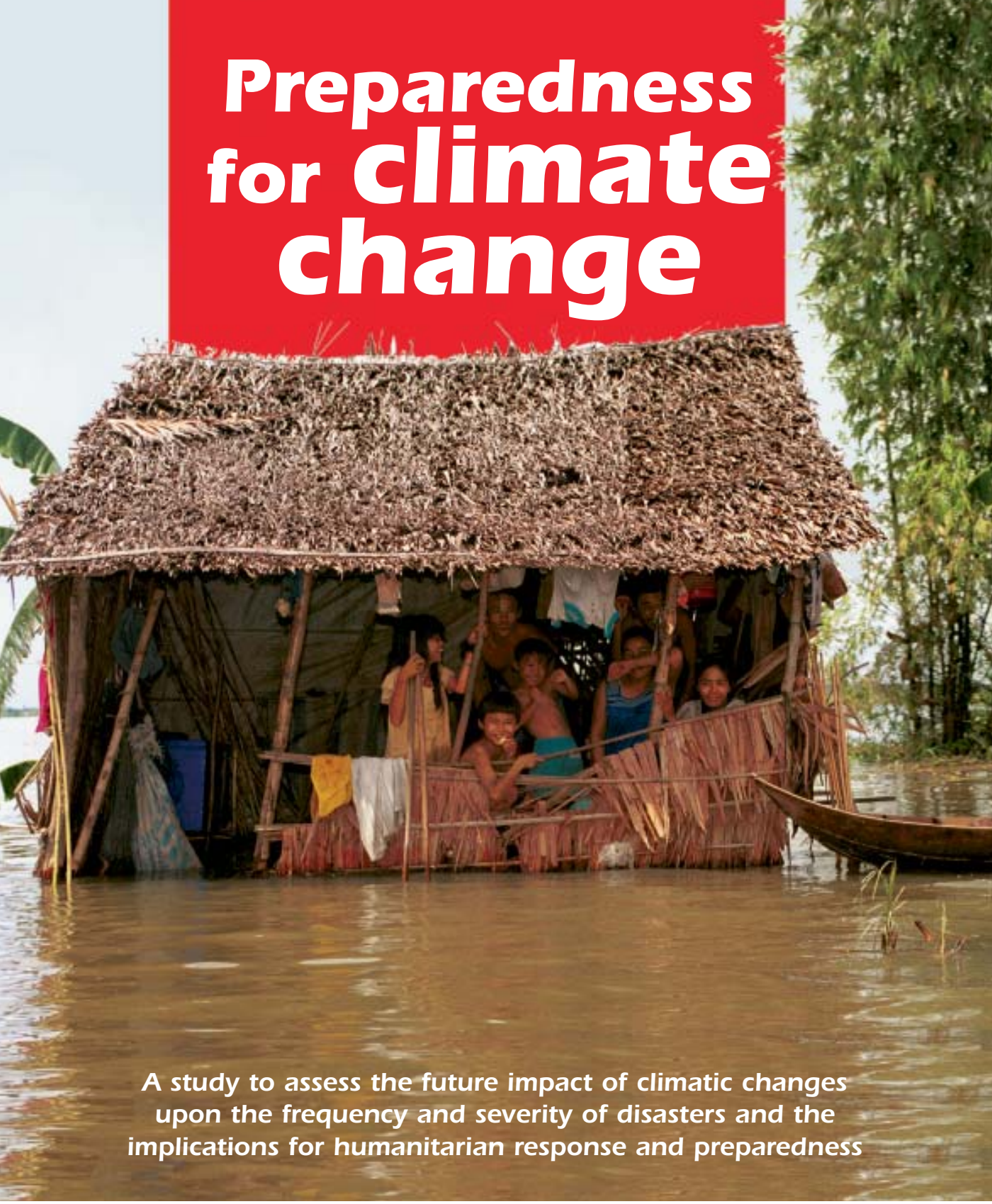
Preparedness for climate change



A study to assess the future impact of climatic changes upon the frequency and severity of disasters and the implications for humanitarian response and preparedness

Het Nederlandse Rode Kruis

Preparedness for climate change

Implications for the International Federation of Red Cross and Red Crescent Societies

A study to assess the future impact of climatic changes upon the frequency and severity of disasters and the implications for humanitarian response and preparedness

Het Nederlandse Rode Kruis

"The most immediate threats to humankind relate to increased variability in the intensity and frequency of storms and other extreme weather- and climate-related events such as floods and droughts, heat waves in major urban areas and the impact of sea-level rise on low-lying coastal regions".

