An aerial view of houses in Haiti in the floods caused by the Tropical Storm Hanna. Source: UN Photo/Marco Dormino.

METHODOLOGY

METHODOLOGY

CLIMATE VULNERABILITY MONITOR

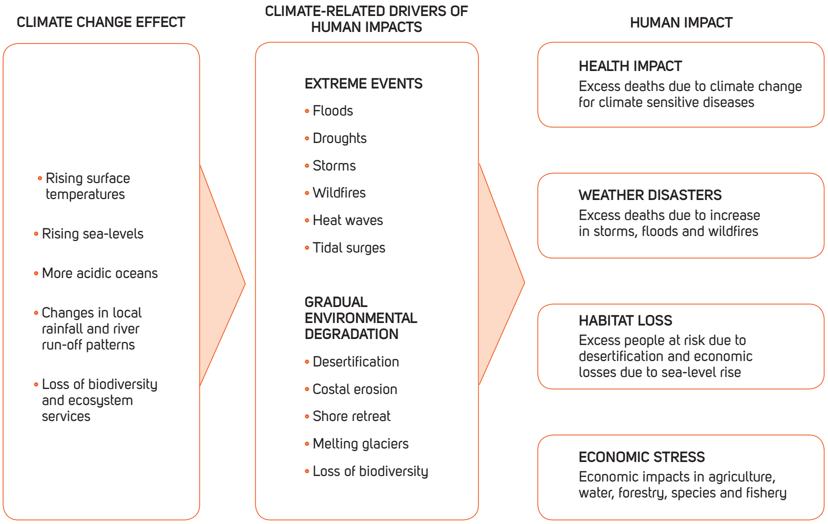
The Climate Vulnerability Monitor measures the impact of climate change on human health, weather, human habitat, and economies and combines those measures into an aggregate index that can be used to gauge our overall vulnerability to climate change on a national, regional, or global level.

There are many dimensions of human development for which the impact of climate change has not been projected in a way that can be applied to a global model. These include factors such as a community's access to education, water, sanitation, energy, and clean cooking environments. The Monitor also does not take into account such aspects of development as good governance, peace and stability, displacement, and gender issues.

Moreover, due to the limitations of available data, not all indicators used in the index have the same baseline years.

FIGURE 1: MODEL FOR CONSTRUCTION OF THE INDEX

The links from increased emission to human impact areas



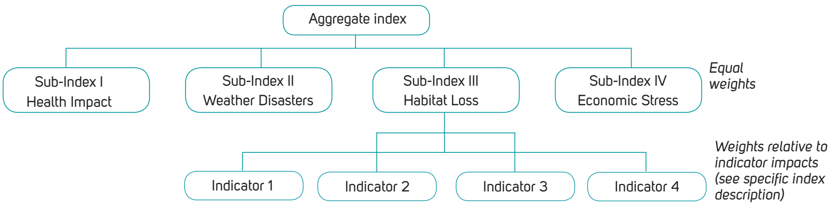
Source: Commons analysis

The Monitor is a work in progress in the sense that new data can be assimilated in the future as it becomes available. And as climate models develop significantly in the future, they will also strengthen the index.

STRUCTURE OF THE INDEX

The aggregate index on climate vulnerability comprises four sub-indices, each made up by a number of indicators.

FIGURE 2: STRUCTURE OF THE INDEX



Source: Commons analysis

INDICATORS AND AGGREGATION

A country's sub-index scores are summarized in an aggregate index score, which provides an indication of the overall impact of climate change.

STRUCTURE OF THE INDEX

INDEX ON CLIMATE VULNERABILITY	SUB-INDEX	INDICATORS
OVERALL INDEX	HEALTH IMPACT	• Malnutrition • Malaria • Diarrhea • Dengue • Cardiovascular diseases • Respiratory diseases
	WEATHER DISASTERS	• Floods • Storms • Wildfires
	HABITAT LOSS	• Desertification • Sea-level rise
	ECONOMIC STRESS	• Agriculture • Forestry • Water resources • Ecosystems • Fisheries

TIMEFRAMES, SOURCES, AND FREQUENCY OF DATA-UPDATES

Indicator scores are reported for Now/2010 and Near Term/2030. The selected data sources use different baseline years for their projections.
Data sources are also likely to be updated on different schedules.

MAIN SOURCES, DATA BASE YEAR, AND FREQUENCY OF UPDATES

SUB-INDEX	MAIN SOURCES	DATA BASE YEAR (PROJECTION)	FREQUENCY OF UPDATES
HEALTH IMPACT	• WHO (2004) Global Climate Change • WHO (2009) Global Health Observatory – Global Burden of Disease Data	• 2004 (2010, 2030)	• New WHO estimates expected in 2011 • Disease burden updates expected every other year
WEATHER DISASTERS	• CRED (2010) Center for Research of the Epidemiology of Disasters • Munich Re (2010) NatCatSERVICE, Statistics on Natural Disasters	• 1990-2009 (2010, 2030)	• Annual updates
HABITAT LOSS	• DIVA (2003) Dynamic Interactive Vulnerability Assessment • PLACE (2010) The Place II Model: "Population, Landscape, and Climate Estimates" • Toth et al. (2005) Millennium Ecosystem Assessment Report	• 2000 (2010, 2030)	• DIVA: no update expected • PLACE: regular data updates
ECONOMIC STRESS	• FUND2.8n (2009) The Climate Framework for Uncertainty, Negotiation and Distribution (FUND) • Earth Trends WRI (2009) for maximum catch potential	• 2001 (2010, 2030) • 2005 (2010, 2030)	• FUND model has regular updates; however national-level indications are updated less frequently • Earth Trends updates are expected every other year

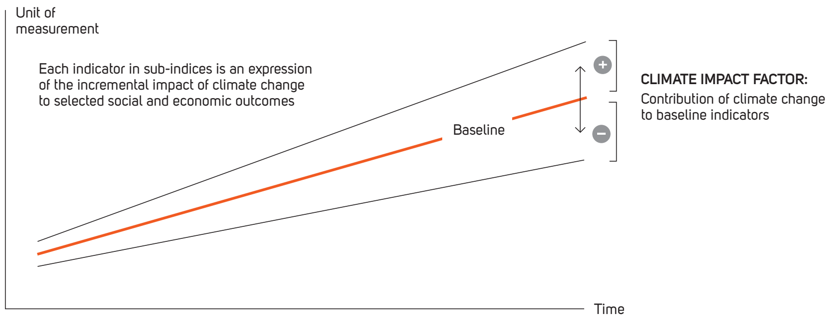
"CLIMATE EFFECT", "CLIMATE IMPACT FACTOR", AND CLIMATE SCENARIO

The index measures the impact of climate change through socio-economic indicators and scores countries based on this climate effect (CE).

