In contrast to the losses in absolute terms, a clearer picture of how the countries are actually economically affected is given by the relative losses, i.e. the total losses related to the national Gross Domestic Product (here expressed in %) (see table 9). This results in a ranking that clearly differs from the Down 10 of the absolute losses. All ten are developing countries - not one OECD country can be found in the Down 10 now. Similar to the relative death toll, it is again mostly small island states that appear among the ten most affected countries. Just like the absolute annual losses on the Cayman Islands and the Seychelles have been caused by extreme events, the relative affectedness of those countries is extraordinarily high. For both of them, the damages have been more than twice as high as the Gross Domestic Product of the respective year, just like in Somalia. Just for comparison it might be added that for Germany 200% of the GDP would mean a loss of about 5,400 billion USD.

For almost all countries, 2004 has been an extremely devastating year in comparison with the values of the previous year or the long-term trend which is additionally distorted upwards in the last decade mainly because of the year 2004. In this analysis, Germany ranks 35 with a damage of 0.05 % in relation to the GDP.

**Table 9: Total losses in relation to the Gross Domestic Product.**

In comparison with the absolute total losses (see previous section) they show a more realistic image of how countries have been economically affected. Especially poorer countries are among the most affected ones. 2004 has been a year of extreme losses: in the case of the first four countries the damage was more than twice as high (> 200%) as the GDP. For comparison: for Germany this would result in losses of about 5,400 billion USD.

| Rank 2004<br>(2003) <sup>19</sup> | Country        | Total losses per<br>unit GDP in % |      | Annual average of total<br>losses per unit GDP in % |           |
|-----------------------------------|----------------|-----------------------------------|------|---|-----------|
|                                   |                | 2004                              | 2003 | 1995-2004   | 1985-1994 |
| 1 (69)                            | Seychelles     | 284.3                             | 0    | 32.4  | 0.03      |
| 2 (50)                            | Somalia        | 221.3                             | 0.01 | 12.6  | 0.38      |
| 3 (69)                            | Grenada        | 206.4                             | 0    | 24.4  | 0.05      |
| 4 (69)                            | Cayman Islands | 200.9                             | 0    | 25.3  | .*        |
| 5 (69)                            | American Samoa | 34.3                              | 0    | .*  | .*        |
| 6 (69)                            | Kenya          | 12.8                              | 0    | 1.8   | 0.01      |
| 7 (69)                            | Bahamas        | 9.5                               | 0    | 4.5   | 0.01      |
| 8 (69)                            | Niue           | 7.7                               | 0    | .*  | .*        |
| 9 (69)                            | Jamaica        | 7.2                               | 0    | 0.9   | 5.6       |
| 10 (48)                           | Bangladesh     | 3.9                               | 0.02 | 1.9   | 3.3       |

\*no adequate basis of data on GDP available

<sup>19</sup> In case of equal values countries are ranked equally.

### Ten year series

The following analysis demonstrates how countries have been economically affected on a relative scale by weather events over the decades. The results show an image that clearly differs in parts from the ranking in 2004 and even more clearly from the analysis of the absolute damages over the decades (see table 10). When calculating the average values of the last decade, the extreme values for the Seychelles, the Cayman Islands and Grenada put the three countries on the first ranks again. The weather-related extreme events of the past decade played a very dominant role for the Caribbean. Apart from the Cayman Islands also St. Kitts and Nevis, Dominica and Honduras are located in this region. They are directly followed by Belize, Antigua and Barbuda and the Bahamas which cannot be seen on the table because it is restricted to the Down10. It is interesting to see that the evaluations for the ten years between 1985 and 1994 show completely different values; here the Caribbean states are less present (Virgin Islands and Jamaica). This points to an increase in intensity in the case of hurricanes, as it has scientifically been observed (ECF/PIK 2004; Kerr 2005; Faust 2006). There are more and more indications that climate change plays an important role for these changes, even if the dimension of its influence is not yet to be clearly determined. In any case it shows that especially small island states in the Caribbean and the Pacific are particularly vulnerable towards the impacts of climate change (see also IPCC 2001). These figures underline results of the Natural Disaster Hotspots Project carried out by the World Bank and Columbia University, where the Caribbean has been identified as a region with high proportional economic loss risks from hydrologic disasters (Dilley et al. 2005).

**Table 10: Long-term average of total losses in relation to the Gross Domestic Product in %.**

| 1995-2004 |                          |       | 1985-1994 |                      |      |
|-----------|--------------------------|-------|-----------|----------------------|------|
| 1         | Seychelles               | 32.4  | 1         | Western Samoa        | 44.8 |
| 2         | Cayman Islands           | 25.3  | 2         | Montserrat           | 36.6 |
| 3         | Grenada                  | 24.4  | 3         | Vanuatu              | 13.8 |
| 4         | Mongolia                 | 17.8  | 4         | Swaziland            | 13.0 |
| 5         | Virgin Islands (USA)     | 17.0* | 5         | Cook Islands         | 11.1 |
| 6         | Korea, Dem. Rep. (North) | 15.9  | 6         | Virgin Islands (USA) | 7.9  |
| 7         | St. Kitts and Nevis      | 14.2  | 7         | Armenia              | 6.8  |
| 8         | Somalia                  | 12.6  | 8         | Jamaica              | 5.6  |
| 9         | Dominica                 | 8.0   | 9         | Tajikistan           | 4.7  |
| 10        | Honduras                 | 7.1   | 10        | Georgia              | 4.6  |

\* estimation

## 5 The Climate Risk Index as a synthesis of the individual analyses: The 10 most affected countries

The Climate Risk Index (CRI) forms the synthesis of the four previously introduced analyses. All four indicators - death toll, deaths per 100,000 inhabitants, total losses in USD and total losses in relation to GDP in % - are equally weighted. The index value is calculated from the rankings in the individual categories. It constitutes the average ranking of a country in the four categories. This represents a simple and transparent approach to balance absolute and relative indicators. Below, the results for 2004 and the last 10 years are presented.

### 5.1 The 10 most affected countries in 2004

According to this synthesis, **Somalia** was the most affected country in 2004. The reason for this is obviously a devastating flood event that cost 150 lives and caused losses of 2 billion dollars in a country which is extremely vulnerable due to internal conflicts and wide-spread poverty. The **Dominican Republic** is part of the Caribbean and therefore of a climatically highly sensitive region that is often ravaged by tropical storms (see 4.4). The majority of damages in 2004 in this area was caused by two devastating storm events, the fatalities primarily by floods. **Bangladesh** was primarily affected by floods in 2004, both with regard to casualties and absolute damages. The latter, however, have also been clearly above the long-term average, contrary to the casualties. Bangladesh belongs to those countries that will particularly be affected by climate change, since various dangers like sea level rise, the intensification of extreme weather events, possible changes of the monsoon (see above) or the melting of the glaciers in the Himalaya are combined in this region and threaten the heavily populated and extremely vulnerable country (ECF/PIK 2004; Schneider/Lane 2006; Huq 2001).

The combination of relative and absolute indicators relativises the dominance of particularly heavily populated or economically particularly powerful countries. It is to be expected that there are constantly higher death tolls in China, Bangladesh and India compared to other countries due to their large populations. Nevertheless, any fatality is a fatality per se, of course, no matter whether it is in a heavily populated or a poor country. And the same holds true for the overall damages in the richest economies USA and Japan. Where many values are accumulated, much damage can be caused.

Finally - as an orientation related to development policy - the values and rankings in the Human Development Index (HDI) help to judge the respective state of development of each country.

Among the Down10, with **Japan** and the **USA** there are only two industrialised countries that are ascribed to the highly developed countries according to the HDI. Their relatively high ranking is primarily due to the high absolute overall damages, where the USA ranks first, Japan second.

Without this ranking they would have fallen out of the Down 10, although their death tolls are also quite high. The vast majority of the countries among the Down 10 are beyond rank 80 in the HDI.

In the case of Somalia, no HDI values could have been calculated yet. In any case, however, the UN regards Somalia as one of the Least Developed Countries (UN 2006).

**Germany** achieves an average rank of 41.75 in the four partial rankings, resulting in rank 33 on the overall ranking. The country has only been part of the Down 10 with regard to

the absolute overall damages, mainly caused by storms, with damages in 2003 having been considerably higher than in 2004 (see 4.3).

**Table 11: Climate Risk Index: the 10 most affected countries of the year 2004.**

The Index is calculated as the average rank of each country in the four analysed indicators (the ranking in the Human Development Index HDI is listed in the right column for comparison only). Somalia as the most affected country, for example, achieves an average rank of 8.5, among others with rank 7 in the overall damages and rank 2 in damages per Gross Domestic Product (GDP). The ranking is strongly dominated by countries that rank low in the HDI.

|    | Country                   | Index value <sup>20</sup> | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank total losses per GDP | For comparison: Rank in HDI 2003 <sup>21</sup> |
|----|---------------------------|---------------------------|-----------------|-------------------------------------|-------------------|---------------------------|--|
| 1  | <b>Somalia</b>            | <b>8.50</b>               | 14              | 11                                  | 7                 | 2                         | -  |
| 2  | <b>Dominican Republic</b> | <b>9.00</b>               | 6               | 5                                   | 14                | 11                        | 95   |
| 3  | <b>Bangladesh</b>         | <b>9.75</b>               | 4               | 20                                  | 5                 | 10                        | 139  |
| 4  | <b>Philippines</b>        | <b>16.75</b>              | 5               | 13                                  | 26                | 23                        | 84   |
| 5  | <b>China</b>              | <b>16.75</b>              | 2               | 48                                  | 3                 | 14                        | 85   |
| 6  | <b>Nepal</b>              | <b>17.00</b>              | 10              | 18                                  | 28                | 12                        | 136  |
| 7  | <b>Madagascar</b>         | <b>17.25</b>              | 8               | 10                                  | 35                | 16                        | 146  |
| 8  | <b>Japan</b>              | <b>18.25</b>              | 11              | 42                                  | 2                 | 18                        | 11   |
| 9  | <b>USA</b>                | <b>18.25</b>              | 7               | 48                                  | 1                 | 17                        | 10   |
| 10 | <b>Bahamas</b>            | <b>20.00</b>              | 51              | 7                                   | 15                | 7                         | 50   |
| 33 | <b>Germany</b>            | <b>41.75</b>              | 39              | 84                                  | 9                 | 35                        | 20   |

## 5.2 The 10 most affected countries in 1995-2004

The Down10 of the Climate Risk Index for the last decade shows results differing in many points compared to 2004.

**Honduras** has been the most affected country regarding the average impacts of the last decade, with Down10 ranks in death toll, deaths per 100,000 inhabitants and total losses related to GDP.

However, more than 90% of the deaths and also the losses were caused by one single event, hurricane Mitch in 1998. This event had a devastating impact on the country's economic and social system.

Mitch also hit **Nicaragua** with a similar impact. The **Dominican Republic** in addition was affected very much in 2004, which made up its rank 2 in the CRI for 2004.

Almost all the deaths in **Venezuela**, as has already been discussed in chapter 4.1, occurred with the floodings in 1999.

**Viet Nam** is one of the countries which have been very constantly affected by extreme weather events in the last decade. In six out of ten years more than 500 deaths and more than 300 million USD total losses were reported.

In **France** and **Germany** (Rank 11) the 2003 extreme heatwave impacted their position in the ranking very much through the large number of fatalities. Nevertheless, in both countries there have also been significant economic losses in the last 10 years, higher in aver-

<sup>20</sup> In case of equal index values, the rank in deaths per 100,000 inhabitants determines the overall rank.

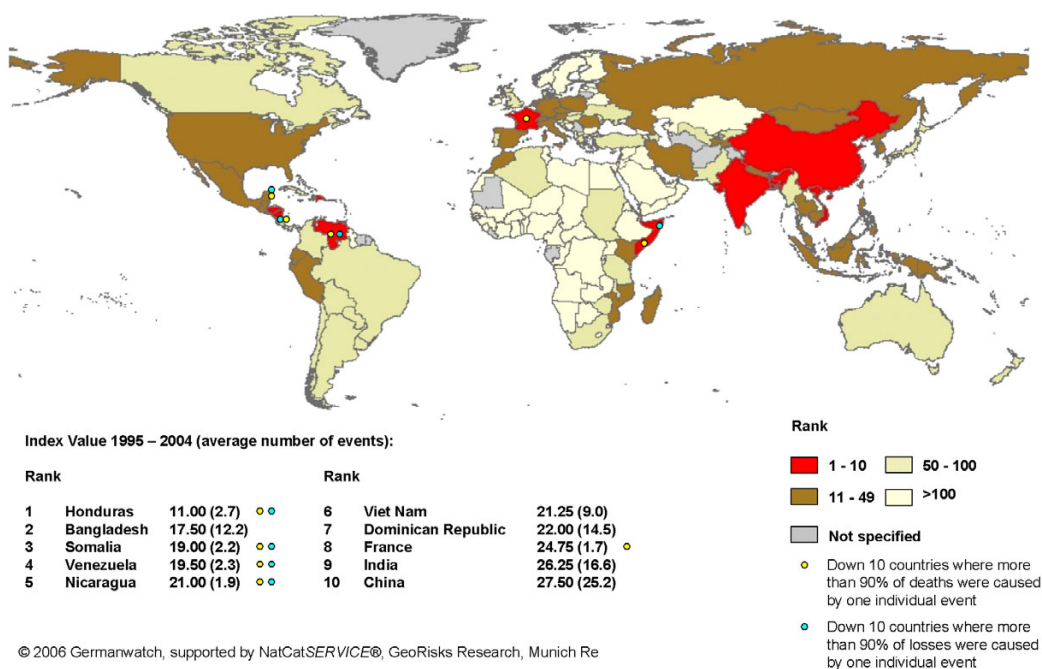
<sup>21</sup> UNDP 2005

age than in 2004, caused by a large number of loss events (an average of 14.5 events in France and 22 in Germany). For example, storm events in France in 1999 led to losses of more than 12,000 million USD.