- Professor G.O.P. Obasi,
Former Secretary General, World Meteorological Organization,
23 March 2003.

Contents

Executive summary

- **Weather-related disasters are increasing:** affecting 2.5 billion people and inflicting more than US$ 400 billion of damage over the past decade. These figures reflect an alarming rise in vulnerability to extreme weather events.

- **Climate change is already happening and it's here to stay:** it is very likely that the global mean surface temperature in the 20th century has risen by about 0,6 °C. The 1990s was the warmest decade, and 1998 was the warmest year on record. This century is expected to see warming quicker than at any time in the past 10,000 years, the modern history of humankind.

- **Climate change will have a variety of impacts:** it is likely to lead to a rise in sea level, more droughts, floods, heat waves, water shortages, and increased threats to human health.

- **Impacts will hit the poor hardest:** climate change will disproportionately affect developing countries, and poor people within all countries.

- **Impacts will be unpredictable:** a country may be hit by drought one year and floods the next. Every government and National Society should assess the range of risks and plan to reduce vulnerability accordingly.

- **Precautionary principle:** a key element of the 1992 UN climate change convention is that a lack of scientific certainty is not an excuse for inaction.

- **Adaptation is essential:** we cannot prevent climate change altogether so we must adapt. That means integrating risk reduction strategies into humanitarian and development strategies.

- **Seven steps for reducing risk:** adapting to climate change requires a particular focus on disaster risk reduction. Only preparing to respond to disaster is not enough. The seven steps towards risk reduction are: carry out climate risk assessment, assess priorities and plan follow-up, raise awareness, establish and enhance partnerships, highlight vulnerability with other actors, document and share experiences, shape global response through advocacy.

- **National Societies can make a major contribution to global efforts:** all four core areas of the Federation *Strategy 2010* – disaster preparedness, disaster response, health and care in the community, and principles and humanitarian values – are critical elements of the response to weather and climate related

disasters. The global network of volunteers working with communities on the frontline of disaster enables the International Federation to build the humanitarian dimension into global development policy. And the mandate for relief, development and health care enables the Federation to integrate disaster risk reduction across multiple sectors.

- **Act now** – in partnership with the world's most vulnerable people, so that they do not suffer the consequences of inaction.

Introduction

The 27th International Conference of the Red Cross and Red Crescent of 1999 adopted the following decision in its Plan of Action: *"The International Federation, while drawing upon existing research and the competence of relevant international bodies, will undertake a study to assess the future impact of climatic changes upon the frequency and severity of disasters and the implications for humanitarian response and preparedness."*

The International Federation was assisted in the preparation of the study by the Red Cross/Red Crescent Centre on Climate Change and Disaster Preparedness of the Netherlands Red Cross (Climate Centre). In June 2002, the Netherlands Red Cross established the Climate Centre in order to raise awareness, develop risk reduction policy and programmes in relation to climate change and disaster preparedness and to advocate the dialogue on climate change and the humanitarian consequences with policy makers on all levels.

The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC) 'Climate change 2001' provides the most comprehensive assessment of the current scientific knowledge on climate change. It was therefore decided that the report would, rather than include a separate study on future impact of climatic changes upon disasters, present a summary analysis of the Third Assessment Report, especially 'Working Group II, Impact, Adaptation and Vulnerability', which has particular relevance for disaster response and preparedness.

Photo opposite page:
Rajasthan, India: In a largely rural state, the loss of 56 million head of livestock is having a devastating impact on people's livelihoods.

1. The future impact of climatic changes upon the frequency and severity of disasters

1.1 Scientific consensus

The scientific consensus on climate change is presented in the reports of the Intergovernmental Panel on Climate Change (IPCC), which was established in 1988 by the United Nation's Environment Programme (UNEP) and the World Meteorological Organization (WMO). The IPCC engages hundreds of the world's leading experts to review the published literature on the scientific and technical aspects of climate change. This section summarizes those findings of the IPCC's most recent comprehensive survey[1], 'The Third Assessment Report (TAR) – Climate change 2001', especially of the Working Group II, 'Impact, Adaptation and Vulnerability', which has particular relevance for disaster response and preparedness.

Climate change is already happening
Global average surface temperatures rose by about 0.6 °C during the 20th century – the greatest rise of the past 1,000 years. The five warmest years on record have all occurred since 1995[2]. Rainfall over land has increased by 5-10% in the Northern hemisphere, while other regions have seen less rain (e.g. north and west Africa and parts of the Mediterranean). In parts of Asia and Africa, the frequency and intensity of droughts have increased in recent decades.