The index assesses the climate effect in two ways:

- By attributing a climate impact factor (CIF) to baseline data derived from peer-reviewed scientific literature[306]
- By using existing complex models that calculate the climate effect[307]

FIGURE 3: CONTRIBUTION OF CLIMATE IMPACT FACTORS TO SOCIAL/ECONOMIC INDICATORS



Source: Commons analysis

Indicators score the effects of climate change on social and economic variables at the country level. This climate effect is calculated based on observed values of social and economic variables and the effects of climate change.

The extent climate change contributes to the development of a given variable is typically expressed as a climate impact factor (CIF). We compute an indicator's climate effect as follows:

$$CE = CIF \cdot variable$$

Variables are expressed in proportional terms to compare scores between countries: per GDP or per capita.

The other approach to indexing climate effect is using existing models. The two models used in the index are:

- FUND2.8n model, which estimates economic losses in various sectors of the economy
- Dynamic Interactive Vulnerability Assessment (DIVA), which estimates economic losses due to sea-level rise

In general, the various climate change models the Monitor uses have a starting point around the year 1990.

We have chosen medium-range climate scenarios in the sub-indices to calculate projections, except for in the sea-level rise indicator, where we have used a high-emission scenario. Recent research-based observations suggest that the high scenario is likely the most appropriate for sea-level rise projections.[308]

INDEX SCORING

The purpose of an index is to:

- Monitor evolution over time
- Draw attention to departures from average behaviour
- Enable comparison between countries

Constructing an index score based on a cross-section of univariate measures requires the choice of a transformation. In the context of monitoring climate impact, the transformation should balance the following goals:

- Preservation of the shape of the original distribution
- Unit-free measure
- Similarity of scale across indices
- Robustness, in the sense that a few extreme observations must not hide changes in remaining observations

We chose the dispersion measure as follows:

- An affine transformation preserves the shape of the original distribution
- Given a measure of dispersion measured in units of the original distribution, if the measure is used as a normalizing factor, the resulting score is both unit-free and similar with respect to scale across indices
- Robust dispersion measures such as mean absolute deviation or median absolute deviation are preferable, since they are somewhat insensitive to extreme observations
- Mean absolute deviation (MAD) is the choice for dispersion measure, since it weighs in extreme observations to some degree, while median absolute deviation does not

The index scores are constructed so that a CE of 100 indicates a neutral climate effect (CIF=0), while values above 100 indicate a negative climate effect, and values below 100 indicate a net gain from the impact of climate change.

The table below shows the range of CIF values in 2010 and 2030:

	CIF 2010 (LOW;HIGH)	CIF 2030 (LOW;HIGH)
MALNUTRITION	0; 0.091	0; 0.145
DIARRHEA	0; 0.038	0; 0.0654
MALARIA	0; 0.160	0; 0.248
DENGUE	0; 0.160	0; 0.248
CVD	-0.001; 0.003	-0.001; 0.005
RESP. DISEASES	-0.001; 0.003	-0.001; 0.005
FLOODS	0.115; 0.725	0.174; 0.815
WD OTHER	0.05	0.1
DESERTIFICATION	-0.007; 0.010	-0.02; 0.03
FISHERY	-0.026; 0.045	-0.13; 0.225

On the sub-index level, the countries have received an index score between 50 and 500.
Data is standardized using the following formula:

$$\text{Index score} = ((\text{variable}_{t,1} / (10 \cdot \text{MAD}(\text{variable})_{2010})) + 1) \cdot 100$$

Where variable is an indicator representing each country (i) at t=2010, 2030.

In sub-indices, variations in data are collapsed by dividing with 10*MAD. By adding 1 and finally multiplying by 100, a neutral or zero climate effect is expressed by 100 while values above 100 express a negative effect of climate change. The MAD is kept at a constant 2010 level to allow for variations over time.

CLIMATE EFFECT VARIABLES	
SUB-INDEX	**CLIMATE EFFECT (CE) INDICATOR**
HEALTH IMPACT	• Excess deaths due to climate change per capita
WEATHER DISASTERS	• Excess deaths due to storms, floods, and wildfires due to climate change per capita • Excess damage cost due to storms, floods, and wildfires due to climate change per GDP
HABITAT LOSS	• People at risk due to climate change-induced desertification • Cost per GDP due to climate change-induced sea-level rise
ECONOMIC STRESS	• Economic loss per GDP due to climate change

The countries are categorized in bands made in steps of ½*MAD from 100. The construction of the scoring means that one MAD of the 2010 score equals 10, resulting in the category bands listed below:

- Below 100 = low (reflecting positive impact of climate change)
- 100-104.99 (1/2*MAD from 100) = Moderate
- 105-109.99 = High -
- 110-114.99 = High +
- 115-119.99 = Severe -
- 120-124.99 = Severe +
- 125-129.99 = Acute -
- 130 and above = Acute +

The category bands have sub-factors or sub-bands ("+" or "-") for Acute, Severe, and High, but not for Moderate or Low. This is because:

- Roughly half of the countries assessed are not projected to face significant negative impacts overall from climate change in the near term (Moderate), and some may even experience small positive effects (Low)
- The indications for these countries are all quite similar, so there is limited basis for distinguishing between them in the Climate Vulnerability Monitor
- The focus of the Monitor is to offer guidance on countries facing High, Severe, and Acute impacts.

This construction method also enables an intuitive comparison between index scores Now (2010) and in the Near Term (2030). The impacts of climate change are expected to effect developments in countries depending on their particular vulnerabilities and exposures.

AGGREGATE INDEX SCORING

The purpose of the aggregate index scoring is to:

- Ensure that outliers in one of the sub-indices are not reflected disproportionally in the overall index
- Reflect highly impacted countries in one or more of the sub-indices

To achieve this scoring each category band on each sub-index is given a number:

- Below 100 = 1
- 100-104.99 = 2
- 105-109.99 = 3
- 110-114.99 = 4
- 115-119.99 = 5
- 120-124.99 = 6
- 125-129.99 = 7
- 130-134.99 = 8
- 135 and above = 9

The countries' average score on the sub-indices is calculated, and the countries are categorized using the legend below:

CATEGORY	LOW	HIGH
ACUTE	>5	
SEVERE	>4	<=5
HIGH	>3	<=4
MODERATE	>2	<=3
LOW		<=2

COUNTRIES INCLUDED AND SPATIAL SCALE

The index is calculated for 184 countries. Since its main objective is to enable comparisons between nations and sub-regions, it measures vulnerability at the national level. Assessment of vulnerability at the sub-national and local level is beyond the scope of this report.

Countries are divided into 20 regions for presentation purposes.