**Bangladesh, China and India** also experienced a large number of events throughout the decade, some of them with devastating impacts. They are among those countries with the highest number of events.

**Table 12: Climate Risk Index: the 10 most affected countries of the years 1995-2004.**

|    | Country            | Index Value | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank total losses per GDP | For comparison: Rank in HDI 2003 |
|----|--------------------|-------------|-----------------|-------------------------------------|-------------------|---------------------------|----------------------------------|
| 1  | Honduras           | 11.00       | 7               | 2                                   | 25                | 10                        | 116                              |
| 2  | Bangladesh         | 17.50       | 5               | 34                                  | 14                | 17                        | 139                              |
| 3  | Somalia            | 19.00       | 20              | 12                                  | 36                | 8                         | -                                |
| 4  | Venezuela          | 19.50       | 2               | 1                                   | 28                | 47                        | 75                               |
| 5  | Nicaragua          | 21.00       | 16              | 3                                   | 50                | 15                        | 112                              |
| 6  | Viet Nam           | 21.25       | 8               | 30                                  | 24                | 23                        | 108                              |
| 7  | Dominican Republic | 22.00       | 11              | 8                                   | 41                | 28                        | 95                               |
| 8  | France             | 24.75       | 4               | 11                                  | 5                 | 79                        | 16                               |
| 9  | India              | 26.25       | 1               | 44                                  | 9                 | 51                        | 127                              |
| 10 | China              | 27.50       | 3               | 79                                  | 2                 | 26                        | 85                               |
| 11 | Germany            | 29.50       | 6               | 20                                  | 4                 | 88                        | 11                               |



**Fig. 7: Climate Risk Index: The 10 most affected countries of the years 1995-2004.**

## 6 Case study: The Philippines

The Philippines are situated in South-East Asia as an archipelago between the Philippine Sea and the South China Sea. The country has a total area of around 300,000 km<sup>2</sup>. The Philippines with their large amount of islands have a comparatively long coast line of altogether 36,289 km, which is roughly the equivalent of the earth's circumference. With a total number of around 87.8 million inhabitants the country is very populous (292 inhabitants per km<sup>2</sup>). The Philippines are part of a region with a high climatic variability. The South-East Asian tropics are characterised by the change between dry period and rainy season that are influenced by intensive trade wind and the Tropical Convergence Zone. The economic activities are strongly influenced by sudden seasonal and annual changes in precipitation and temperatures. Population and economy of the Philippines have to deal with various weather and other natural risks. On average, around 20 tropical typhoons pass over the Philippine sovereign territory each year, 8 or 9 of which strike the country endangering a large number of people exposed to these risks (Greenpeace 2005; UNDP 2004). They constantly involve severe precipitation and considerable floods.

In addition to this, the country is repeatedly affected by droughts that are partially caused by El Nino. Statistics also show a multitude of earthquakes. According to the data of Munich Re, events of all types have been registered on the Philippines within 14 of the 25 evaluated years (both weather-related and geological).

### 6.1 Climate trends and hazards

Today's as well as future weather-related climate risks for the Philippines can be attributed to four phenomena:

- Changes in the precipitation regime;
- Rise in temperature;
- Increase of risk caused by typhoons;
- Drought caused by El Nino events.

Figure 8 shows a synopsis of projections in relation to those four aspects, on the basis of which the endangerment of the various regions is evaluated. Especially the risks caused by a change in precipitation and by typhoons are regarded as considerably relevant. Another direct risk is the expected sea level rise as well as indirect impacts, like the impacts of the abovementioned factors on agricultural productivity or the intensified pressure on forests caused by drought. Scientific evaluations indicate both a rise in the average temperature in the past 40 years and increasing fluctuations in temperature that amplify since the beginning of the 1980s. The temperature trend is altogether consistent in comparison with other countries in this region (Greenpeace 2005).

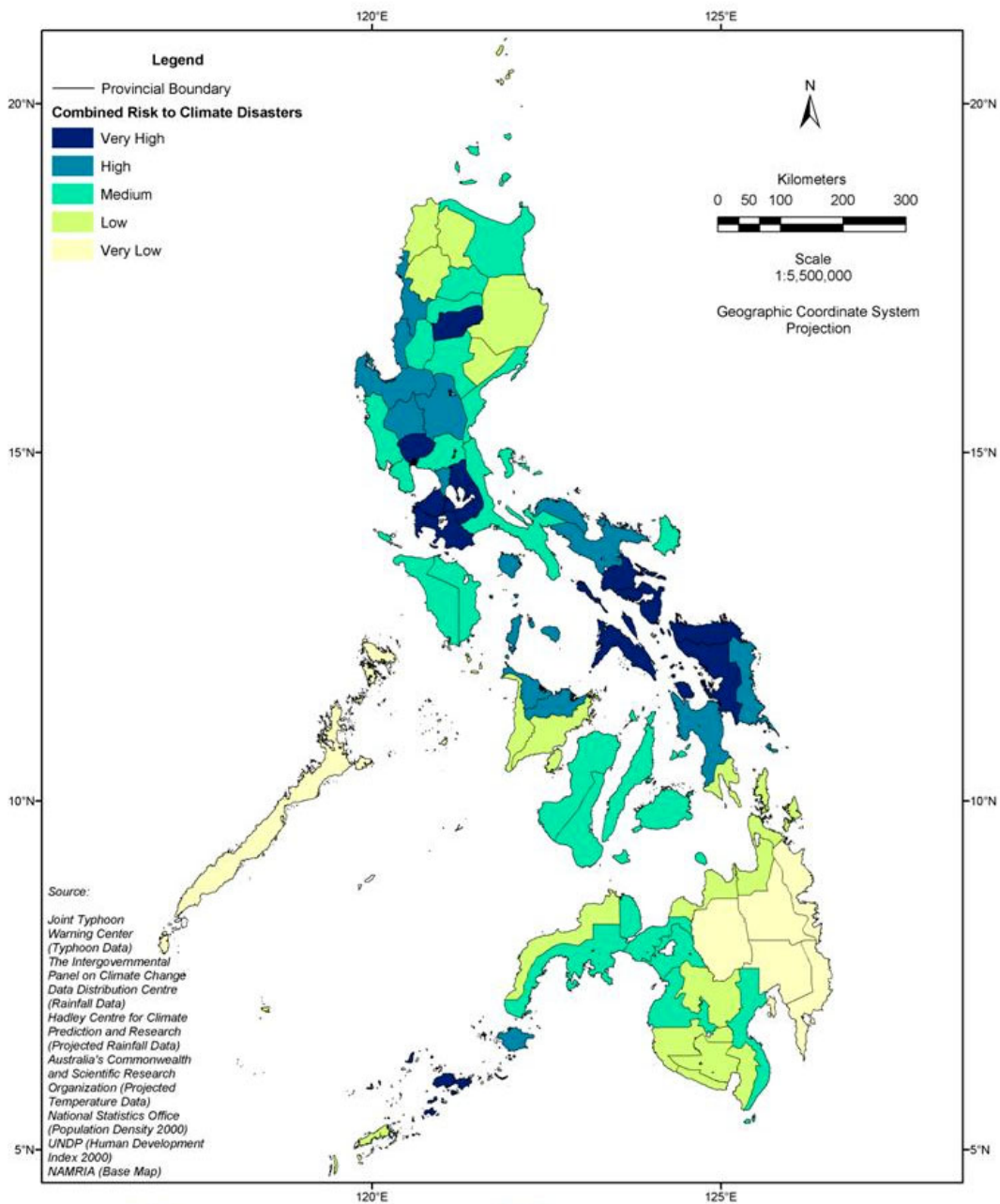
Simultaneously, the overall precipitation decreased over the past 100 years by ca. 6%, especially in winter (dry period) between December and February (Hulme/Sheard 1999). Although the dimension of the previous sea level rise does not show a clear trend, the possible rise in the future will involve great danger. The Philippines feature an enormous coast line, where 10 of the country's biggest cities are situated (Hulme/Sheard 1999). A significant long-term rise will therefore endanger both the living space and the industrial area of a wide range of people.

Manila Bay, for example, is considered to be the second most productive fishing ground in the country. Drinking water reservoirs might lose their vital function, caused by intrusion of salt water.

A rise of 30 cm by 2045 might endanger more than 2,000 hectares and around 500,000 people.

The possible damage of mangroves, seaweed and other marine ecosystems from climate change could endanger the economic existence particularly for the poor coastal population.

For the future, an intensification of floods and drought caused by El Nino is considered likely (IPCC 2001). Both drought caused by El Nino and intense precipitation, storms and floods due to La Nina have left their marks in both population and economy. Particularly during the past 30 years, an increase in number and intensity of El Nino/La Nina events can be noticed.



**Fig. 8: Endangerment of Philippine regions towards climate change.**

For the purpose of this evaluation, projections on the change of precipitation, the rise in temperature and the risks caused by typhoons and drought caused by El Nino have been aggregated (Manila Observatory 2005).

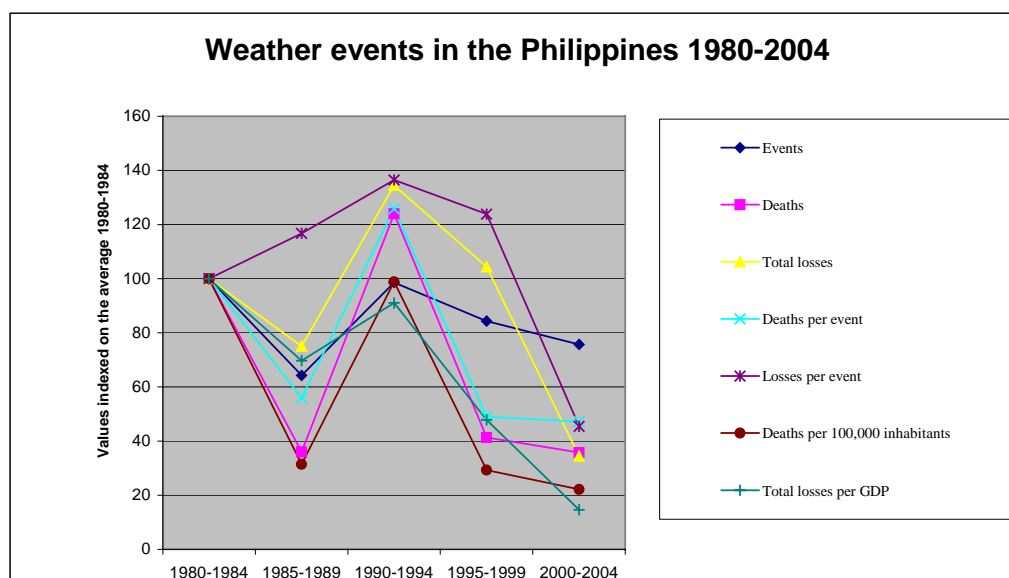
## 6.2 Weather-related loss events on the Philippines 1980-2004

For 2004, altogether 11 events that cost 1012 lives and caused economic losses in the amount of 120.95 million dollars are registered in the database of Munich Re (see table 13). In 2004, the country ranked 4th in the Climate Risk Index of the countries most affected by weather events (see table 11) and rank 18 in the decadal analysis (1995-2004). The figures for 2004 are in no way extraordinarily high. During the past 25 years, higher losses have been registered eight times, within five annual periods more people died. Nevertheless, the comparison in the Climate Risk Index with other countries shows that the Philippines are exposed to serious and regularly occurring weather risks.

**Table 13: Weather damage events on the Philippines in 2004.**

| Category                               | Events | Deaths | Insured losses in million US\$ | Total losses in million US\$ |
|--|--------|--------|--------------------------------|------------------------------|
| Storms                                 | 8      | 960    | 0                              | 100.85                       |
| Floods                                 | 2      | 44     | 0                              | 20.05                        |
| Extreme temperature and mass movements | 1      | 8      | 0                              | 0.05                         |

Figure 9 shows the results of the data evaluation for the past 25 years. Altogether, almost 300 weather-related damage events have been registered that cost more than 21,700 lives and caused losses of more than 4.3 billion US dollars. The average of the years 1980-1984 constitutes a base value for all considered indicators, in order to enable comparability of the development for the different indicators. The period between 1990 and 1994 stands out in the case of almost all indicators, primarily due to a devastating typhoon in 1991 that claimed over 6000 fatalities. Altogether, all lines show a decreasing trend over the past ten years and some even a decreasing trend on the whole compared to 1980-1984 if the period between 1990 and 1994 is left out due to the particularly extreme event. In spite of that, however, clear differences are noticeable.