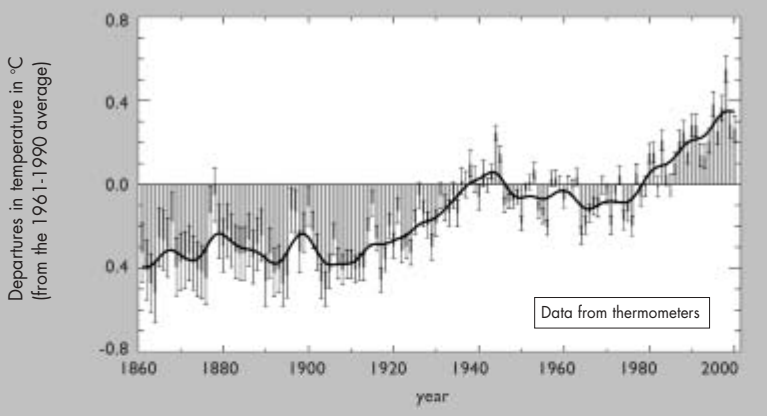
Climate change is largely caused by humans
According to the IPCC: "there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities".

Climate change is here to stay
The IPCC has made various projections for the climate in the coming century, based on different socio-economic scenarios. But whatever the scenario, climate change is

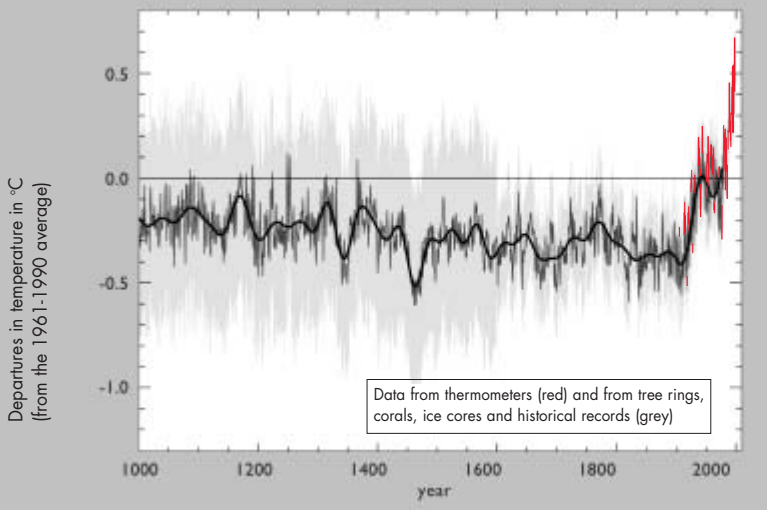
[1] IPCC Third Assessment Report (TAR): Climate Change 2001.
In the rest of this chapter, all descriptions of climate change (historical observations and future projections) are drawn from the IPCC TAR Synthesis Report, unless other references are provided.
The IPCC Synthesis Report's Summary for Policymakers provides a comprehensive overview of the IPCC's findings (in just over 30 pages). For the full reports, and further information, please refer to www.ipcc.ch.
[2] World Meteorological Organization, June 2003.

Photo opposite page:
Mozambique, March 2000: With clean water in short supply, many people are forced to resort to using flood water for cooking, cleaning and drinking. The risk of disease outbreak is high.