REGIONS AND COUNTRIES

REGION	COUNTRY
AUSTRALASIA	Australia, New Zealand
CARIBBEAN	Antigua and Barbuda, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago
CENTRAL AFRICA	Angola, Cameroon, Central African Republic, Chad, Congo, DRC Congo, Equatorial Guinea, Gabon, Sao Tome and Principe
CENTRAL AMERICA	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
EAST AFRICA	Burundi, Comoros, Ethiopia, Eritrea, Djibouti, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, Zimbabwe, Uganda, Tanzania, Zambia
EAST ASIA	China, Japan, North Korea, South Korea, Mongolia
EASTERN EUROPE	Bulgaria, Belarus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Slovakia, Ukraine
MIDDLE EAST	Bahrain, Cyprus, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Turkey, Yemen
NORTH AFRICA	Algeria, Libya, Morocco, Sudan, Tunisia, Egypt
NORTH AMERICA	Canada, United States of America
NORTHERN EUROPE	Denmark, Finland, Iceland, Ireland, Norway, Sweden, United Kingdom
PACIFIC	Solomon Islands, Fiji, Kiribati, Vanuatu, Micronesia, Marshall Islands, Palau, Papua New Guinea, Tonga, Tuvalu, Samoa
RUSSIA AND CENTRAL ASIA	Azerbaijan, Armenia, Georgia, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan
SOUTH AMERICA	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela
SOUTH ASIA	Afghanistan, Bangladesh, Bhutan, Sri Lanka, India, Iran, Maldives, Nepal, Pakistan
SOUTHEAST ASIA	Brunei, Myanmar, Cambodia, Indonesia, Laos, Malaysia, Philippines, Timor-Leste, Singapore, Vietnam, Thailand
SOUTHERN AFRICA	Botswana, Lesotho, Namibia, South Africa, Swaziland
SOUTHERN EUROPE	Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Malta, Portugal, Slovenia, Spain, Macedonia
WEST AFRICA	Cape Verde, Benin, Gambia, Ghana, Guinea, Cote d'Ivoire, Liberia, Mali, Mauritania, Niger, Nigeria, Guinea-Bissau, Senegal, Sierra Leone, Togo, Burkina Faso
WESTERN EUROPE	Austria, Belgium, France, Germany, Luxembourg, Netherlands, Switzerland

The report also makes use of a variety of socio-economic groupings.

REGIONS AND COUNTRIES	
LANDLOCKED LEAST DEVELOPED COUNTRIES (LLDC)	Afghanistan, Armenia, Azerbaijan, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Ethiopia, Kazakhstan, Kyrgyzstan, Laos, Lesotho, Macedonia, Malawi, Mali, Mongolia, Nepal, Niger, Paraguay, Moldova, Rwanda, Swaziland, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe,
SMALL ISLAND DEVELOPING STATES (SIDS)	Antigua and Barbuda, Bahamas, Barbados, Belize, Cape Verde, Comoros, Cuba, Dominica, Dominican Republic, Fiji, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia, Palau, Papua New Guinea, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Seychelles, Singapore, Solomon Islands, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu
INDUSTRIALIZED COUNTRIES (ANNEX I)	Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States
HIGH-GROWTH EMERGING COUNTRIES	Bangladesh, Brazil, China, Egypt, India, Indonesia, Iran, Mexico, Nigeria, Pakistan, Philippines, Russia, South Korea, Turkey, Vietnam
DEVELOPING COUNTRIES	Afghanistan, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Botswana, Brazil, Brunei, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Cote d'Ivoire, Cuba, Cyprus, Djibouti, Dominica, Dominican Republic, DRC Congo, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Laos, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, North Korea, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Rwanda, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, South Korea, Sri Lanka, Sudan, Suriname, Swaziland, Syria, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, United Arab Emirates, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe

SUB-INDEX ON HEALTH IMPACT

SUB-INDEX HEALTH IMPACT

SUB-INDEX	CLIMATE EFFECT (CE)	CLIMATE IMPACT FACTOR	DATA SOURCE
HEALTH IMPACT	Excess deaths per capita due to climate change for malnutrition (incl. acute respiratory infections) (%)	Climate impact factor (CIF) estimates for climate-sensitive diseases WHO (2004)[309]	WHO (2009)[310]
	Excess deaths per capita due to climate change for malaria (%)		
	Excess deaths per capita due to climate change for diarrhea (%)		
	Excess deaths per capita due to climate change for dengue (%)		
	Excess deaths per capita due to climate change for cardiovascular diseases (%)		
	Excess deaths per capita due to climate change for respiratory diseases (%)		

CALCULATION FROM WHO RISK FACTORS TO CLIMATE IMPACT FACTOR

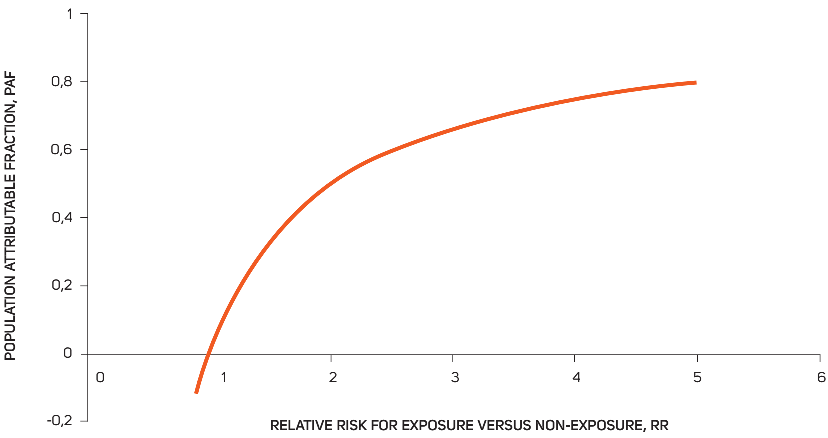
WHO has estimated climate risk factors for a range of climate-sensitive diseases at the level of WHO regions (14) derived from complex models that account for a number of different climatic influences on climate-sensitive health disorders/diseases.

The interpretation assumes *total exposure*, meaning that all people, within each WHO region, are exposed equally to climate change. The equation below defines *PAF* (Population Attributable Fraction, *CIF*) as:

$$PAF = P \cdot (RR-1) / [P \cdot (RR-1)+1] = (RR-1) / [(RR-1)+1]$$

Where *P* = prevalence of exposure (assumed to equal 1), and *RR*=relative risk for exposed versus non-exposed. In the case of climate change, the *RR* measure expresses the extra risk associated with the existence of abnormal weather patterns. For example, *RR*=2 indicates that the risk of dying due to flooding is twice as high in the case of climate change as it is the case of no climate change. The PAF expresses the fraction of risk -- for example, of deaths driven by climate -- and is, by construction, always smaller than 1.

The direct relationship between RR and PAF is illustrated in the figure below.



Baseline period: Baseline estimates of the burden of disease are taken from the WHO Burden of Disease Database, published 2004, estimates published 2009. This data is at the national level.

CALCULATION OF CLIMATE EFFECT AND INDEX SCORE

The WHO's 2009 "Global Health Observatory – Global Burden of Disease Database" report,[311] has baseline estimates of the burden of disease at the country level.