**Fig. 9: Weather-related loss events 1980-2004: development of various indicators of affectedness.**

In order to decrease the influence of extreme values, the figure shows average values over periods of five years.

The average of the past five years, for example, shows a clear decrease particularly in the case of damages, much more clearly than the decrease in events. So a disproportionate mitigation can be identified here. This might be a response to the relatively effective catastrophe prevention work on the Philippines. Particularly in the case of the overall damages, some kind of a trend reversal is noticeable in comparison with the first ten years. One constant noticeable factor is also the decline of how the country has been economically affected - overall damages in relation to GDP - since the higher values in the period between 1990 and 1994. The event-specific death toll, however, has rather stayed constant, while the death toll per 100,000 inhabitants has decreased even more.

### **Box 3: Adaptation to climate change using the example of the Philippine National Red Cross**

#### **The Philippine National Red Cross: Integrated Community Disaster Planning Programme (ICDPP) (since 1995)**

The program consists of six steps:

- 1. Partnership with municipal and provincial government units:** This helps to root the preparedness concept in local planning, to gain technical and financial support for mitigation measures, and to ensure the programme's long-term sustainability.
- 2. Community disaster action team formation and training:** The core of the programme is the group of community volunteers (including fishermen, women, youth and businessmen) who are trained in vulnerability and capacity assessments, disaster management and information dissemination. They work with the community to prepare a disaster action plan.
- 3. Risk and resources mapping:** This identifies the most important local hazards, who and what may be at risk, and which mitigation measures are possible. The maps are often employed as land use planning tools by local government units.
- 4. Community mitigation measures:** Based on the disaster action plan, the community will initiate mitigation measures, which may be physical structures (e.g. seawalls, evacuation centres), health related measures (e.g. clean water supply) or planning tools (e.g. land use plans, evacuation plans). These measures are undertaken by community volunteers with support from the Red Cross and local government.
- 5. Training and education:** This is integral to all steps of the programme – both in training the disaster action teams and in disseminating information to the whole community.
- 6. Sustainability:** Long-term impact can only be ensured by embedding the concept of communitybased disaster preparedness within local government units (LGUs). This means incorporating the recommendations of community disaster action plans into LGU land use planning and annual budgeting. Sustainability also implies regular update training of the disaster action teams.

The program is run in 75 rural communities in altogether 5 provinces. 105 projects have been realised since the beginning of the program (IFRC 2003).

### **6.3 Adaptation to climate change**

The dangers posed by global warming are not ignored in the Philippines - a country that is so much characterised by weather events. In the "Initial National Communication" to the Climate Secretariat of the UN, the government refers to its country as "considerably vulnerable towards the impacts of climate change" (Philippines 1999: XV). The amount of weather events shows that already now, irrespective of future climate change, measures of prevention and adaptation to storms, floods and drought are due. Adaptation to already known climate risks, however, is considered to be the first central step to a preparation for future risks of climate change which are not exactly known yet.

The various risks certainly demand various measures. The sea level rise needs to be dealt with differently than the danger of intense typhoons. Some measures are more expensive, like the stabilizing of the coast against sea level rise, some less, like early warning systems based on "traditional" communication technology. Indigenous communities on the Philippines, for example, use horns and drums to spread information about approaching weather extremes among the population (Tibig 2003). In its project "Integrated Community Disaster Planning Programme (ICDPP)", the Philippine Red Cross banks on a series of measures that are particularly to enhance the population's or specific local peoples' knowledge about action as well as the capacity to act (see box 3). The "Citizens' Disaster Response Center" that has, according to own statements, reached more than 3 million Filipinos with its activities, has already taken an active part in catastrophe prevention for 20 years now. With a network of regional centres, the organisation works in the whole country (CDRC 2006). The capacity to act and responsibility of the local players/population plays an important role in the adaptation to climate risks, since the local environmental, economic and social conditions decisively characterise the vulnerability and resistibility of the people towards extreme weather events and therefore also the dimensions of the floods', typhoons' and heatwaves' impacts. The exemplarily mentioned activities of the two organisations start with this premise.

Additionally, approaches to action can be followed at other levels like

- Development of a strategic policy framework for climate change adaptation measures at national level;
- Harmonisation and integration of adaptation to climate change into sustainable economic development;
- Registration of all factors relevant to vulnerability as well as
- Development of adaptation strategies, including various levels of territorial or time planning, in order to meet the locally and regionally differing requirements concerning financial, technical and political instruments (Goco 2005).

### **6.4 Conclusion**

The Philippines are exposed to a wide range of weather risks that might partially aggravate in the future due to anthropogenic climate change. There are, however, a range of initiatives that have already taken an active part in taking measures to prevent weather-related catastrophes for several years now and have supported a wide range of people with their efforts. It is hard to tell how much it is due to these initiatives that the situation with regard to the death toll and the number of economic damages has rather improved over the past years than aggravated. Those activities, however, unquestionably help to deal with the future challenges and dangers of climate change, as long as they keep within reasonable limits that do not exceed the adaptive capacity of the country, its inhabitants and its economy.

## 7 Literature

- Brauch, H.G. (2005): Threats, Challenges, Vulnerabilities and Risks in Environmental and Human Security. SOURCE Publications Series No.1/2005. United Nations University UNU-EHS. Bonn.
- Cardona, O.D. et al. (2004): Results of Application of the System of Indicators on Twelve Countries of the Americas. IDB/IDEA Program of Indicators for Disaster Risk Management, Manizales: National University of Colombia. Download at <http://idea.manizales.unal.edu.co/ProyectosEspeciales/adminIDEA/CentroDocumentacion/DocDigitales/documentos/04%20Results%20-%20System%20of%20Indicators%20IADB-IDEA%20Phase%20III%20M1.pdf> on 7 June 2006.
- Carreño, M.L., Cardona, O.D., Barbat, A.H. (2006, in press). A disaster risk management performance index, *Journal of Natural Hazards*, Springer.
- CDRC (2005): <http://www.cdrc-phil.org>
- Climate Action Network (2002): Preventing dangerous climate change. Download at <http://www.climateactionnetwork.org/docs/CAN-adequacy30102002.pdf> on 7 June 2006.
- Dilley, M. (2005): Natural Disaster Hotspots – a global risk analysis. Synthesis Report. Download at <http://sedac.ciesin.columbia.edu/hazards/hotspots/synthesisreport.pdf> on 7 June 2006.
- Emanuel, K. (2005): Increasing destructiveness of tropical cyclones over the past 30 years. *Nature* 436:686-688.
- Faust, E. (2006): Verändertes Hurrikanrisiko, Januar 2006, Aktualisierung zum Abschluss der Hurrikansaison 2005. Download at [http://www.munichre.com/assets/pdf/georisks/changing\\_hurricane\\_risk\\_de.pdf?rdm=2](http://www.munichre.com/assets/pdf/georisks/changing_hurricane_risk_de.pdf?rdm=2) on 31 January 06.
- Goco, J. (2005): Philippine Vulnerability Assessment and Adaptation Experience. Download at [http://www.ap-net.org/docs/15th\\_seminar/philippines\\_050912\\_aps3.pdf](http://www.ap-net.org/docs/15th_seminar/philippines_050912_aps3.pdf) on 17 December 05.
- Greenpeace (2005): Crisis or opportunity: climate change impacts. Download at <http://www.greenpeace.org/raw/content/seasia/en/press/reports/crisis-or-opportunity.pdf> on 15 December 05.
- Guha-Sapir, D./Hargitt, D./Hoyois, P. (2004): Thirty years of natural disasters 1974-2003: The numbers. Louvain-la-Neuve.
- Hadley Centre (2005): Stabilising climate to avoid dangerous climate change - a summary of relevant research at the Hadley Centre. Download at [http://www.metoffice.com/research/hadleycentre/pubs/brochures/2005/CLIMATE\\_CHANGE\\_JOURNAL\\_150.pdf](http://www.metoffice.com/research/hadleycentre/pubs/brochures/2005/CLIMATE_CHANGE_JOURNAL_150.pdf) on 15 December 05.
- Hulme, M. and Sheard, N. (1999) Climate Change Scenarios for the Philippines Climatic Research Unit. Norwich, UK. Download at [www.cru.uea.ac.uk/~mikeh/research/philippines.pdf](http://www.cru.uea.ac.uk/~mikeh/research/philippines.pdf) on 18 December 05.
- Huq, S. (2001): Climate Change and Bangladesh. In *Science* November 2001, Vol. 294. Nr. 5547. S. 1617ff.
- IFRC (2003): Risk reduction in practice: a Philippines case study. Download at [http://maindb.unfccc.int/public/adaptation/adaptation\\_casestudy.pl?id\\_project=73](http://maindb.unfccc.int/public/adaptation/adaptation_casestudy.pl?id_project=73) on 18 December 05.
- IPCC (2001): Climate Change 2001 - Synthesis Report, Genf, <http://www.ipcc.ch>.
- Manila Observatory (2005): Mapping Philippine Vulnerability to Environmental Disasters. Download at [http://www.observatory.ph/vm/cw\\_maps.html](http://www.observatory.ph/vm/cw_maps.html) on 27 January 06.
- Munich Re (2003): NatCatSERVICE® - a guide to the Munich Re database for natural catastrophes. Munich. Download at [http://www.munichre.com/publications/302-03901\\_en.pdf](http://www.munichre.com/publications/302-03901_en.pdf) on 7 June 2006.
- Munich Re (2004): Topics Geo – Natural catastrophes 2003. Download at [http://www.munichre.com/publications/302-04772\\_en.pdf?rdm=46545](http://www.munichre.com/publications/302-04772_en.pdf?rdm=46545) on 7 June 2006.
- Munich Re (2005): MunichRe (2005) Megacities – Megarisks: Trends and challenges for insurance and risk management. Knowledge Series. Download at [http://www.munichre.com/publications/302-04271\\_en.pdf?rdm=43386](http://www.munichre.com/publications/302-04271_en.pdf?rdm=43386) on 7 June 2006.

- Munich Re (2006): Topics Geo – Annual review: Natural catastrophes 2005. Download at [http://www.munichre.com/publications/302-04772\\_en.pdf?rdm=46545](http://www.munichre.com/publications/302-04772_en.pdf?rdm=46545) on 7 June 2006.
- Pan-American Health Organization (POHA) (2006): Disasters: Preparedness and mitigation in the Americas. Newsletter. Available at <http://www.paho.org/english/dd/ped/newsletter.htm>
- Pezza, A./Simmonds, I. (2005): The First South Atlantic Hurricane: Unprecedented Blocking, Low Shear, and Climate Change. *Geophysical Research Letters* 32(L15712). 12 August 2005.
- Philippines (1999): The Philippines' Initial National Communication on Climate Change. Download at <http://unfccc.int/resource/docs/natc/phinc1.pdf> on 14 December 05.
- Rahmstorf, S. et al. (2005): Hurricanes and Global Warming - Is There a Connection? <http://www.realclimate.org> on 2 September 05.
- Ridgwell, A.J. (2002): Dust in the Earth system: The biogeochemical linking of land, air, and sea. Download at [http://merlin.eos.ubc.ca/publications/ridgwell\\_2002.pdf](http://merlin.eos.ubc.ca/publications/ridgwell_2002.pdf) on 14 December 05.
- Schellnhuber, H.J. (Ed.) (2006): *Avoiding dangerous climate change*. Cambridge University Press, Cambridge. Download at <http://www.defra.gov.uk/environment/climatechange/internat/dangerous-cc.htm> on 31 January 2006.
- Schneider, S.H./Lane, J. (2006): An overview of "dangerous" climate change. In: *Avoiding dangerous climate change*. Schellnhuber H.J. (Ed.). Cambridge University Press, Cambridge.
- Stern, N. (2006a): What is the Economics of Climate Change? Stern Review on the Economics of Climate Change. Discussion Paper. Download at [http://www.hm-treasury.gov.uk/media/213/42/What\\_is\\_the\\_Economics\\_of\\_Climate\\_Change.pdf](http://www.hm-treasury.gov.uk/media/213/42/What_is_the_Economics_of_Climate_Change.pdf) on 27 February 06.
- Stern, N. (2006b): What is the Economics of Climate Change? Stern Review on the Economics of Climate Change. Discussion Paper. Technical Annex: The science of climate change. download at [http://www.hm-treasury.gov.uk/media/695/0E/Oxonia\\_Technical\\_Annex\\_FINAL.pdf](http://www.hm-treasury.gov.uk/media/695/0E/Oxonia_Technical_Annex_FINAL.pdf) on 27 February 06.
- Stott, P.A./Stone, D.A./Allen, M.R. (2004): Human contribution to the European heatwave of 2003. In: *Nature*, Vol. 432, p. 610-614.
- Tibig, L. (2003): Local Coping Strategies and Technologies for Adaptation in the Philippines. Download at [http://maindb.unfccc.int/public/adaptation/adaptation\\_casestudy.pl?id\\_project=22](http://maindb.unfccc.int/public/adaptation/adaptation_casestudy.pl?id_project=22) on 12 December 05.
- UN (2006): United Nations Statistics Division, <http://unstats.un.org/unsd/>
- UNDP (2002): *Living with risk - A global review of disaster reduction initiatives*. Download at [http://www.undp.org/bcpr/disred/documents/publications/isdr\\_livingwithrisk2002.pdf](http://www.undp.org/bcpr/disred/documents/publications/isdr_livingwithrisk2002.pdf) on 7 June 2006.
- UNDP (2004): *Reducing disaster risk – a challenge for development. A global report*. Download at <http://www.undp.org/bcpr/disred/rdr.htm> on 7 June 2006.
- UNDP (2005): *Human Development Report 2005 - International cooperation at a crossroads: Aid, trade and security in an unequal world*. Download at <http://hdr.undp.org/reports/global/2005/> on 12 December 05.
- UNFCCC (2006): *Adaptation. Local coping strategies data bank*. Available at <http://maindb.unfccc.int/public/adaptation/>
- Webster, P.J. et al. (2005): Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment. *Science* 309: 1844:1846.
- Wirtz, A. (2006): personal communication, Munich Re.
- World Bank (2006): *World Development Indicators Data Query*. Download at <http://devdata.worldbank.org/data-query/> on 14 December 2005.