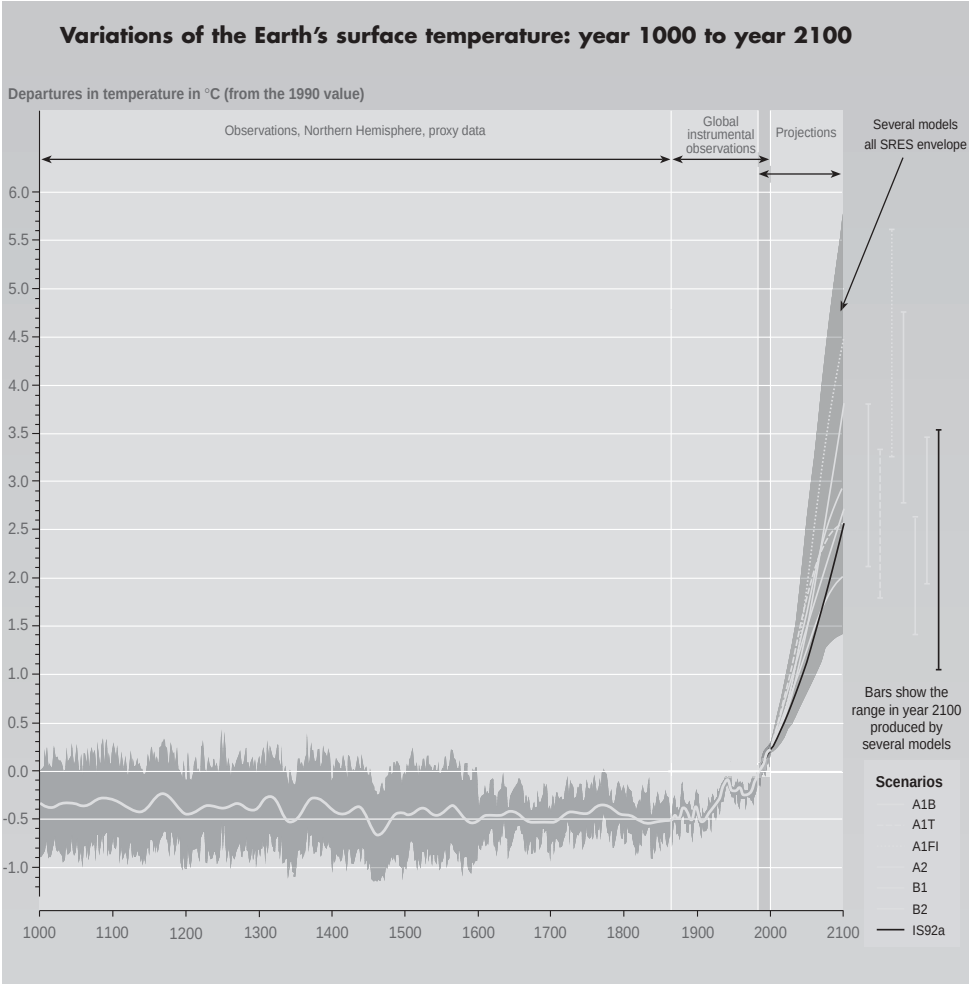
Variations of the Earth's surface temperature for the past 140 years (global)



Variations of the Earth's surface temperature for the past 1000 years (Northern Hemisphere)



here to stay. The global mean surface temperature is projected to increase by 1.4-5.8°C by 2100 – a rate of warming that's very likely without precedent during at least the last 10,000 years. This projected temperature increase is likely to lead to both increases and decreases in rainfall, depending on the region. The average sea level is projected to rise by between 0.09 and 0.88 m, with significant regional variations. The IPCC also projects an increase in climate variability and changes in the frequency, intensity and duration of extreme events, such as more hot days, heat waves, heavy rainfall and fewer cold days. These changes would lead to increased risks of floods and droughts in many regions. Current studies also suggest that peak wind and precipitation intensity of tropical cyclones are likely to increase over some areas.



Impacts will hit the world's poor hardest

A warmer world will have positive and negative effects. But the bigger the changes, the more negative the effects will be. Broadly speaking, heavier rains in regions that already attract precipitation, and more drought in drier, mid-continental regions. Water shortages are projected to worsen in many water scarce areas of the world, and threats to human health are likely to increase, particularly in tropical/subtropical countries. Direct health impacts will be caused by heat stress and death or injury in floods and storms. Other threats will arise indirectly, through changes in the range of disease vectors (e.g. mosquitoes), and decreases in water quality, air quality and food security. The impacts of climate change will fall disproportionately upon developing countries and poor persons within all countries. This in turn will exacerbate existing inequities in health status and access to adequate food, clean water, and other resources. Millions of people on small islands and along low-lying coastal areas are at particular risk from sea level rise and storm surges.

1. The future impact of climatic changes upon the frequency and severity of disasters

1.2 What can be done?

Climate change and its impacts can be lessened by reducing emissions of 'greenhouse gases' (e.g. CO_2 and methane). In 1992, the UN Framework Convention on Climate Change (UNFCCC) was established to try and stabilize greenhouse gas concentrations sufficiently to "prevent dangerous anthropogenic interference with the climate system"[3]. One key element is the precautionary principle – in the face of severe climate-related risks, a lack of complete scientific certainty cannot be an excuse for inaction to address the problem. As scientific evidence for climate change grew stronger during the 1990s, parties to the UNFCCC created the Kyoto Protocol, which includes mandatory reductions of greenhouse gas emissions for developed countries. The Protocol is currently close to ratification[4].