The WHO's 2004 "Comparative Quantification of Health Risk, Global and Regional Burden of Disease Attributable to Risk Factors" report,[312] has estimated climate impact factors (CIF) for climate-sensitive diseases at the level of WHO regions (14) derived from complex models that account for a number of different climatic influences on climate-sensitive health disorders/diseases.

The climate effect (CE) is calculated by multiplying the variable (disease burden) with the CIF, as shown in the formula below.

$$CE\_Malnutrition_{2010} = \frac{(CIF\_Malnutrition_{2010,country} \cdot Disease\ Burden_{2004,\ country})}{Population_{2004,country}}$$

Disease burden in 2010 uses the WHO's 2004,[313] while the disease burden in 2030 is projected using the UN 2010 estimates of population growth to 2030.[314]

The total excess deaths due to climate change for a country is the sum of the CE for diseases comprising the sub-index health impact (cf. Table 4 above):

$$SUM\ (CE_{2010,deaths}) = CE\_Malnutrition_{2010} + CE\_Malaria_{2010} + CE\_Diarrhea_{2010} + CE\_Dengue_{2010} + CE\_Cardiovascular\ Diseases_{2010} + CE\_Respiratory\ Diseases_{2010}$$

The sub-index score is calculated by using the index calculation formula below:

$$Index\ score_{2010} = ((SUM\ (CE_{2010,deaths)}) / (10 \cdot MAD\ (SUM\ (CE_{2010,deaths})) +1) \cdot 100$$

The calculation of 2030 estimates uses WHO 2004 CIF for 2030[315] and the disease burden projected for 2030, using population projections from the UN.[316]

CLIMATE SCENARIOS

The World Health Organization has three emission scenarios and three uncertainty scenarios resulting in a total of nine climate impact factors (CIF) per region.[317] For the purpose of the Health Impact sub-index, the two mid-range scenarios have been applied to measure the medium expected climate change impact:

- Mid-range: "Emission reduction resulting in stabilization at 750 ppm C02 equivalent by 2210 (s750)"[318]
- Mid-range uncertainty scenario is used "Making an adjustment for biological adaptation"[319]

Thus only one impact factor is chosen per region.

The WHO CIF estimates include 2010, 2020, and 2030 estimates. It uses the HadCM2 global climate model previously used by IPCC.[320]

SUB-INDEX ON WEATHER DISASTERS

SUB-INDEX WEATHER DISASTERS

SUB-INDEX	SUB-SUB-INDEX	CLIMATE EFFECT (CE) INDICATOR	CLIMATE IMPACT FACTOR (CIF)	SOURCE
WEATHER DISASTERS	DEATHS	Excess deaths per capita due to climate change for floods (%)	WHO estimates	WHO (2004)[321] CRED (2010)[322]
		Excess deaths per capita due to climate change for storms (%)	Hypothetical estimate 2010: 5% 2030: 10%	
		Excess deaths per capita due to climate change for wildfires (%)		
	DAMAGE COSTS	Excess damage costs relative to GDP due to floods (GDP USD %)	Hypothetical estimate 2010: 5% 2030: 10%	CRED (2010)[323]
		Excess damage costs relative to GDP due to storms (GDP USD %)		
		Excess damage costs relative to GDP due to wildfires (GDP USD %)		
		Excess damage costs relative to GDP due to natural disasters (GDP USD %)		Munich Re (2010)[324] GermanWatch (2010)[325]

CYCLICAL ADJUSTMENT

The sub-index is created using data from the Emergency Events Database (EM-DAT) and Munich Re NatCatSERVICE.[326] EM-DAT is maintained by the WHO Collaborating Centre for Research on the Epidemiology of Disasters.[327] EM-DAT includes data on a number of indicators (events, deaths, affected, economic damages) for a range of different disasters (drought, earthquake, epidemic, extreme temperature, flood, insect infestation, mass movement dry, mass movement wet, volcano, storm, wildfire).

The index also uses another set of data from the Munich Re NatCatSERVICE database[328] and from GermanWatch,[329] comprising some 28,000 data records on natural disasters. Approximately 1,000 events are recorded and analyzed every year.

The indicators used in the sub-index are deaths and damage costs, since these are regarded as the most reliable available data. Furthermore, only deaths and damage costs due to floods, storms, and wildfires are included in the index.

Floods, storms, and wildfires are highly variable phenomena. To obtain a more robust predictor of future events from past observations, the variable used to indicate risk of exposure to floods and storms is the average annual impact between 1990 and 2009.

The data on natural disasters is in many cases disparate.[330] The data source for deaths is exclusively EM-DAT. The approach for establishing damage costs is to combine data from EM-DAT and NatCatSERVICE databases to increase data reliability. The highest damage-cost value reflected in the two databases for the 20-year period is chosen for each country. This is done to cover lack of reporting in one of the databases, while there is little fear of overstating costs.

CALCULATION OF CLIMATE EFFECT AND INDEX SCORE

In the sub-index, two underlying indices for deaths and for damage costs are constructed.

The weather disaster deaths sub-index uses two types of climate impact factors (CIF). For floods the impact of climate change is calculated using a climate impact factor derived from WHO.[331] For storms and wildfires, 5% CIF is used in 2010, and 10% CIF is used in 2030 (see climate scenarios below).

The climate effect (CE) for excess deaths due to storms is calculated as follows for each country (2010 as example):

$$CE\_Storms\_Deaths_{2010} = \frac{(CIF\_Storms_{2010,country} \cdot Avg.\ Deaths_{1990\text{-}2009,country})}{Population_{2010,country}}$$

The total excess deaths per capita due to climate change for a country is the sum of the CE for storms, floods, and wildfires, comprising the underlying weather disaster deaths sub-index (cf. Table 5 above):

$$SUM\ (CE2010,deaths)) = CE\_Storm_{2010,deaths} + CE\_Floods_{2010,deaths} + CE\_WildFire_{2010,deaths}$$

Calculation of the index score is completed using the method described in the introductory section:

$$Index\ score_{2010} = ((SUM\ (CE_{2010,deaths)}) / (10 \cdot MAD\ (SUM\ (CE_{2010deaths})) +1) \cdot 100$$

The same approach is used for constructing the weather disaster damage cost sub-index, again with storms as an example:

$$CE\_Storms\_DamageCost_{2010} = \frac{(CIF\_Storms_{2010,country} \cdot Avg.DamageCost_{1990\text{-}2009,country})}{GDP_{2010,country}}$$

Similarly to deaths, the CEs are summed and the index calculated. To reflect both deaths and damage cost in the weather disaster sub-index, the overall index score is constructed by adding the two indices with a weight of 20% of damage cost and 100% weighting of deaths.

$$Weather\ Disaster\ index\ score = index\ score\ deaths + 20\% \cdot (index\ score\ damage\ cost\ -100)$$

CLIMATE SCENARIOS

Rising temperatures increase the amount of energy in the atmosphere and also affect weather patterns. However, there is no scientific consensus on the impact of disasters in terms of projections for all disaster types of how this will affect impacts in terms of deaths and damage costs. Accordingly, the weather disaster sub-index uses two sets of climate scenarios.