## 8 Annex

**Table 14: Analysis of weather-related events:  
Partial indicators 2004**

| Country                        | Death toll | Deaths per 100,000 inhabitants | Total losses in million USD | Total losses per unit GDP in % |
|--------------------------------|------------|--------------------------------|-----------------------------|--------------------------------|
| Afghanistan                    | 12         | 0.05                           | 0.51                        | 0.01                           |
| Albania                        | 3          | 0.09                           | 0.11                        | 0.00                           |
| Algeria                        | 9          | 0.03                           | 15.2                        | 0.02                           |
| American Samoa                 | 0          | 0.00                           | 150                         | 34.26                          |
| Angola                         | 28         | 0.20                           | 0.1                         | 0.00                           |
| Argentina                      | 14         | 0.04                           | 0.07                        | 0.00                           |
| Armenia                        | 0          | 0.00                           | 0.08                        | 0.00                           |
| Australia                      | 42         | 0.21                           | 111.36                      | 0.02                           |
| Austria                        | 6          | 0.07                           | 16.61                       | 0.01                           |
| Azerbaijan                     | 3          | 0.04                           | 0.11                        | 0.00                           |
| Bahamas                        | 11         | 3.47                           | 500                         | 9.51                           |
| Bangladesh                     | 1112       | 0.79                           | 2202.69                     | 3.87                           |
| Barbados                       | 1          | 0.37                           | 0                           | 0.00                           |
| Belgium                        | 1          | 0.01                           | 0.05                        | 0.00                           |
| Bermuda Islands                | 0          | 0.00                           | 0.01                        | 0.00                           |
| Bolivia                        | 0          | 0.00                           | 0.01                        | 0.00                           |
| Bosnia Herzegovina             | 0          | 0.00                           | 0.35                        | 0.00                           |
| Botswana                       | 0          | 0.00                           | 0.05                        | 0.00                           |
| Brazil                         | 187        | 0.10                           | 420.02                      | 0.07                           |
| Bulgaria                       | 0          | 0.00                           | 0.12                        | 0.00                           |
| Byelarus                       | 0          | 0.00                           | 0.02                        | 0.00                           |
| Canada                         | 8          | 0.03                           | 340.39                      | 0.03                           |
| Cayman Islands                 | 1          | 2.27                           | 3000                        | 200.89                         |
| Central African Republic       | 5          | 0.13                           | 0.1                         | 0.01                           |
| Chile                          | 6          | 0.04                           | 5.05                        | 0.01                           |
| China                          | 1328       | 0.10                           | 10238.41                    | 0.62                           |
| Colombia                       | 42         | 0.09                           | 5.05                        | 0.01                           |
| Cook Islands                   | 1          | 1.25                           | 0.02                        | 0.02                           |
| Costa Rica                     | 2          | 0.05                           | 0.02                        | 0.00                           |
| Croatia                        | 2          | 0.04                           | 0.1                         | 0.00                           |
| Cuba                           | 4          | 0.04                           | 0.25                        | 0.81                           |
| Cyprus                         | 0          | 0.00                           | 0.25                        | 0.00                           |
| Czech Republic                 | 3          | 0.03                           | 0.02                        | 0.00                           |
| Denmark                        | 0          | 0.00                           | 0                           | 0.00                           |
| Djibouti                       | 70         | 9.78                           | 0.02                        | 0.00                           |
| Dominican Republic             | 445        | 5.02                           | 500.05                      | 2.68                           |
| Ecuador                        | 0          | 0.00                           | 0.1                         | 0.00                           |
| El Salvador                    | 2          | 0.03                           | 0.05                        | 0.00                           |
| Ethiopia                       | 8          | 0.01                           | 0.6                         | 0.01                           |
| Federated States of Micronesia | 1          | 0.93                           | 0.5                         | 0.21                           |
| Fiji                           | 10         | 1.18                           | 0.63                        | 0.02                           |
| Finland                        | 3          | 0.06                           | 24                          | 0.01                           |
| France                         | 30         | 0.05                           | 0.89                        | 0.00                           |
| Gambia                         | 6          | 0.41                           | 0.35                        | 0.08                           |
| Georgia                        | 1          | 0.02                           | 2                           | 0.04                           |
| Germany                        | 23         | 0.03                           | 1366.31                     | 0.05                           |
| Greece                         | 1          | 0.01                           | 240.66                      | 0.12                           |
| Grenada                        | 39         | 36.90                          | 900                         | 206.37                         |
| Guam                           | 0          | 0.00                           | 0.55                        | 0.02                           |
| Guatemala                      | 2          | 0.02                           | 0.07                        | 0.00                           |
| Haiti                          | 3463       | 40.31                          | 2                           | 0.06                           |
| Hong Kong                      | 0          | 0.00                           | 0.01                        | 0.00                           |
| Hungary                        | 1          | 0.01                           | 2.1                         | 0.00                           |
| India                          | 1115       | 0.10                           | 1013.53                     | 0.15                           |
| Indonesia                      | 132        | 0.06                           | 12.74                       | 0.00                           |
| Iran                           | 68         | 0.10                           | 0.24                        | 0.00                           |
| Iraq                           | 0          | 0.00                           | 0.05                        | 0.00                           |
| Ireland                        | 0          | 0.00                           | 12.02                       | 0.01                           |
| Israel                         | 0          | 0.00                           | 2                           | 0.00                           |
| Italy                          | 10         | 0.02                           | 95.62                       | 0.01                           |
| Jamaica                        | 18         | 0.68                           | 575                         | 7.16                           |
| Japan                          | 205        | 0.16                           | 15536.71                    | 0.34                           |
| Jordan                         | 2          | 0.04                           | 0.01                        | 0.00                           |
| Kazakhstan                     | 28         | 0.19                           | 0.07                        | 0.00                           |
| Kenya                          | 51         | 0.16                           | 2000.51                     | 12.82                          |

|  |      |       |          |        |
|--|------|-------|----------|--------|
| Korea, Democratic Republic (North Korea) | 24   | 0.11  | 10       | 0.10   |
| Korea, Republic (South Korea)            | 10   | 0.02  | 824.76   | 0.12   |
| Kyrgyzstan                               | 44   | 0.86  | 0.08     | 0.00   |
| Latvia                                   | 12   | 0.52  | 0.03     | 0.00   |
| Lebanon                                  | 2    | 0.04  | 0.31     | 0.00   |
| Macedonia                                | 15   | 0.73  | 3.01     | 0.06   |
| Madagascar                               | 266  | 1.53  | 21       | 0.48   |
| Malaysia                                 | 18   | 0.07  | 0.25     | 0.00   |
| Malta                                    | 0    | 0.00  | 0        | 0.00   |
| Mexico                                   | 81   | 0.08  | 0.97     | 0.00   |
| Moldova                                  | 4    | 0.09  | 0.01     | 0.00   |
| Morocco                                  | 0    | 0.00  | 0.01     | 0.00   |
| Mozambique                               | 0    | 0.00  | 0.01     | 0.00   |
| Myanmar                                  | 220  | 0.44  | 2        | 0.02   |
| Namibia                                  | 6    | 0.30  | 1.01     | 0.02   |
| Nepal                                    | 212  | 0.84  | 100.04   | 1.49   |
| Netherlands                              | 0    | 0.00  | 150.05   | 0.03   |
| New Zealand                              | 10   | 0.25  | 232.47   | 0.23   |
| Nicaragua                                | 25   | 0.45  | 0.1      | 0.00   |
| Nigeria                                  | 84   | 0.06  | 0.65     | 0.00   |
| Niue                                     | 1    | 46.38 | 0.5      | 7.75   |
| Northern Mariana Islands                 | 2    | 2.50  | 0.05     | 0.01   |
| Norway                                   | 0    | 0.00  | 2        | 0.00   |
| Pakistan                                 | 47   | 0.03  | 0.1      | 0.00   |
| Panama                                   | 11   | 0.36  | 2.15     | 0.02   |
| Papua New Guinea                         | 1    | 0.02  | 0.05     | 0.00   |
| Paraguay                                 | 2    | 0.03  | 0.1      | 0.00   |
| Peru                                     | 103  | 0.37  | 3.06     | 0.00   |
| Philippines                              | 1012 | 1.22  | 120.95   | 0.14   |
| Poland                                   | 45   | 0.12  | 1.03     | 0.00   |
| Portugal                                 | 83   | 0.80  | 1.17     | 0.00   |
| Puerto Rico                              | 4    | 0.10  | 100.01   | 0.13   |
| Romania                                  | 53   | 0.24  | 25.95    | 0.04   |
| Russia                                   | 87   | 0.06  | 126.23   | 0.02   |
| Saudi Arabia                             | 5    | 0.02  | 0.02     | 0.00   |
| Seychelle                                | 3    | 3.54  | 2000     | 284.29 |
| Sierra Leone                             | 0    | 0.00  | 0.02     | 0.00   |
| Singapore                                | 0    | 0.00  | 0.1      | 0.00   |
| Slovakia                                 | 5    | 0.09  | 206.01   | 0.50   |
| Slovenia                                 | 2    | 0.10  | 15.01    | 0.05   |
| Somalia                                  | 150  | 1.51  | 2000     | 221.31 |
| South Africa                             | 7    | 0.02  | 0.63     | 0.00   |
| Spain                                    | 28   | 0.07  | 0.48     | 0.00   |
| Sri Lanka                                | 8    | 0.04  | 0.05     | 0.00   |
| St. Lucia                                | 0    | 0.00  | 0        | 0.00   |
| St. Vincent                              | 0    | 0.00  | 0        | 0.00   |
| Sweden                                   | 2    | 0.02  | 0.01     | 0.00   |
| Switzerland                              | 10   | 0.14  | 124.87   | 0.03   |
| Syria                                    | 5    | 0.03  | 0.1      | 0.00   |
| Taiwan                                   | 68   | 0.30  | 508.1    | 0.17   |
| Tajikistan                               | 13   | 0.20  | 2.8      | 0.13   |
| Tanzania                                 | 14   | 0.04  | 0.1      | 0.00   |
| Thailand                                 | 17   | 0.03  | 6.3      | 0.00   |
| Tonga                                    | 1    | 0.98  | 0.02     | 0.01   |
| Trinidad and Tobago                      | 4    | 0.30  | 0.05     | 0.00   |
| Turkey                                   | 58   | 0.08  | 3.47     | 0.00   |
| Uganda                                   | 0    | 0.00  | 0.5      | 0.01   |
| Ukraine                                  | 10   | 0.02  | 30       | 0.05   |
| United Arab Emirates                     | 2    | 0.05  | 0        | 0.00   |
| United Kingdom                           | 7    | 0.01  | 341.9    | 0.02   |
| United States of America                 | 299  | 0.10  | 48824.17 | 0.42   |
| Vanuatu                                  | 1    | 0.47  | 0.1      | 0.03   |
| Venezuela                                | 12   | 0.05  | 0.02     | 0.00   |
| Vietnam                                  | 153  | 0.19  | 38.67    | 0.09   |
| Western Samoa                            | 1    | 0.56  | 0.5      | 0.14   |
| Yemen                                    | 16   | 0.08  | 0.1      | 0.00   |
| Zambia                                   | 10   | 0.09  | 0.5      | 0.01   |

Main Sources:

NatCatSERVICE, Munich Re

World Bank: World Development Indicators

**Table 15: Analysis of weather-related events:  
Climate Risk Index 2006**

(based on values for 2004, see table 14)

| Rank<br>Climate<br>Risk<br>Index | Country                                  | Climate<br>Risk<br>Index<br>Value | Rank<br>Total<br>Number<br>of<br>Deaths | Rank<br>Deaths<br>per<br>100,000<br>inhabi-<br>tants | Rank<br>Total<br>Dam-<br>ages in<br>Mio.<br>USD | Rank<br>Damages<br>per unit<br>GDP in% |
|----------------------------------|--|-----------------------------------|---|--|---|--|
| 1                                | Somalia                                  | 8.50                              | 14                                      | 11   | 7   | 2                                      |
| 2                                | Dominican Republic                       | 9.00                              | 6                                       | 5  | 14  | 11                                     |
| 3                                | Bangladesh                               | 9.75                              | 4                                       | 20   | 5   | 10                                     |
| 4                                | Philippines, The                         | 16.75                             | 5                                       | 13   | 26  | 23                                     |
| 5                                | China                                    | 16.75                             | 2                                       | 48   | 3   | 14                                     |
| 6                                | Nepal                                    | 17.00                             | 10                                      | 18   | 28  | 12                                     |
| 7                                | Madagascar                               | 17.25                             | 8                                       | 10   | 35  | 16                                     |
| 8                                | Japan                                    | 18.25                             | 11                                      | 42   | 2   | 18                                     |
| 9                                | United States of America                 | 18.25                             | 7                                       | 48   | 1   | 17                                     |
| 10                               | Bahamas, The                             | 20.00                             | 51                                      | 7  | 15  | 7                                      |
| 11                               | Kenya                                    | 20.00                             | 26                                      | 42   | 6   | 6                                      |
| 12                               | Jamaica                                  | 20.75                             | 40                                      | 22   | 12  | 9                                      |
| 13                               | India                                    | 20.75                             | 3                                       | 48   | 10  | 22                                     |
| 14                               | Haiti                                    | 21.75                             | 1                                       | 2  | 51  | 33                                     |
| 15                               | Taiwan                                   | 22.00                             | 22                                      | 32   | 13  | 21                                     |
| 16                               | Seychelles                               | 23.00                             | 78                                      | 6  | 7   | 1                                      |
| 17                               | Brazil                                   | 27.00                             | 12                                      | 48   | 16  | 32                                     |
| 18                               | Cayman Islands                           | 27.75                             | 94                                      | 9  | 4   | 4                                      |
| 19                               | Vietnam                                  | 28.50                             | 13                                      | 40   | 31  | 30                                     |
| 20                               | New Zealand                              | 31.75                             | 53                                      | 35   | 20  | 19                                     |
| 21                               | Myanmar                                  | 32.75                             | 9                                       | 27   | 51  | 44                                     |
| 22                               | Romania                                  | 33.00                             | 25                                      | 36   | 33  | 38                                     |
| 23                               | Australia                                | 34.50                             | 30                                      | 37   | 27  | 44                                     |
| 24                               | Macedonia                                | 36.25                             | 44                                      | 21   | 47  | 33                                     |
| 25                               | Russia                                   | 37.75                             | 17                                      | 66   | 24  | 44                                     |
| 26                               | Korea, Democratic Republic (North Korea) | 38.75                             | 38                                      | 47   | 41  | 29                                     |
| 27                               | Peru                                     | 39.50                             | 16                                      | 29   | 46  | 67                                     |
| 28                               | Tajikistan                               | 39.50                             | 47                                      | 38   | 48  | 25                                     |
| 29                               | Portugal                                 | 40.25                             | 19                                      | 19   | 56  | 67                                     |
| 30                               | Slovakia                                 | 40.25                             | 70                                      | 55   | 21  | 15                                     |
| 31                               | Switzerland                              | 40.50                             | 53                                      | 44   | 25  | 40                                     |
| 32                               | Grenada                                  | 41.00                             | 32                                      | 3  | 126   | 3                                      |
| 33                               | Germany                                  | 41.75                             | 39                                      | 84   | 9   | 35                                     |
| 34                               | Niue                                     | 42.50                             | 94                                      | 1  | 67  | 8                                      |
| 35                               | Fiji                                     | 43.25                             | 53                                      | 14   | 62  | 44                                     |
| 36                               | Panama                                   | 43.75                             | 51                                      | 31   | 49  | 44                                     |
| 37                               | Puerto Rico                              | 44.00                             | 74                                      | 48   | 29  | 25                                     |
| 38                               | Colombia                                 | 45.50                             | 30                                      | 55   | 43  | 54                                     |
| 39                               | Korea, Republic (South Korea)            | 46.00                             | 53                                      | 93   | 11  | 27                                     |
| 40                               | Indonesia                                | 46.75                             | 15                                      | 66   | 39  | 67                                     |
| 41                               | Turkey                                   | 49.00                             | 24                                      | 60   | 45  | 67                                     |
| 42                               | Federated Islands of Micronesia          | 49.25                             | 94                                      | 16   | 67  | 20                                     |
| 43                               | Gambia, The                              | 49.50                             | 66                                      | 28   | 73  | 31                                     |
| 44                               | Poland                                   | 49.50                             | 28                                      | 46   | 57  | 67                                     |
| 45                               | Namibia                                  | 50.00                             | 66                                      | 32   | 58  | 44                                     |
| 46                               | Djibouti                                 | 50.25                             | 21                                      | 4  | 109   | 67                                     |
| 47                               | Canada                                   | 50.75                             | 61                                      | 84   | 18  | 40                                     |
| 48                               | Slovenia                                 | 51.00                             | 83                                      | 48   | 38  | 35                                     |
| 49                               | Mexico                                   | 51.50                             | 20                                      | 60   | 59  | 67                                     |
| 50                               | Western Samoa                            | 51.75                             | 94                                      | 23   | 67  | 23                                     |
| 51                               | Kyrgyzstan                               | 52.00                             | 29                                      | 17   | 95  | 67                                     |
| 52                               | Nigeria                                  | 53.00                             | 18                                      | 66   | 61  | 67                                     |
| 53                               | Nicaragua                                | 53.25                             | 37                                      | 26   | 83  | 67                                     |
| 54                               | Ukraine                                  | 53.25                             | 53                                      | 93   | 32  | 35                                     |
| 55                               | Iran                                     | 54.00                             | 22                                      | 48   | 79  | 67                                     |
| 56                               | Austria                                  | 54.75                             | 66                                      | 63   | 36  | 54                                     |
| 57                               | Angola                                   | 55.50                             | 34                                      | 38   | 83  | 67                                     |
| 58                               | Algeria                                  | 56.25                             | 60                                      | 84   | 37  | 44                                     |

| Rank<br>Climate<br>Risk<br>Index | Country                  | Climate<br>Risk<br>Index<br>Value | Rank<br>Total<br>Number<br>of<br>Deaths | Rank<br>Deaths<br>per<br>100,000<br>inhabi-<br>tants | Rank<br>Total<br>Dam-<br>ages in<br>Mio.<br>USD | Rank<br>Damages<br>per unit<br>GDP in% |
|----------------------------------|--------------------------|-----------------------------------|---|--|---|--|
| 59                               | United Kingdom           | 56.75                             | 64                                      | 102  | 17  | 44                                     |
| 60                               | Zambia                   | 57.25                             | 53                                      | 55   | 67  | 54                                     |
| 61                               | France                   | 57.50                             | 33                                      | 70   | 60  | 67                                     |
| 62                               | Italy                    | 57.50                             | 53                                      | 93   | 30  | 54                                     |
| 63                               | Finland                  | 58.00                             | 78                                      | 66   | 34  | 54                                     |
| 64                               | Thailand                 | 58.75                             | 42                                      | 84   | 42  | 67                                     |
| 65                               | Spain                    | 59.00                             | 34                                      | 63   | 72  | 67                                     |
| 66                               | Kazakhstan               | 59.50                             | 34                                      | 40   | 97  | 67                                     |
| 67                               | Chile                    | 59.50                             | 66                                      | 75   | 43  | 54                                     |
| 68                               | Cuba                     | 59.50                             | 74                                      | 75   | 76  | 13                                     |
| 69                               | Afghanistan              | 59.75                             | 49                                      | 70   | 66  | 54                                     |
| 70                               | Vanuatu                  | 60.50                             | 94                                      | 25   | 83  | 40                                     |
| 71                               | Greece                   | 60.50                             | 94                                      | 102  | 19  | 27                                     |
| 72                               | American Samoa           | 60.50                             | 107                                     | 107  | 23  | 5                                      |
| 73                               | Northern Marian Islands  | 61.25                             | 83                                      | 8  | 100   | 54                                     |
| 74                               | Malaysia                 | 61.50                             | 40                                      | 63   | 76  | 67                                     |
| 75                               | Latvia                   | 61.75                             | 48                                      | 24   | 108   | 67                                     |
| 76                               | Central African Republic | 63.00                             | 70                                      | 45   | 83  | 54                                     |
| 77                               | Yemen                    | 63.25                             | 43                                      | 60   | 83  | 67                                     |
| 78                               | Cook Islands             | 64.75                             | 94                                      | 12   | 109   | 44                                     |
| 79                               | Pakistan                 | 65.25                             | 27                                      | 84   | 83  | 67                                     |
| 80                               | Tanzania                 | 67.50                             | 45                                      | 75   | 83  | 67                                     |
| 81                               | Tonga                    | 68.00                             | 94                                      | 15   | 109   | 54                                     |
| 82                               | Trinidad and Tobago      | 68.25                             | 74                                      | 32   | 100   | 67                                     |
| 83                               | Georgia                  | 69.00                             | 94                                      | 93   | 51  | 38                                     |
| 84                               | Netherlands              | 69.00                             | 107                                     | 107  | 22  | 40                                     |
| 85                               | Albania                  | 70.25                             | 78                                      | 55   | 81  | 67                                     |
| 86                               | Ethiopia                 | 70.25                             | 61                                      | 102  | 64  | 54                                     |
| 87                               | Argentina                | 71.00                             | 45                                      | 75   | 97  | 67                                     |
| 88                               | South Africa             | 71.50                             | 64                                      | 93   | 62  | 67                                     |
| 89                               | Venezuela                | 73.75                             | 49                                      | 70   | 109   | 67                                     |
| 90                               | Lebanon                  | 74.50                             | 83                                      | 75   | 73  | 67                                     |
| 91                               | Azerbaijan               | 75.25                             | 78                                      | 75   | 81  | 67                                     |
| 92                               | Sri Lanka                | 75.75                             | 61                                      | 75   | 100   | 67                                     |
| 93                               | Syria                    | 76.00                             | 70                                      | 84   | 83  | 67                                     |
| 94                               | Croatia                  | 77.00                             | 83                                      | 75   | 83  | 67                                     |
| 95                               | Ireland                  | 77.00                             | 107                                     | 107  | 40  | 54                                     |
| 96                               | Hungary                  | 78.25                             | 94                                      | 102  | 50  | 67                                     |
| 97                               | Moldova                  | 78.50                             | 74                                      | 55   | 118   | 67                                     |
| 98                               | Barbados                 | 79.00                             | 94                                      | 29   | 126   | 67                                     |
| 99                               | Paraguay                 | 79.25                             | 83                                      | 84   | 83  | 67                                     |
| 100                              | Guam                     | 80.75                             | 107                                     | 107  | 65  | 44                                     |
| 101                              | Costa Rica               | 82.25                             | 83                                      | 70   | 109   | 67                                     |
| 102                              | Israel                   | 83.00                             | 107                                     | 107  | 51  | 67                                     |
| 102                              | Norway                   | 83.00                             | 107                                     | 107  | 51  | 67                                     |
| 104                              | El Salvador              | 83.50                             | 83                                      | 84   | 100   | 67                                     |
| 105                              | Uganda                   | 83.75                             | 107                                     | 107  | 67  | 54                                     |
| 106                              | Czech Republic           | 84.50                             | 78                                      | 84   | 109   | 67                                     |
| 107                              | Saudi Arabia             | 84.75                             | 70                                      | 93   | 109   | 67                                     |
| 108                              | Guatemala                | 85.00                             | 83                                      | 93   | 97  | 67                                     |
| 109                              | Jordan                   | 85.75                             | 83                                      | 75   | 118   | 67                                     |
| 110                              | United Arab Emirates     | 86.50                             | 83                                      | 70   | 126   | 67                                     |
| 111                              | Papua New Guinea         | 88.50                             | 94                                      | 93   | 100   | 67                                     |
| 112                              | Bosnia Herzegovina       | 88.50                             | 107                                     | 107  | 73  | 67                                     |
| 113                              | Cyprus                   | 89.25                             | 107                                     | 107  | 76  | 67                                     |
| 114                              | Sweden                   | 90.25                             | 83                                      | 93   | 118   | 67                                     |
| 115                              | Bulgaria                 | 90.25                             | 107                                     | 107  | 80  | 67                                     |
| 116                              | Belgium                  | 90.75                             | 94                                      | 102  | 100   | 67                                     |
| 117                              | Ecuador                  | 91.00                             | 107                                     | 107  | 83  | 67                                     |
| 117                              | Singapore                | 91.00                             | 107                                     | 107  | 83  | 67                                     |
| 119                              | Armenia                  | 94.00                             | 107                                     | 107  | 95  | 67                                     |
| 120                              | Botswana                 | 95.25                             | 107                                     | 107  | 100   | 67                                     |
| 120                              | Iraq                     | 95.25                             | 107                                     | 107  | 100   | 67                                     |
| 122                              | Byelarus                 | 97.50                             | 107                                     | 107  | 109   | 67                                     |
| 122                              | Sierra Leone             | 97.50                             | 107                                     | 107  | 109   | 67                                     |

| Rank<br>Climate<br>Risk<br>Index | Country     | Climate<br>Risk<br>Index<br>Value | Rank<br>Total<br>Number<br>of<br>Deaths | Rank<br>Deaths<br>per<br>100,000<br>inhabi-<br>tants | Rank<br>Total<br>Dam-<br>ages in<br>Mio.<br>USD | Rank<br>Damages<br>per unit<br>GDP in% |
|----------------------------------|-------------|-----------------------------------|---|--|---|--|
| 124                              | Bermuda     | 99.75                             | 107                                     | 107  | 118   | 67                                     |
| 124                              | Bolivia     | 99.75                             | 107                                     | 107  | 118   | 67                                     |
| 124                              | Hong Kong   | 99.75                             | 107                                     | 107  | 118   | 67                                     |
| 124                              | Morocco     | 99.75                             | 107                                     | 107  | 118   | 67                                     |
| 124                              | Mozambique  | 99.75                             | 107                                     | 107  | 118   | 67                                     |
| 129                              | Denmark     | 101.75                            | 107                                     | 107  | 126   | 67                                     |
| 129                              | Malta       | 101.75                            | 107                                     | 107  | 126   | 67                                     |
| 129                              | St. Lucia   | 101.75                            | 107                                     | 107  | 126   | 67                                     |
| 129                              | St. Vincent | 101.75                            | 107                                     | 107  | 126   | 67                                     |