However, projected climate change and its effects cannot be prevented entirely[5]. The IPCC scientists therefore advise a combined strategy of reducing greenhouse gas emissions and adaptation to the impacts of climate change[6]. Adaptation can reduce the adverse effects of climate change and produce additional benefits. Three international funds have been established that could fund adaptation in developing countries, but only one is currently operational. In practice, adaptation will work best if it is integrated into policies, which deal with current climate-related risks, in the context of ongoing sustainable development and disaster risk reduction[7].

[3] In other words, to prevent greenhouse gas emissions from human activities affecting the climate system in such a way that it would have dangerous consequences.

[4] It requires the signature of at least 55 parties to the UNFCCC, including Annex 1 countries (more developed countries which have to meet emissions reduction targets) accounting for at least 55% of the 1990 emissions of all Annex 1 countries together. As of September 2003, 84 countries had signed the Protocol and 117 had ratified or acceded to it.

[5] The greater the reductions in emissions and the earlier they are introduced, the smaller and slower the projected warming and the rise in sea levels. However, given the emissions that have already taken place, neither a reduction of greenhouse gas emissions, nor even stabilization of their concentrations in the atmosphere at a low level, will altogether prevent climate change and sea-level rise, or their impacts.

[6] IPCC TAR Synthesis Report, 2001, summary for policymakers: "Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts".

[7] See also Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation, June 2003, World Bank et al, www.worldbank.org/povcc.

2. Implications for humanitarian response and preparedness

Since 1999, when the 27th International Conference of the Red Cross and Red Crescent decided to study climate change in relation to humanitarian response and preparedness, scientific concerns about climate change have increased, as expressed in the IPCC Third Assessment Report 2001, and weather-related disasters have continued to soar.

33 years of natural disasters

	1970s	1980s	1990s	1993-2002
Number of reported disasters	1,110	1,987	2,742	2,935
Number reported killed	1.96m	800,000	790,000	531,000
Number reported affected	740m	1.45bn	1.96bn	2.5bn
Amount of disaster damage (US$)	131bn	204bn	629bn	655bn

Note: Over the past decade, weather-related disasters accounted for 90% of all reported natural disasters, 86% of all deaths from natural disasters, 99% of all those affected by natural disasters and 63% of damage caused by natural disasters. Sources: World Disasters Report, 2002 and 2003.

The growing concerns about climate change come against the backdrop of a worrying rise in the vulnerability to natural disasters. The past few decades have seen a reduction in the number of people killed by natural disasters (probably at least in part due to better disaster preparedness[8]), but a dramatic increase in the number of people affected and socio-economic losses. Last year alone, over 600 million people were affected by hydro-meteorological disasters – triple the decade's average[9]. This rise in losses and people affected reflects a growing vulnerability to natural hazards, and in particular to weather- and climate-related hazards, which dominate the disaster statistics[10]. This growing vulnerability is intimately tied to development patterns: environmentally unsound practices, global environmental changes, population growth, urbanization, social injustice, poverty, and short-term economic vision are producing vulnerable societies[11]. While climate change may already be playing a

[8] World Disasters Report 2002.
[9] World Disasters Report 2003.
[10] Ibidem.
[11] Living with Risk: A global review of disaster risk reduction initiatives, Preliminary version, UNISDR, Geneva 2002.

role[12], the key origin of rising disaster losses is increasing vulnerability. The projected trends in extreme events and additional uncertainties associated with climate change will compound these risks and make the challenge of reducing them more urgent yet at the same time more difficult.

Climate change will directly affect the work of many governments and National Societies. While some impacts can be projected fairly accurately, many others will only become apparent once climate change progresses. In their work with disaster preparedness and response, National Societies and other humanitarian organizations are dealing with risks on a daily basis. Climate change not only raises the risks, but also increases the uncertainties.

A country may be hit by a once-a-century flood this year, and by a heat wave or drought the next. A 'well-prepared' organization will be aware that the range of extreme events may be growing, and will enhance its strategies to reduce people's vulnerability to such events. For some practical risk reduction options see below.