There is a consensus that precipitation will intensify with rising temperatures impact on floods. We use the same WHO source to establish the impact of climate change on excess deaths from flood events as we used for the health impact index.

Storms and wildfires are highly variable over time, and it is challenging to statistically establish the climate change signal in observations of events over the last 20-30 years. Several groups of scientists are engaged in complex modelling to establish projections for how storm patterns will change with climate change. The effects are expected to be complex with different regions experiencing different event frequency, average of intensity, and intensity of top wind speeds.[332]

Consensus estimates have not yet been established for projections of these effects.

In line with its principles of applying due precaution and establishing relevant policy guidance, this report uses a set of hypothetical climate impact factors for areas where established estimates are not available – damage costs due to floods, and for excess deaths and damage costs due to storms and wildfires. These hypothetical factors are 5% for 2010 and 10% for 2030. These factors are moderate in comparison to studies of the increasing frequency of loss events,[333] and they are in line with regional projections for instance for the United States.[334] It is expected that improved estimates will be available by the time that the next version of this report is published.

For Floods, The World Health Organization has three emission scenarios and three uncertainty scenarios giving a total of nine Climate Impact Factors (CIF) per region.[335] For the purpose of the floods CIF, the two mid-range scenarios have been applied to measure the medium expected climate change impact:

- Mid-range: “Emission reduction resulting in stabilization at 750 ppm C02 equivalent by 2210 (s750)”[336]
- Mid-range uncertainty scenario is used “Making an adjustment for biological adaptation”[337]

Thus only one impact factor is chosen per region.

SUB-INDEX ON HABITAT LOSS

HABITAT LOSS

SUB-INDEX	SUB-SUB-INDEX	CLIMATE EFFECT (CE) INDICATOR	CLIMATE IMPACT FACTOR (CIF)	SOURCE
HABITAT LOSS	DESERTIFICATION	Excess population per capita at risk due to climate change in climatic zone: dry, steppe vegetation type (%)	IMAGE 2.2 estimates in the Millennium Ecosystem Assessment[338]	PLACE II (2010)[339] Toth et al. (2005)[340]
		Excess population per capita at risk due to climate change in climatic zone: Dry, Steppe Vegetation Type, Subtropical desert with average temperature >18 °C.		
		Excess population per capita at risk due to climate change in climatic zone: dry, steppe vegetation type, cool dry climate, middle latitude deserts.		
		Excess population per capita at risk due to climate change in climatic zone: dry, steppe vegetation type, temperature of warmest month < 18 °C.		
	SEA-LEVEL RISE	Tidal basin nourishment costs relative to GDP (USD) (%)	Economic impacts calculated in DIVA	DIVA (2003)[341]
		Beach nourishment costs relative to GDP (USD) (%)		
		Land loss costs relative to GDP (USD) (%)		
		Migration costs relative to GDP (USD) (%)		
		River dike costs relative to GDP (USD) (%)		
		River flood costs relative to GDP (USD) (%)		
		Salinity intrusion costs relative to GDP (USD) (%)		
		Sea dike costs relative to GDP (USD) (%)		
		Sea flood costs relative to GDP (USD) (%)		
		Wetland nourishment costs relative to GDP (USD) (%)		

CALCULATION OF CLIMATE EFFECT

The Sea-Level Rise Indicator in the sub-index is calculated by using a set of variables indicating the projected economic losses as a share of GDP due to sea-level rise caused by climate change from the Dynamic Interactive Vulnerability Assessment (DIVA) tool;[342] a geographic information system (GIS)-based tool to assess impacts and vulnerability to sea-level rise at scales from coastal segment up to global. It comprises a database, a series of algorithms, and a graphical user interface. In the DIVA database, the world's coastlines are divided into 12,148 segments with an average coastal segment length of 70km. DIVA provides a multitude of parameters for each of the segments, including population density, frequency and height of storm surges, and coastal wetland areas. These are used as inputs for the extended sea-level rise cost function. DIVA also contains various data at other scales, including countries, major rivers, tidal basins, and administrative units (states, prefectures, etc.).

The economic losses modelled in the DIVA due to sea-level rise is the cost of:
- Tidal basin nourishment (adaptation cost)
- Beach nourishment (adaptation cost)
- Land loss (losses)
- Migration (adaptation cost)
- River dike (adaptation cost)
- River flood (losses)
- Salinity intrusion (losses)
- Sea dike (adaptation cost)
- Sea flood (losses)
- Wetland nourishment (adaptation cost)

Each of the cost components is derived from the DIVA model in 2010 and 2030 and the climate effect is calculated simply by dividing the cost with GDP.

$$\text{CE\_Land Loss}_{2010,country} = \frac{\text{Cost of Land Loss}_{2010,country}}{\text{GDP}_{2010,country}}$$

We can use the same method to calculate the sea-level rise index score as we used in the Health Impact and Weather Disaster sections:
- Adding all CE effects
- Calculating the index score

$$\text{Index score}_{2010} = ((\text{SUM}(\text{CE}_{2010,gdp}) / (10 \cdot \text{MAD}(\text{SUM}(\text{CE}_{2010,gdp})) +1) \cdot 100$$

The Desertification Indicator in the sub-index is calculated by using a variable indicating the share of the population living in areas at risk of desertification from the PLACE II database (Population, Landscape, and Climate Estimates).[343] This data set has been released as part of SEDAC's National Aggregates of Geospatial Data Collection.

SEDAC, the Socioeconomic Data and Applications Center, is one of the Distributed Active Archive Centers (DAACs) in the Earth Observing System Data and Information System (EOSDIS) of the U.S. National Aeronautics and Space Administration. PLACE II is managed by the Center for International Earth Science Information Network (CIESIN) at Columbia University.[344]

PLACE II estimates the number of people (head counts and percentages) and the land area (square kilometres and percentages) represented within each class of a number of demographic, physical, biological, and climatic variables for each country around the world, for the years 1990 and 2000.[345]

The measure used in the sub-index is the share of populations living in areas that are at risk of desertification (defined as population in climatic zones that is classified as dry, steppe vegetation type).

The impact of climate change on the population at risk to desertification has been derived from the Millennium Ecosystem Assessment Report (1999) using the IMAGE model that is developed by the IMAGE team under the authority of the Netherlands Environmental Assessment Agency (PBL). IMAGE is used to provide regional estimates of desertification.[346]

Climate impact factors are assumed to follow a linear trajectory from 2000 to 2050, as suggested by the four scenarios in the IMAGE2.2. model. Thus, scores for 2010 and 2030 can be derived by combining the IMAGE model projections and the PLACE model baseline data from 2000.