**Table 16: Analysis of weather-related events:  
Partial indicators, annual average 1995-2004**

| Country                        | Death toll | Deaths per 100,000 inhabitants | Total losses in million USD | Total losses per unit GDP in % |
|--------------------------------|------------|--------------------------------|-----------------------------|--------------------------------|
| Afghanistan                    | 158.3      | x                              | 1.41                        | 0.04                           |
| Albania                        | 2.3        | 0.07                           | 5.91                        | 0.15                           |
| Algeria                        | 97.4       | 0.32                           | 34.17                       | 0.06                           |
| American Samoa                 | 0.4        | 0.70                           | 15.00                       | x                              |
| Angola                         | 11.6       | 0.09                           | 0.02                        | 0.00                           |
| Anguilla                       | 0          | x                              | 15.00                       | 2.54                           |
| Antigua and Barbuda            | 2          | 2.76                           | 41.30                       | 6.32                           |
| Argentina                      | 17.5       | 0.05                           | 498.20                      | 0.21                           |
| Armenia                        | 0.4        | 0.01                           | 11.27                       | 0.53                           |
| Australia                      | 20.9       | 0.11                           | 677.49                      | 0.16                           |
| Austria                        | 16.6       | 0.21                           | 380.72                      | 0.17                           |
| Azerbaijan                     | 3.9        | 0.05                           | 21.57                       | 0.41                           |
| Bahamas                        | 1.6        | 0.53                           | 202.57                      | 4.55                           |
| Bahrain                        | 5.7        | 0.87                           | 0.96                        | 0.01                           |
| Bangladesh                     | 812.4      | 0.62                           | 879.80                      | 1.91                           |
| Barbados                       | 0.1        | 0.04                           | 0.02                        | 0.00                           |
| Belgium                        | 2.3        | 0.02                           | 122.65                      | 0.05                           |
| Belize                         | 3.1        | 1.25                           | 53.01                       | 6.58                           |
| Benin                          | 1.3        | 0.02                           | 0.07                        | 0.00                           |
| Bermuda                        | 0.4        | 0.63                           | 50.42                       | 1.44                           |
| Bolivia                        | 32.3       | 0.39                           | 13.14                       | 0.16                           |
| Bosnia Herzegovina             | 0.3        | 0.01                           | 16.10                       | 0.34                           |
| Botswana                       | 2.8        | 0.17                           | 2.56                        | 0.05                           |
| Brazil                         | 109.5      | 0.06                           | 70.20                       | 0.01                           |
| British Virgin Islands         | 0          | 0.00                           | 0.00                        | x                              |
| Brunei                         | 0          | x                              | 0.21                        | x                              |
| Bulgaria                       | 3.8        | 0.05                           | 1.89                        | 0.01                           |
| Burkina Faso                   | 0          | 0.00                           | 0.01                        | 0.00                           |
| Burundi                        | 0.6        | 0.01                           | 0.00                        | 0.00                           |
| Byelarus                       | 7.6        | 0.08                           | 6.48                        | 0.04                           |
| Cambodia                       | 55.4       | 0.44                           | 23.42                       | 0.64                           |
| Cameroon                       | 8.1        | 0.05                           | 0.48                        | 0.00                           |
| Canada                         | 15.4       | 0.05                           | 617.91                      | 0.09                           |
| Cayman Islands                 | 0.1        | 1.16                           | 304.01                      | 25.26                          |
| Central African Republic       | 1.1        | 0.03                           | 0.06                        | 0.01                           |
| Chad                           | 0.7        | 0.01                           | 0.60                        | 0.03                           |
| Chile                          | 10         | 0.07                           | 68.62                       | 0.09                           |
| China                          | 1781.7     | 0.14                           | 11375.81                    | 1.04                           |
| Colombia                       | 73.1       | 0.17                           | 12.70                       | 0.01                           |
| Congo, Democratic Republic     | 13.2       | 0.03                           | 0.40                        | 0.01                           |
| Congo, Republic                | 0.2        | 0.01                           | 0.01                        | 0.00                           |
| Cook Islands                   | 0.9        | x                              | 0.51                        | 0.55                           |
| Costa Rica                     | 8.2        | 0.22                           | 51.18                       | 0.34                           |
| Croatia                        | 4.5        | 0.10                           | 41.32                       | 0.18                           |
| Cuba                           | 4.2        | 0.04                           | 237.52                      | 0.88                           |
| Cyprus                         | 6.4        | 0.85                           | 5.76                        | 0.06                           |
| Czech Republic                 | 9.6        | 0.09                           | 479.40                      | 0.71                           |
| Denmark                        | 1          | 0.02                           | 266.07                      | 0.15                           |
| Djibouti                       | 7          | 1.07                           | 0.06                        | 0.01                           |
| Dominica                       | 0          | 0.00                           | 20.51                       | 8.05                           |
| Dominican Republic             | 399.1      | 4.82                           | 152.99                      | 0.88                           |
| East Timor                     | 0.2        | x                              | 0.02                        | x                              |
| Ecuador                        | 40.6       | 0.33                           | 88.00                       | 0.39                           |
| Egypt                          | 13.4       | 0.02                           | 2.97                        | 0.00                           |
| El Salvador                    | 30.2       | 0.49                           | 47.51                       | 0.37                           |
| Eritrea                        | 0          | 0.00                           | 0.01                        | 0.00                           |
| Estonia                        | 0.1        | 0.01                           | 0.16                        | 0.00                           |
| Ethiopia                       | 40.4       | 0.06                           | 0.96                        | 0.01                           |
| Faroe Islands                  | 0          | 0.00                           | 0.01                        | x                              |
| Federated States of Micronesia | 6.1        | 5.70                           | 0.42                        | 0.20                           |
| Fiji                           | 4.3        | 0.53                           | 4.09                        | 0.21                           |
| Finland                        | 0.3        | 0.01                           | 2.91                        | 0.00                           |
| France                         | 1520.8     | 2.58                           | 2136.60                     | 0.14                           |
| French Guyana                  | 0          | x                              | 0.01                        | x                              |
| French Polynesia               | 1.9        | 0.82                           | 0.31                        | 0.01                           |
| Gambia                         | 5.9        | 0.46                           | 0.14                        | 0.03                           |
| Georgia                        | 1.6        | 0.03                           | 8.93                        | 0.26                           |
| Germany                        | 727.7      | 0.89                           | 2449.21                     | 0.11                           |

| Country                            | Death toll | Deaths per 100,000 inhabitants | Total losses in million USD | Total losses per unit GDP in % |
|------------------------------------|------------|--------------------------------|-----------------------------|--------------------------------|
| Ghana                              | 11.5       | 0.06                           | 1.66                        | 0.02                           |
| Greece                             | 11.9       | 0.11                           | 176.59                      | 0.13                           |
| Greenland                          | 0          | 0.00                           | 0.00                        | x                              |
| Grenada                            | 3.9        | 3.84                           | 90.00                       | 24.40                          |
| Guadeloupe                         | 0.5        | 0.11                           | 6.05                        | 0.17                           |
| Guam                               | 0.3        | 0.20                           | 78.26                       | 3.13                           |
| Guatemala                          | 58.6       | 0.52                           | 30.79                       | 0.15                           |
| Guinea                             | 2.6        | 0.04                           | 0.10                        | 0.00                           |
| Guyana                             | 0          | 0.00                           | 12.30                       | 1.72                           |
| Haiti                              | 382.4      | 4.85                           | 18.69                       | 0.54                           |
| Honduras                           | 577.9      | 9.06                           | 402.32                      | 7.09                           |
| Hong Kong                          | 2.4        | 0.04                           | 15.09                       | 0.01                           |
| Hungary                            | 16.2       | 0.16                           | 69.30                       | 0.12                           |
| Iceland                            | 3.5        | 1.25                           | 0.56                        | 0.01                           |
| India                              | 4402.3     | 0.44                           | 1290.91                     | 0.27                           |
| Indonesia                          | 345.3      | 0.17                           | 1012.57                     | 0.56                           |
| Iran                               | 88.3       | 0.14                           | 1123.92                     | 0.99                           |
| Iraq                               | 0          | 0.00                           | 0.01                        | 0.00                           |
| Ireland                            | 2.8        | 0.07                           | 43.79                       | 0.04                           |
| Israel                             | 2.7        | 0.04                           | 16.63                       | 0.02                           |
| Italy                              | 445.3      | 0.77                           | 1740.49                     | 0.14                           |
| Ivory Coast                        | 3.2        | 0.02                           | 0.10                        | 0.00                           |
| Jamaica                            | 4.3        | 0.17                           | 66.78                       | 0.88                           |
| Japan                              | 67.9       | 0.05                           | 3100.08                     | 0.07                           |
| Jordan                             | 1.9        | 0.04                           | 1.91                        | 0.02                           |
| Kazakhstan                         | 16.6       | 0.11                           | 3.53                        | 0.01                           |
| Kenya                              | 40.1       | 0.14                           | 204.52                      | 1.78                           |
| Kiribati                           | 0          | 0.00                           | 0.01                        | 0.02                           |
| Korea, Democratic Republic (North) | 46.1       | 0.21                           | 1741.60                     | 15.95                          |
| Korea, Republic (South)            | 139.8      | 0.30                           | 1544.98                     | 0.30                           |
| Kuwait                             | 0.2        | 0.01                           | 0.02                        | 0.00                           |
| Kyrgyzstan                         | 10.6       | 0.22                           | 0.63                        | 0.04                           |
| Laos                               | 1.5        | 0.03                           | 2.64                        | 0.15                           |
| Latvia                             | 3.5        | 0.15                           | 0.11                        | 0.00                           |
| Lebanon                            | 0.6        | 0.01                           | 0.22                        | 0.00                           |
| Lesotho                            | 0.1        | 0.01                           | 1.00                        | 0.10                           |
| Libya                              | 0          | 0.00                           | 4.20                        | 0.01                           |
| Luxembourg                         | 0          | 0.00                           | 1.00                        | 0.00                           |
| Macedonia                          | 1.5        | 0.07                           | 35.30                       | 0.87                           |
| Madagascar                         | 84         | 0.55                           | 8.43                        | 0.21                           |
| Malawi                             | 8          | 0.08                           | 20.48                       | 1.09                           |
| Malaysia                           | 74.3       | 0.32                           | 70.79                       | 0.08                           |
| Mali                               | 2.1        | 0.02                           | 0.06                        | 0.00                           |
| Malta                              | 0          | 0.00                           | 4.00                        | 0.10                           |
| Mexico                             | 207.9      | 0.21                           | 894.66                      | 0.18                           |
| Moldova                            | 2.9        | 0.07                           | 3.45                        | 0.20                           |
| Mongolia                           | 13.1       | 0.55                           | 200.02                      | 17.83                          |
| Morocco                            | 40.4       | 0.14                           | 117.97                      | 0.32                           |
| Mozambique                         | 115.6      | 0.66                           | 53.70                       | 1.45                           |
| Myanmar                            | 226.3      | 0.48                           | 0.57                        | 0.01                           |
| Namibia                            | 0.8        | 0.04                           | 0.21                        | 0.01                           |
| Nepal                              | 325.3      | 1.43                           | 18.31                       | 0.35                           |
| Netherlan                          | 101.6      | 0.64                           | 238.34                      | 0.06                           |
| New Caledonia                      | 0.2        | 0.09                           | 0.11                        | 0.00                           |
| New Zealand                        | 3.7        | 0.10                           | 130.85                      | 0.20                           |
| Nicaragua                          | 297        | 5.93                           | 102.67                      | 2.73                           |
| Niger                              | 2.4        | 0.02                           | 3.33                        | 0.15                           |
| Nigeria                            | 51.7       | 0.04                           | 10.74                       | 0.02                           |
| Niue                               | 0.1        | 5.00                           | 0.05                        | 0.77                           |
| Northern                           | 0.2        | 0.29                           | 0.00                        | 0.00                           |
| Norway                             | 1.8        | 0.04                           | 24.60                       | 0.01                           |
| Oman                               | 4.1        | 0.17                           | 1.90                        | 0.01                           |
| Pakistan                           | 288.4      | 0.21                           | 20.08                       | 0.03                           |
| Panama                             | 12.7       | 0.45                           | 1.73                        | 0.02                           |
| Papua New Guinea                   | 262.1      | 5.17                           | 16.82                       | 0.43                           |
| Paraguay                           | 14.3       | 0.27                           | 1.62                        | 0.02                           |
| Peru                               | 163.3      | 0.63                           | 72.93                       | 0.13                           |
| Philippines                        | 496.9      | 0.66                           | 133.48                      | 0.17                           |
| Poland                             | 38.5       | 0.10                           | 468.51                      | 0.26                           |
| Portugal                           | 25.3       | 0.25                           | 147.49                      | 0.12                           |
| Puerto Rico                        | 1.4        | 0.04                           | 658.83                      | 1.22                           |
| Romania                            | 66.6       | 0.30                           | 128.99                      | 0.30                           |
| Russia                             | 198.4      | 0.14                           | 461.02                      | 0.13                           |
| Rwanda                             | 10         | 0.14                           | 0.13                        | 0.01                           |
| Saudi Arabia                       | 5.8        | 0.03                           | 5.38                        | 0.00                           |
| Senegal                            | 8.9        | 0.09                           | 0.96                        | 0.02                           |