We calculate the desertification index similarly to how we calculate the other indices, except that we divide the scores 20*MAD in the index score construction:

Index score = $((SUM(CE_{2010,pop\_at\_risk}) / (20 \cdot MAD(SUM(CE_{2010,pop\_at\_risk})) + 1) \cdot 100$

This deviation from the general index calculation rule is done to make the desertification sub-index comparable to the sea-level rise sub-index due to many extreme values in the former index.

The sub-index score is calculated by adding the score on the Sea-Level Rise Indicator and the score on the Desertification Indicator and subtracting 100. This combination of the two effects allows the sub-index to indicate which countries are most exposed to either sea-level rise or desertification and to particularly highlight the countries that are exposed to both effects. This index thus avoids penalizing countries that are landlocked or not exposed to desertification.

Habitat Loss index score = (Index score SLR + Index score desertification) - 100

CLIMATE SCENARIOS

The desertification risk measure is a simple average of the different IMAGE projections listed below.[347]

- Global Orchestration
- Order from Strength
- TechnoGarden
- Adapting Mosaic

For the sea-level rise cost calculations used in DIVA, the A1FI scenario is used as the projection method.

SUB-INDEX ON ECONOMIC STRESS

ECONOMIC STRESS

SUB-INDEX	CLIMATE EFFECT (CE) INDICATOR	CLIMATE IMPACT FACTOR (CIF)	SOURCE
ECONOMIC STRESS	Costs relative to GDP (USD) due to effect on water	Economic impacts calibrated in the FUND2.8n model	FUND (2009)[348]
	Costs relative to GDP (USD) due to effect on agriculture		
	Costs relative to GDP (USD) due to effect on forestry		
	Costs relative to GDP due to effect on ecosystems/biodiversity		
	Change in fishery exports relative to GDP (USD) due to effect on fisheries	Estimate of change in Maximum catch potential	Cheung et al. (2010)[349] Earth Trends WRI (2010)[350]

CALCULATION OF CLIMATE EFFECT

We calculate the Economic Stress Sub-index using a set of variables indicating the projected economic losses in different economic sectors as a share of GDP due to climate change.

Estimates for four economic sectors are based on the FUND 2.8n model. We calculate the Climate Effect by use of the FUND model (Climate Framework for Uncertainty, Negotiation and Distribution).[351] FUND is an integrated assessment model of climate change. The model links exogenous population and per capita income scenarios with simple models of technology, economics, emissions, atmospheric chemistry, climate and sea-levels in order to estimate impacts such as migration, disease burdens and economic effects on a sector basis. The model runs in steps of 5 years from 1950 to 2100 and covers 207 countries. The FUND2.8n model is based on the more sophisticated FUND2.8 model that provides annual estimates of outcomes for 16 regions up to 2030. All estimates in the FUND model are made with 1995 US dollars as the benchmark year.

One notable change has been made to the FUND model, namely to reduce in half the "water resources sensitivity parameter with regard to temperature change" for the "Former Soviet Union" region. This rationale for the change was as follows:

- Former Soviet Union water resources impact is an outlier value that overshadows the impacts in other regions
- To improve the sensitivity of the Economic sub-index to negative impacts in other regions

The sub-index combines indicators of climate change impacts on economic sectors that are stressed by climate change.

- Land sectors (Agriculture, Forestry, Water and Biodiversity): climate change related loss or gain in economic output in these sectors in 2010 and 2030.
- Marine sector (Fisheries): climate change related loss or gain in the economic value of exports of the fisheries sector in 2010 and 2030

We calculate economic loss in fisheries using Cheung et al. 2010 estimates.[352] Cheung et al. estimate the change in maximum catch potential due to climate change. The higher (numerically) the latitude, the larger the increase in maximum catch potential, and the opposite holds true for low-latitude countries. Thus, tropical countries close to the equator face a decreasing maximum catch potential, while especially northern countries experience gains.

Cheung et al. show specific estimates for 20 countries. These are taken directly as climate impact factors (CIFs). The countries not listed are given general risk factors using the specifications below:

- Countries > 55 lat = 0,3
- Countries in the tropics < 0,23 (num) = -0,2

Calculation of the index scores follows the same procedure as the other sub-indices

$$CE\_Land\_Sectors2010,country = \frac{Cost\ of\ Land\ Sectors2010,country}{GDP_{2010,country}}$$

And

$$SUM\ (CE_{2010,gdp)}) = CE\_Land\_Sectors_{2010,gdp} + CE\_Marine\_Sector_{2010,gdp}$$

And

$$Index\ score = ((SUM\ (CE_{2010,gdp)}) / (10 \cdot MAD\ (SUM\ (CE_{2010,gdp})) +1) \cdot 100$$

CLIMATE SCENARIOS

The FUND scenario is based on the EMF14 Standardized Scenario and lies somewhere between the IS92a and IS92f scenarios.[353] The scenario used for fisheries is the SRES (Special Report on Emissions Scenarios) A1B scenario. This scenario assumes that the greenhouse gas concentration will be stabilized at 720 ppm by the year 2100. It describes a world of very rapid economic growth, low population growth, rapid introduction of new and more efficient technologies, and moderate use of resources with a balanced use of technologies.

EXAMPLE SUB-INDEX CALCULATION: HEALTH IMPACT IN BANGLADESH

CODE	VARIABLE	CALCULATION	BASELINE	2010	2030
HI1	Disease Burden Malnutrition (1000 persons)	-	132		
HI2	Disease Burden Diarrheal (1000 persons)	-	74		
HI3	Disease Burden Malaria (1000 persons)	-	6		
HI4	Disease Burden Dengue (1000 persons)	-	2		
HI5	Disease Burden CVD (1000 persons)	-	290		
HI6	Disease Burden Resp. Diseases (1000 persons)	-	65		
HI7;I13	CIF Malnutrition	-		0,09	0,15
HI8; HI14	CIF Diarrheal	-		0,04	0,07
HI9; HI15	CIF Malaria	-		0,00	0,01
HI10; I16	CIF Dengue	-		0,00	0,01
HI11; I17	CIF CVD	-		0,00	0,00
HI12; 18	CIF Resp. Diseases	-		0,00	0,00
HI19	Population WHO 2004, (1000 persons)	-	150528		
HI20	Population UN 2030 (1000 persons)	-	204927		
HI21	Population Growth Factor, 2004 to 2030	(HI20-HI19)/HI19+1	1		
HI22; I28	CE Malnutrition	**2010:** HI7*HI1; **2030:** HI13*HI1*HI21		11,98	26,07
HI23; HI29	CE Diarrhea	**2010:** HI8*HI2; **2030:** HI14*HI2*HI21		2,83	6,55
HI24; HI30	CE Malaria	**2010:** HI9*HI3; **2030:** HI15*HI3*HI21		0,00	0,09
HI25; HI31	CE Dengue	**2010:** HI10*HI4; **2030:** HI16*HI4*HI21		0,00	0,03
HI26; HI32	CE CVD	**2010:** HI11*HI5; **2030:** HI17*HI5*HI21		0,87	1,97
HI27; HI33	CE Resp. Diseases	**2010:** HI12*HI6; **2030:** HI18*HI6*HI21		0,19	0,44
HI34; HI35	CE TOTAL	**2010:** sum(HI22;HI27); **2030:** sum(HI28;HI33)		15,87	35,14
HI36; I37	CE TOTAL per capita	**2010:** HI34/HI19 **2030:** HI35/HI20		0,000105	0,000171
HI38; I39	MAD 2010	Mean(abs(HI36-mean(HI36)))		0,0000545	0,0000545
HI40; I41	Health sub-index	**2010:** (HI36/(HI38*10)+1)*100;		119,34	131,46
HI42; HI43	Category	**2030:** (HI37/(HI39*10)+1)*100		HIGH +	ACUTE -

EXAMPLE SUB-INDEX CALCULATION: WEATHER DISASTERS IN BANGLADESH

CODE	VARIABLE	CALCULATION	BASELINE	2010	2030
WD1	Weather Disaster Burden Floods (average # of persons, 1990 - 2009)	-	267.40		
WD2	Weather Disaster Burden Storms (average # of persons, 1990 - 2009)	-	7410.05		
WD3	Weather Disaster Burden Wildfire (average # of persons, 1990 - 2009)	-	0.00		
WD4; WD7	CIF Floods	-		0.12	0.17
WD5; WD8	CIF Storms	-		0.05	0.10
WD6; WD9	CIF Wildfires	-		0.05	0.10
WD10	Population World Bank (average, 1990-2008)	-	138106.23		
WD11	Population UN 2030 (1000 persons)	-	204926.85		
WD12	Population Growth Factor, 1990-2008 avg – 2030	(WD11-WD10)/WD10+1	1.48		
WD13; WD16	CE Floods	**2010:** WD1*WD4; **2030:** WD1*WD7*WD12		30.76	68.86
WD14; WD17	CE Storms	**2010:** WD2*WD5; **2030:** WD2*WD8*WD12		370.50	1099.53
WD15; WD18	CE wildfires	**2010:** WD3*WD6; **2030:** WD3*WD9*WD12		0.00	0.00
WD19; WD20	CE (deaths) TOTAL	**2010:** sum(WD4;WD6); **2030:** sum(WD7;WD9)		401.27	1168.39
WD21; WD22	CE (deaths) TOTAL per capita	**2010:** WD19/(WD10*1000); **2030:** WD20/(WD11*1000)		2.90548E-06	5.7015E-06
WD23; WD24	MAD 2010, deaths	Mean(abs(WD21-mean(CE deaths Total per capita 2010)))		0.000001	0.000001
WD25; WD26	Weather disasters sub-sub-index (deaths)	**2010**: (WD21/(WD23*10)+1)*100; **2030:** (WD22/(WD24*10)+1)*100		130.68	160.21
WD27	Weather Disaster Burden Floods (average damage costs 1990 - 2009, 1000 USD)	-	394215.00		
WD28	Weather Disaster Burden Storms (average damage costs 1990 - 2009, 1000 USD)	-	263875.00		
WD29	Weather Disaster Burden Wildfires (average damage costs 1990 - 2009, 1000 USD)	-	0.00		
WD30	MunichRE* (average costs per GDP, 1990-2008)	-	0.0181		
WD31; WD32	CIF Damage Costs	-		0.05	0.1
WD33	GDP FUND (average, 1995, 2000, 2005, 2010) (billion 1995 USD)	-	56.7235		
WD34	GDP FUND 2030 (billion 1995 USD)	-	152.796		
WD35	GDP Growth Factor	-	2.69		
WD36	Damage Costs (1000 1995 USD)	MAX(sum(WD27:WD29; WD30*WD33*100000)	1026695.59		
WD37; WD38	CE Damage Costs	**2010:** WD36*WD31; **2030:** WD36*WD32*WD35		51334.78	276561.48
WD39; WD40	CE Damage Costs per GDP	**2010:** WD37/(WD33*1000000); **2030:** WD38/(WD34*1000000)		0.0009	0.0018
WD41; WD42	MAD 2010, Damage Costs	Mean(abs(WD39-mean(CE damage costs per GDP 2010)))		0.0006	0.0006
WD43; WD44	Weather Disasters sub-sub-index (damage costs)	**2010:** (WD39/(WD41*10)+1)*100; **2030:** (WD40/(WD42*10)+1)*100		114.28	128.55
WD45; WD46	Weather Disasters sub-index	**2010:** ((WD25-100)+(WD43-100)*0.2)+100; **2030:** ((WD26-100)+(WD44-100)*0.2)+100		133.54	165.92
WD47; WD48	Category	-		Acute+	Acute+

*storms and floods, as well as temperature extremes and mass movements (heat and cold waves, etc.)

EXAMPLE SUB-INDEX CALCULATION: HABITAT LOSS IN BANGLADESH

CODE	VARIABLE	CALCULATION	BASELINE	2010	2030
HL1	Population living in drylands PLACE 2000	-	0		
HL2; HL3	CIF desertification	-		0.0045	0.0135
HL4; HL5; HL6	Population FUND 1000 persons	-	129790.7	151123.72	184852.8649
HL7; HL8	Population growth factor	**2010:** (HL5-HL4)/HL4+1 **2030:** (HL6-HL4)/HL4+1		1.164365	1.424238
HL9; HL10	CE desertification	**2010:** HL1*HL2*HL7 **2030:** HL1*HL3*HL8		0	0
HL11; HL12	CE desertification per capita	**2010:** HL9/HL5 **2030:** HL10/HL6		0	0
HL13; HL14	MAD 2010, desertification	Mean(abs(HL11-mean(CE desertification per capita 2010)))		0.0003534	0.0003534
HL15; HL16	Desertification sub-sub-index (deaths)	**2010:** (HL11/(HL13*10)+1)*100; **2030:** (HL12/(HL14*10)+1)*100		100	100
HL17; HL18	CE SLR costs (million USD)	-		353.10	1447.31
HL19	GDP FUND 2010 (billion USD)	-	76.974		
HL20; HL21	CE SLR costs per GDP	**2010:** HL17/(HL19*1000); **2030:** HL18/(HL19*1000)		0.0046	0.0188
HL22; HL23	MAD 2010, SLR	Mean(abs(HL20-mean(CE SLR costs per GDP)))		0.0211	0.0211
HL24; HL25	Desertification sub-sub-index (deaths)	**2010:** (HL20/(HL22*10)+1)*100; **2030:** (HL21/(HL23*10)+1)*100		102.176	108.921
HL26; HL27	Habitat Loss sub-index	**2010:** HL15+HL24-100; **2030:** HL16+HL25-100		102.1764	108.9207
HL28; HL29	Category	-		MODERATE	HIGH-