| Country                  | Death toll | Deaths per 100,000 inhabitants | Total losses in million USD | Total losses per unit GDP in % |
|--------------------------|------------|--------------------------------|-----------------------------|--------------------------------|
| Seychelles               | 0.3        | 0.37                           | 200.00                      | 32.45                          |
| Sierra Leone             | 1.5        | 0.03                           | 0.31                        | 0.04                           |
| Singapore                | 0.2        | 0.01                           | 0.33                        | 0.00                           |
| Slovakia                 | 7.6        | 0.14                           | 58.47                       | 0.24                           |
| Slovenia                 | 1.1        | 0.06                           | 11.92                       | 0.05                           |
| Solomon Islands          | 0          | 0.00                           | 0.03                        | 0.01                           |
| Somalia                  | 220.5      | 2.56                           | 202.33                      | 12.64                          |
| South Africa             | 64.7       | 0.15                           | 115.83                      | 0.08                           |
| Spain                    | 56.2       | 0.14                           | 1155.52                     | 0.18                           |
| Sri Lanka                | 36.3       | 0.20                           | 5.74                        | 0.04                           |
| St. Kitts and Nevis      | 0.4        | 0.92                           | 44.20                       | 14.19                          |
| St. Lucia                | 0          | 0.00                           | 0.65                        | 0.10                           |
| St. Vincent              | 0.8        | 0.72                           | 2.10                        | 0.63                           |
| Sudan                    | 53.3       | 0.17                           | 4.05                        | 0.03                           |
| Swaziland                | 1.3        | 0.13                           | 0.51                        | 0.03                           |
| Sweden                   | 1.1        | 0.01                           | 19.02                       | 0.01                           |
| Switzerland              | 110.9      | 1.54                           | 468.45                      | 0.16                           |
| Syria                    | 2.5        | 0.02                           | 0.14                        | 0.00                           |
| Taiwan                   | 67.5       | 0.30                           | 367.53                      | 0.13                           |
| Tajikistan               | 23.1       | 0.38                           | 22.59                       | 1.80                           |
| Tanzania                 | 28.7       | 0.09                           | 4.89                        | 0.06                           |
| Thailand                 | 146        | 0.24                           | 154.01                      | 0.11                           |
| Togo                     | 0          | 0.00                           | 0.01                        | 0.00                           |
| Tonga                    | 0.1        | 0.10                           | 0.42                        | 0.26                           |
| Trinidad                 | 0.6        | 0.05                           | 0.32                        | 0.00                           |
| Tunisia                  | 2.6        | 0.03                           | 0.06                        | 0.00                           |
| Turkey                   | 45.9       | 0.07                           | 225.35                      | 0.11                           |
| Tuvalu                   | 0          | x                              | 0.01                        | x                              |
| Uganda                   | 35.4       | 0.15                           | 0.31                        | 0.01                           |
| Ukraine                  | 18.5       | 0.04                           | 29.22                       | 0.07                           |
| United Arab Emirates     | 0.2        | 0.01                           | 28.26                       | 0.05                           |
| United Kingdom           | 21.1       | 0.04                           | 721.62                      | 0.05                           |
| United States of America | 371.6      | 0.13                           | 20013.57                    | 0.21                           |
| Uruguay                  | 7.9        | 0.24                           | 30.52                       | 0.17                           |
| Uzbekistan               | 19.6       | 0.08                           | 5.06                        | 0.04                           |
| Vanuatu                  | 0.1        | 0.05                           | 0.33                        | 0.13                           |
| Venezuela                | 3007.1     | 12.48                          | 325.89                      | 0.33                           |
| Vietnam                  | 497.4      | 0.64                           | 427.94                      | 1.37                           |
| Virgin Islands (US)      | 0.9        | 0.83                           | 116.01                      | 16.99                          |
| Western Samoa            | 0.1        | 0.06                           | 0.06                        | 0.02                           |
| Yemen                    | 54.2       | 0.31                           | 0.24                        | 0.00                           |
| Yugoslavia               | 0.3        | x                              | 85.71                       | x                              |
| Zambia                   | 1.7        | 0.02                           | 1.41                        | 0.04                           |
| Zimbabwe                 | 14.8       | 0.12                           | 15.47                       | 0.18                           |

X = no figure due to lack of sound data basis

Main sources:

NatCatSERVICE, Munich Re

World Bank: World Development Indicators

UNDP: Human Development Report

UN Statistical Yearbooks

**Table 17: Analysis of weather-related events: Climate Risk Index 1995-2004**

(based on average values 1995-2004, see table 16)

| Rank Climate Risk Index | Country                  | Climate Risk Index Value | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank losses per GDP |
|-------------------------|--------------------------|--------------------------|-----------------|-------------------------------------|-------------------|---------------------|
| 1                       | Honduras                 | 11.00                    | 7               | 2                                   | 25                | 10                  |
| 2                       | Bangladesh               | 17.50                    | 5               | 34                                  | 14                | 17                  |
| 3                       | Somalia                  | 19.00                    | 20              | 12                                  | 36                | 8                   |
| 4                       | Venezuela                | 19.50                    | 2               | 1                                   | 28                | 47                  |
| 5                       | Nicaragua                | 21.00                    | 16              | 3                                   | 50                | 15                  |
| 6                       | Vietnam                  | 21.25                    | 8               | 30                                  | 24                | 23                  |
| 7                       | Dominican Republic       | 22.00                    | 11              | 8                                   | 41                | 28                  |
| 8                       | France                   | 24.75                    | 4               | 11                                  | 5                 | 79                  |
| 9                       | India                    | 26.25                    | 1               | 44                                  | 9                 | 51                  |
| 10                      | China                    | 27.50                    | 3               | 79                                  | 2                 | 26                  |
| 11                      | Germany                  | 29.50                    | 6               | 20                                  | 4                 | 88                  |
| 12                      | Italy                    | 30.25                    | 10              | 25                                  | 7                 | 79                  |
| 13                      | Korea, Dem. Rep. (North) | 30.50                    | 46              | 64                                  | 6                 | 6                   |
| 14                      | Indonesia                | 32.75                    | 14              | 69                                  | 12                | 36                  |
| 15                      | Switzerland              | 33.50                    | 28              | 13                                  | 22                | 71                  |
| 16                      | Korea, Rep. (South)      | 34.00                    | 26              | 53                                  | 8                 | 49                  |
| 17                      | Mozambique               | 34.50                    | 27              | 28                                  | 62                | 21                  |
| 18                      | Haiti                    | 35.50                    | 12              | 7                                   | 85                | 38                  |
| 19                      | Philippines              | 36.75                    | 9               | 28                                  | 43                | 67                  |
| 20                      | Mongolia                 | 37.25                    | 73              | 35                                  | 37                | 4                   |
| 21                      | Iran                     | 37.25                    | 32              | 79                                  | 11                | 27                  |
| 22                      | Papua New Guinea         | 37.50                    | 18              | 5                                   | 87                | 40                  |
| 23                      | USA                      | 39.25                    | 13              | 87                                  | 1                 | 56                  |
| 24                      | Nepal                    | 39.75                    | 15              | 14                                  | 86                | 44                  |
| 25                      | Mexico                   | 40.00                    | 21              | 63                                  | 13                | 63                  |
| 26                      | Grenada                  | 40.75                    | 100             | 9                                   | 51                | 3                   |
| 27                      | Kenya                    | 45.75                    | 51              | 79                                  | 34                | 19                  |
| 28                      | Romania                  | 46.25                    | 38              | 53                                  | 45                | 49                  |
| 29                      | Netherlands              | 47.75                    | 30              | 30                                  | 31                | 100                 |
| 30                      | Peru                     | 47.75                    | 23              | 32                                  | 55                | 81                  |
| 31                      | Ecuador                  | 47.75                    | 48              | 49                                  | 52                | 42                  |
| 32                      | Spain                    | 48.25                    | 41              | 79                                  | 10                | 63                  |
| 33                      | Belize                   | 49.00                    | 107             | 15                                  | 63                | 11                  |
| 34                      | Cambodia                 | 49.50                    | 42              | 44                                  | 78                | 34                  |
| 34                      | Taiwan                   | 49.50                    | 37              | 53                                  | 27                | 81                  |
| 36                      | Tajikistan               | 50.75                    | 59              | 47                                  | 79                | 18                  |
| 37                      | El Salvador              | 51.25                    | 56              | 40                                  | 66                | 43                  |
| 38                      | Russia                   | 51.25                    | 22              | 79                                  | 23                | 81                  |
| 39                      | Cayman Islands           | 52.50                    | 162             | 17                                  | 29                | 2                   |
| 40                      | Bahamas                  | 52.50                    | 125             | 37                                  | 35                | 13                  |
| 41                      | Antigua and Barbuda      | 53.00                    | 120             | 10                                  | 70                | 12                  |
| 42                      | Thailand                 | 53.00                    | 25              | 59                                  | 40                | 88                  |
| 43                      | Virgin Islands (US)      | 53.25                    | 137             | 23                                  | 48                | 5                   |
| 44                      | Poland                   | 54.75                    | 52              | 94                                  | 21                | 52                  |
| 45                      | Austria                  | 55.50                    | 65              | 64                                  | 26                | 67                  |
| 46                      | Morocco                  | 55.75                    | 49              | 79                                  | 47                | 48                  |
| 47                      | Madagascar               | 56.25                    | 33              | 35                                  | 101               | 56                  |
| 48                      | Guatemala                | 56.50                    | 40              | 39                                  | 73                | 74                  |
| 49                      | Czech Republic           | 58.00                    | 81              | 98                                  | 20                | 33                  |
| 50                      | Malaysia                 | 59.00                    | 34              | 50                                  | 56                | 96                  |
| 51                      | Seychelles               | 59.25                    | 150             | 48                                  | 38                | 1                   |
| 52                      | Australia                | 59.50                    | 61              | 90                                  | 16                | 71                  |
| 53                      | St. Kitts and Nevis      | 59.75                    | 146             | 19                                  | 67                | 7                   |
| 54                      | Portugal                 | 61.00                    | 58              | 58                                  | 42                | 86                  |
| 55                      | Algeria                  | 63.25                    | 31              | 50                                  | 72                | 100                 |
| 56                      | Costa Rica               | 63.25                    | 83              | 61                                  | 64                | 45                  |
| 57                      | Jamaica                  | 63.25                    | 96              | 69                                  | 60                | 28                  |
| 58                      | Japan                    | 63.50                    | 36              | 117                                 | 3                 | 98                  |
| 59                      | Argentina                | 64.00                    | 64              | 117                                 | 19                | 56                  |
| 60                      | South Africa             | 65.00                    | 39              | 76                                  | 49                | 96                  |
| 61                      | Bermuda                  | 66.25                    | 146             | 32                                  | 65                | 22                  |
| 62                      | Bolivia                  | 66.50                    | 55              | 46                                  | 94                | 71                  |

| Rank Climate Risk Index | Country                   | Climate Risk Index Value | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank losses per GDP |
|-------------------------|---------------------------|--------------------------|-----------------|-------------------------------------|-------------------|---------------------|
| 63                      | Turkey                    | 68.50                    | 47              | 106                                 | 33                | 88                  |
| 64                      | Pakistan                  | 70.25                    | 17              | 64                                  | 83                | 117                 |
| 65                      | Slovakia                  | 70.50                    | 87              | 79                                  | 61                | 55                  |
| 66                      | Cuba                      | 70.75                    | 98              | 125                                 | 32                | 28                  |
| 67                      | Guam                      | 71.25                    | 150             | 67                                  | 54                | 14                  |
| 68                      | Greece                    | 71.25                    | 75              | 90                                  | 39                | 81                  |
| 69                      | Uruguay                   | 71.50                    | 86              | 59                                  | 74                | 67                  |
| 70                      | Hungary                   | 71.50                    | 67              | 75                                  | 58                | 86                  |
| 71                      | Malawi                    | 73.75                    | 85              | 103                                 | 82                | 25                  |
| 72                      | Puerto Rico               | 74.00                    | 130             | 125                                 | 17                | 24                  |
| 73                      | Canada                    | 74.25                    | 68              | 117                                 | 18                | 94                  |
| 74                      | Fed. States of Micronesia | 74.50                    | 91              | 4                                   | 143               | 60                  |
| 75                      | Fiji                      | 75.00                    | 96              | 37                                  | 111               | 56                  |
| 76                      | New Zealand               | 75.25                    | 103             | 94                                  | 44                | 60                  |
| 77                      | United Kingdom            | 76.00                    | 60              | 125                                 | 15                | 104                 |
| 78                      | Zimbabwe                  | 77.75                    | 69              | 89                                  | 90                | 63                  |
| 79                      | Cyprus                    | 79.25                    | 90              | 22                                  | 105               | 100                 |
| 80                      | St. Vincent               | 80.25                    | 139             | 26                                  | 121               | 35                  |
| 81                      | Croatia                   | 80.25                    | 95              | 94                                  | 69                | 63                  |
| 82                      | Myanmar                   | 82.25                    | 19              | 41                                  | 138               | 131                 |
| 82                      | Brazil                    | 82.25                    | 29              | 112                                 | 57                | 131                 |
| 84                      | Colombia                  | 82.50                    | 35              | 69                                  | 95                | 131                 |
| 85                      | Sri Lanka                 | 83.75                    | 53              | 67                                  | 106               | 109                 |
| 86                      | Macedonia                 | 83.75                    | 127             | 106                                 | 71                | 31                  |
| 87                      | Azerbaijan                | 84.50                    | 100             | 117                                 | 80                | 41                  |
| 88                      | Sudan                     | 85.50                    | 44              | 69                                  | 112               | 117                 |
| 89                      | Chile                     | 84.50                    | 79              | 106                                 | 59                | 94                  |
| 90                      | Ukraine                   | 90.25                    | 63              | 125                                 | 75                | 98                  |
| 91                      | Panama                    | 91.00                    | 74              | 43                                  | 125               | 122                 |
| 92                      | Tanzania                  | 91.00                    | 57              | 98                                  | 109               | 100                 |
| 93                      | Niue                      | 92.50                    | 162             | 6                                   | 170               | 32                  |
| 94                      | Paraguay                  | 94.00                    | 70              | 57                                  | 127               | 122                 |
| 95                      | Bahrain                   | 94.50                    | 94              | 21                                  | 132               | 131                 |
| 96                      | Uzbekistan                | 95.50                    | 62              | 103                                 | 108               | 109                 |
| 97                      | Kyrgyzstan                | 96.00                    | 78              | 61                                  | 136               | 109                 |
| 98                      | Denmark                   | 96.00                    | 136             | 144                                 | 30                | 74                  |
| 99                      | Iceland                   | 97.25                    | 104             | 15                                  | 139               | 131                 |
| 100                     | Moldova                   | 97.25                    | 108             | 106                                 | 115               | 60                  |
| 101                     | Nigeria                   | 97.75                    | 45              | 125                                 | 99                | 122                 |
| 102                     | Ireland                   | 98.00                    | 109             | 106                                 | 68                | 109                 |
| 103                     | Yemen                     | 99.75                    | 43              | 52                                  | 152               | 152                 |
| 104                     | Kazakhstan                | 100.00                   | 65              | 90                                  | 114               | 131                 |
| 105                     | Byelarus                  | 100.25                   | 87              | 103                                 | 102               | 109                 |
| 106                     | Albania                   | 100.25                   | 117             | 106                                 | 104               | 74                  |
| 107                     | Botswana                  | 100.50                   | 109             | 69                                  | 120               | 104                 |
| 108                     | Djibouti                  | 100.75                   | 89              | 18                                  | 165               | 131                 |
| 109                     | Guadeloupe                | 101.25                   | 145             | 90                                  | 103               | 67                  |
| 110                     | Gambia                    | 102.00                   | 92              | 42                                  | 157               | 117                 |
| 111                     | Uganda                    | 102.50                   | 54              | 76                                  | 149               | 131                 |
| 112                     | Belgium                   | 102.75                   | 117             | 144                                 | 46                | 104                 |
| 113                     | Georgia                   | 103.50                   | 125             | 137                                 | 100               | 52                  |
| 114                     | Oman                      | 105.50                   | 99              | 69                                  | 123               | 131                 |
| 115                     | Ethiopia                  | 106.00                   | 49              | 112                                 | 132               | 131                 |
| 116                     | French Polynesia          | 106.25                   | 121             | 24                                  | 149               | 131                 |
| 117                     | Dominica                  | 106.50                   | 170             | 166                                 | 81                | 9                   |
| 118                     | Senegal                   | 108.50                   | 82              | 98                                  | 132               | 122                 |
| 119                     | Armenia                   | 109.00                   | 146             | 153                                 | 98                | 39                  |
| 120                     | Ghana                     | 109.25                   | 77              | 112                                 | 126               | 122                 |
| 121                     | Bosnia Herzegovina        | 109.25                   | 150             | 153                                 | 89                | 45                  |
| 122                     | Slovenia                  | 111.50                   | 133             | 112                                 | 97                | 104                 |
| 123                     | Israel                    | 111.50                   | 111             | 125                                 | 88                | 122                 |
| 124                     | Rwanda                    | 112.00                   | 79              | 79                                  | 159               | 131                 |
| 125                     | Niger                     | 112.25                   | 115             | 144                                 | 116               | 74                  |
| 126                     | Tonga                     | 112.75                   | 162             | 94                                  | 143               | 52                  |
| 127                     | Guyana                    | 113.00                   | 170             | 166                                 | 96                | 20                  |
| 128                     | Norway                    | 114.00                   | 123             | 125                                 | 77                | 131                 |
| 129                     | Laos                      | 114.25                   | 127             | 137                                 | 119               | 74                  |
| 130                     | Hong Kong                 | 115.50                   | 115             | 125                                 | 91                | 131                 |
| 131                     | Bulgaria                  | 118.50                   | 102             | 117                                 | 124               | 131                 |
| 132                     | Swaziland                 | 118.75                   | 131             | 87                                  | 140               | 117                 |
| 133                     | Egypt                     | 121.00                   | 71              | 144                                 | 117               | 152                 |

| Rank Climate Risk Index | Country                  | Climate Risk Index Value | Rank death toll | Rank deaths per 100,000 inhabitants | Rank total losses | Rank losses per GDP |
|-------------------------|--------------------------|--------------------------|-----------------|-------------------------------------|-------------------|---------------------|
| 134                     | Congo, Dem. Rep.         | 121.25                   | 72              | 137                                 | 145               | 131                 |
| 135                     | United Arab Emirates     | 122.00                   | 155             | 153                                 | 76                | 104                 |
| 136                     | Saudi Arabia             | 122.25                   | 93              | 137                                 | 107               | 152                 |
| 137                     | Jordan                   | 122.50                   | 121             | 125                                 | 122               | 122                 |
| 138                     | Latvia                   | 123.00                   | 104             | 76                                  | 160               | 152                 |
| 139                     | Cameroon                 | 123.75                   | 84              | 117                                 | 142               | 152                 |
| 140                     | Angola                   | 124.50                   | 76              | 98                                  | 172               | 152                 |
| 141                     | Sweden                   | 125.25                   | 133             | 153                                 | 84                | 131                 |
| 142                     | Zambia                   | 126.25                   | 124             | 144                                 | 128               | 109                 |
| 143                     | Vanuatu                  | 126.50                   | 162             | 117                                 | 146               | 81                  |
| 144                     | Sierra Leone             | 130.50                   | 127             | 137                                 | 149               | 109                 |
| 145                     | Lesotho                  | 134.00                   | 162             | 153                                 | 130               | 91                  |
| 146                     | Malta                    | 135.00                   | 170             | 166                                 | 113               | 91                  |
| 147                     | Chad                     | 137.00                   | 141             | 153                                 | 137               | 117                 |
| 148                     | Northern Mariana Islands | 137.00                   | 155             | 56                                  | 185               | 152                 |
| 149                     | Namibia                  | 137.50                   | 139             | 125                                 | 155               | 131                 |
| 150                     | Guinea                   | 137.75                   | 112             | 125                                 | 162               | 152                 |
| 151                     | Trinidad                 | 139.75                   | 142             | 117                                 | 148               | 152                 |
| 152                     | Western Samoa            | 140.25                   | 162             | 112                                 | 165               | 122                 |
| 153                     | St. Lucia                | 140.50                   | 170             | 166                                 | 135               | 91                  |
| 154                     | Ivory Coast              | 141.00                   | 106             | 144                                 | 162               | 152                 |
| 155                     | New Caledonia            | 141.25                   | 155             | 98                                  | 160               | 152                 |
| 156                     | Tunisia                  | 141.50                   | 112             | 137                                 | 165               | 152                 |
| 157                     | Central African Republic | 141.50                   | 133             | 137                                 | 165               | 131                 |
| 158                     | Syria                    | 141.75                   | 114             | 144                                 | 157               | 152                 |
| 159                     | Finland                  | 143.25                   | 150             | 153                                 | 118               | 152                 |
| 160                     | Libya                    | 144.25                   | 170             | 166                                 | 110               | 131                 |
| 161                     | Mali                     | 145.00                   | 119             | 144                                 | 165               | 152                 |
| 162                     | Benin                    | 147.75                   | 131             | 144                                 | 164               | 152                 |
| 163                     | Lebanon                  | 150.00                   | 142             | 153                                 | 153               | 152                 |
| 164                     | Singapore                | 151.50                   | 155             | 153                                 | 146               | 152                 |
| 165                     | Barbados                 | 152.75                   | 162             | 125                                 | 172               | 152                 |
| 166                     | Luxembourg               | 154.50                   | 170             | 166                                 | 130               | 152                 |
| 167                     | Estonia                  | 155.75                   | 162             | 153                                 | 156               | 152                 |
| 168                     | Burundi                  | 158.00                   | 142             | 153                                 | 185               | 152                 |
| 168                     | Kuwait                   | 158.00                   | 155             | 153                                 | 172               | 152                 |
| 170                     | Kiribati                 | 158.50                   | 170             | 166                                 | 176               | 122                 |
| 171                     | Congo, Republic          | 159.00                   | 155             | 153                                 | 176               | 152                 |
| 172                     | Solomon Islands          | 159.50                   | 170             | 166                                 | 171               | 131                 |
| 173                     | Eritrea                  | 166.00                   | 170             | 166                                 | 176               | 152                 |
| 173                     | Togo                     | 166.00                   | 170             | 166                                 | 176               | 152                 |
| 173                     | Burkina Faso             | 166.00                   | 170             | 166                                 | 176               | 152                 |
| 173                     | Iraq                     | 166.00                   | 170             | 166                                 | 176               | 152                 |

## Germanwatch

We are an independent, non-profit and non-governmental North-South Initiative. Since 1991, we have been active on the German, European and international level concerning issues such as trade, environment and North-South relations. Complex problems require innovative solutions. Germanwatch prepares the ground for necessary policy changes in the North which preserve the interests of people in the South. On a regular basis, we present significant information to decision-makers and supporters. Most of the funding for Germanwatch comes from donations, membership fees and project grants.

Our central goals are:

- Effective and fair instruments as well as economic incentives for climate protection
- Ecologically and socially sound investments
- Compliance of multinational companies with social and ecological standards
- Fair world trade and fair chances for developing countries by cutting back dumping and subsidies in world trade.

For further information, please contact one of our offices

### **Germanwatch - Berlin Office**

Voßstraße 1

10117 Berlin, Germany

Ph.: +49 (0) 30 - 28 88 356-0

Fax: +49 (0) 30 - 28 88 356-1

### **Germanwatch - Bonn Office**

Dr. Werner-Schuster-Haus

Kaiserstraße 201

53113 Bonn, Germany

Ph.: +49 (0) 228 - 60492-0

Fax: +49 (0) 228 - 60492-19

E-mail: [info@germanwatch.org](mailto:info@germanwatch.org)

or visit our website:

**[www.germanwatch.org](http://www.germanwatch.org)**