EXAMPLE SUB-INDEX CALCULATION: ECONOMIC STRESS IN BANGLADESH

CODE	VARIABLE	CALCULATION	BASELINE	2010	2030
ES1	Fishery Exports 2005 (million 2005 USD)	-	359.47		
ES2	GDP World Bank 2005 (billion 2005 USD)	-	60.278		
ES3	GDP FUND 2005 (billion 1995 USD)	-	62.856		
ES4	GDP FUND 2030 (billion 1995 USD)		152.796		
ES5	GDP FUND 2010 (billion USD)	-	76.974		
ES6	Fishery Exports relative to GDP 2005	ES1/(ES2*1000)	0.005964		
ES7	Fishery Exports 2005 (million 1995 USD)	ES6*ES3*1000	374.873		
ES8	GDP Growth Factor	(ES4-ES3)/ES3+1	2.431		
ES9; ES10	CIF Fisheries	-		-0.025	-0.125
ES11; ES16	CE Fisheries (million 1995 USD)	2010: (ES7*ES9)*-1; 2030: (ES7*ES10*ES8)*-1		9.3718296	113.9097126
ES12; ES17	CE Agriculture (million 1995 USD)	-		-3.616149	-7.937206
ES13; ES18	CE Forestry (million 1995 USD)	-		-4.113147	-10.387434
ES14; ES19	CE Water (million 1995 USD)	-		105.072469	273.70844
ES15; ES20	CE Ecosystems (million 1995 USD)	-		2.199358	8.033951
ES21; ES22	CE Total	2010: sum(ES11:ES15); 2030: sum(ES16:ES20)		108.914	377.327
ES23; ES24	CE Total per GDP	2010: ES21/(ES5*1000); 2030: ES22/(ES4*1000)		0.001415	0.002469
ES25; ES26	MAD 2010	Mean(abs(ES23-mean(CE total per GDP 2010)))		0.00213	0.00213
ES27; ES28	Economic Stress subindex	2010: (ES23/(ES25*10)+1)*100;		106.647025	111.600803
ES29; ES30	Category	2030: (ES24/(ES26*10)+1)*100		HIGH-	HIGH+

ADAPTATION PERFORMANCE REVIEW

Whereas the Index on climate vulnerability highlights key vulnerabilities to climate change through the lens of estimated/measurable impacts on human society, the Adaptation Performance Review is a rating system on adaptive effectiveness that assesses measures known to be effective to a specific degree in limiting the impact on vulnerable populations as identified in the Climate Vulnerability Monitor/Index section of the report. The key criteria used in the rating system are summarized in the table below:

CRITERIA	OPERATIONAL QUESTIONS
COST-EFFECTIVENESS	• Cost-effectiveness rating • Time horizon (from implementation to impact) • Variability
CO-BENEFITS	• Co-benefits rating • Equity • Variability
FEASIBILITY	• Implementation risks • Sensitivity to exogenous factors • Variability
SCALABILITY	• Technical specifications and guidelines • Training programmes • LDC relevance • Case examples
EVIDENCE-BASED	• Peer-reviewed studies • Type of assessments • Linked to vulnerability assessment • Recognition by policy-makers

CATALOGUE OF ADAPTIVE MEASURES

We have built up the catalogue of adaptation intervention sets based on a comprehensive review of national programmes of action and pilot schemes. We selected adaptation interventions sets based on bottom-up reviews of projects that are currently being planned or implemented, and we have categorized them according to the most relevant areas of vulnerability following the Index structure.[354] The report does not cover exogenous factors such as legislation, local capacities, policy frameworks, private sector strategies of risk transfer, etc. This could create a bias towards project-based adaptation measures as opposed to adaptation that addresses an underlying governance.

DESK REVIEW APPROACH

We identified and rated the adaptive measures primarily based on a desk review of published materials. We focused on material that is published either in a peer-reviewed source or by an institution that is internationally recognized as a credible source of information on climate change and adaptation issues.[355]

CATEGORIES OF MEASURES IN THE CATALOGUE

The catalogue is divided into a number of categories to ensure a good distribution of measures across the key areas of vulnerability and types of interventions.

The intervention sets fall into the four index categories:

- Health
- Weather Disasters
- Habitat Loss
- Economic Stress

RATING METHODOLOGY

The indicator set covers the key factors that determine whether a specific intervention is attractive to a community that is vulnerable to a certain type of climate impact. Each adaptation intervention set is rated based on a standard approach:

- Indicator set across a set of key dimensions of attractiveness
- Qualitative criteria and rating guide for each indicator
- System for aggregating ratings across criteria and indicators

INDICATORS AND RATING SYSTEM

Each indicator is operationalized through a set of qualitative criteria that are assigned scores and weights to make up a compound rating on each indicator.

INDICATOR RATING SYSTEM GUIDE

CRITERIA	OPERATIONAL QUESTIONS	HIGHEST (5)	LOWEST (1)	SUB-WEIGHT	WEIGHT
COST-EFFECTIVENESS (CE)	Cost-effectiveness rating	Very high/self-financing	Very low	50%	40%
	Time horizon	Short term (within 1 year)	10+ years	25%	
	Variability	Fully consistent	Inconsistent	25%	
CO-BENEFITS (CB)	Co-benefits rating	Large impact on dev./hum indicators	Negative	50%	15%
	Equity	All groups, incl. poorest	Mostly benefit wealthy	25%	
	Variability	Fully consistent	Inconsistent	25%	
FEASIBILITY (F)	Implementation risks	Always succeeds	Mostly likely to fail	50%	15%
	Sensitivity to exogenous factors	Not sensitive	Very sensitive	25%	
	Variability	Fully consistent	Inconsistent	25%	
SCALABILITY (S)	Tech specs and guidelines	Rich and accessible doc	Little, hard-to-get info	25%	15%
	Training programmes	Many, affordable	No programmes	25%	
	LDC relevance	Very relevant	Not relevant	25%	
	Case examples	Many, well-documented	No case examples	25%	
EVIDENCE (E)	Peer reviewed studies	Several, high-profile	None	40%	15%
	Type of assessments	Empirical, detailed	Qualitative, general	30%	
	Linked to vulnerability assessment	Specific	Unspecific	15%	
	Recognition by policy-makers	High, frequent	Low	15%	

An overall rating is calculated by combining the scores across the indicators.

The rating scores are consequently made on a 1-5 scale, resulting in the category bounds listed below:

- >0-1 = Very Low
- >1-2 = Low
- >2-3 = Medium
- >3-4 = High
- >4-5 = Very High

A high rate of livestock deaths is reported from Ethiopia's Ogaden region due to drought and other factors. Source: UN Photo/Gijs van't Klooster.