Practical risk reduction options

- Much of the Red Cross/Red Crescent Societies' work in disaster preparedness and response already focuses on the effects of weather-related disasters. Climate change is likely to change the range, severity and frequency of such hazards. Hence it acts as an additional incentive for the Federation to expand current programmes. However, rather than only preparing to respond to the impacts of disasters, the Federation must strive to reduce the vulnerability of the world's poorest and most exposed people. A sample of relevant Red Cross/ Red Crescent experiences in risk reduction that are relevant to changing climate risks includes:
- Community based disaster preparedness and mitigation programmes, based on community vulnerability and capacity assessment (VCA – International Federation methodological tool).
- Supporting the design and construction of community shelters, elevated food and seeds storage and stronger homes in areas prone to flooding and windstorms (India, Bangladesh and Viet Nam).
- Promoting community's construction of flood platforms, simple earth mounds, providing safe elevated areas for people and livestock (South Asia).
- Local coping mechanisms: (Solomon Islands, Sudan).
- Designing and improving evacuation routes and sites (South East Asia and Ethiopia).

[12] IPCC Third Assessment Synthesis Report, 2001.

- Improving simple early warning and evacuation systems along flood-prone rivers, in combination with awareness about local knowledge (South and South East Asia, Central America).
- Promoting the extension of famine early warning systems to the community and household level (Africa).
- Reinforcing riverbanks, along with irrigation canal refurbishment to prevent water loss (Dushanbe, Tajikistan).
- Construction of erosion gabions along flood-prone rivers (Ethiopia, Nepal, Lesotho).
- Terracing strategies to prevent landslides and soil erosion, along with water trapping for drought/flood prone areas (Ethiopia).
- Supporting rainwater harvesting programmes and spring water protection projects in drought-prone areas (East Africa).
- Regular cleaning-up of sites where disease vectors are abundant, such as stagnant or polluted water (Syria, Sudan).
- Mangrove conservation and replanting programmes along coastlines, generally in cooperation with other agencies (Viet Nam).
- Community based programmes in coastal areas to raise awareness of heat-related illness due to increasingly warm weather (South Asia).
- Supporting community seed bank development, in which local communities build up a safety buffer ready to face shortages during expected or recurrent droughts (Kenya, Uganda, Ethiopia, Central America).

Adapting to climate change requires a particular focus on disaster risk reduction. Some risks can be predicted and planned for accordingly as part of ongoing disaster preparedness and health and care programmes. But specific impacts will not be uniform across the globe, so each organization must assess those risks in partnership with national and regional experts (e.g. institutes for meteorology and hydrology).

In some places, climate change impacts may appear to be less important than other issues facing the country and its National Society. Sub-Saharan Africa, for example, is gripped by the devastating HIV/AIDS pandemic, which clearly requires priority attention. Yet, as the experience of the 2000-03 food crisis has shown, climatic hazards – such as drought – combine with poverty and disease and other vulnerabilities to create a compound disaster which can only be solved through an integrated approach.

It is important that disaster preparedness and health programmes pay attention to local knowledge about trends in risks and vulnerabilities. Older people remember how weather patterns have changed over the years, which developments may have left the community more vulnerable and which coping mechanisms have worked best. National Societies' volunteer networks and the community-based nature of

Vulnerability and Capacity Assessments make the International Federation well qualified to carry out such dialogue.

The global threats posed by climate change are discussed further below in relation to the four core areas of the International Federation's *Strategy 2010*.

Promotion of humanitarian values

Extreme weather events hit hardest when they compound other development problems that reduce the coping capacity of those affected. The poorest, the most socially or economically marginalized, the weakest and most ill are also those people most vulnerable to the impacts of climate change. Upholding the principle of *humanity* – which seeks to "prevent and alleviate human suffering" and to "protect life and health" – may become even more of a challenge as the effects of climate change take hold.

Disaster response

All over the world, extreme weather events may become more frequent, intense and long-lasting – which in turn may lead to more disasters. Climate scientists project a widespread increase in the risk of flooding for tens of millions of people due to heavier rainfall and sea level rise[13]. Droughts, heat waves, and other weather-related extremes are likely to further stretch the disaster response capacities of National Societies.

Disaster preparedness

The key strategy in dealing with the uncertainties of climate change is to enhance existing activities, which minimize current disaster risks. This means two things: improving the disaster preparedness efforts of governments, the National Societies and other humanitarian organizations and integrating disaster risk reduction into development strategies. Misguided development is increasing people's vulnerability to extreme weather events, through for example: poor land use (building on floodplains or unstable slopes), deforestation, uncontrolled population growth and urbanization, social injustice, poverty and economic short-termism. The International Federation also has a role to convince other development actors of the need to integrate disaster risk reduction in their programmes.

Some projected impacts of climate change are sufficiently certain to warrant proactive risk reduction measures now. For example, mountain glaciers and icecaps are melting

[13]IPCC TAR, Working Group II: Impacts, Adaptation and Vulnerability, Summary for Policymakers.

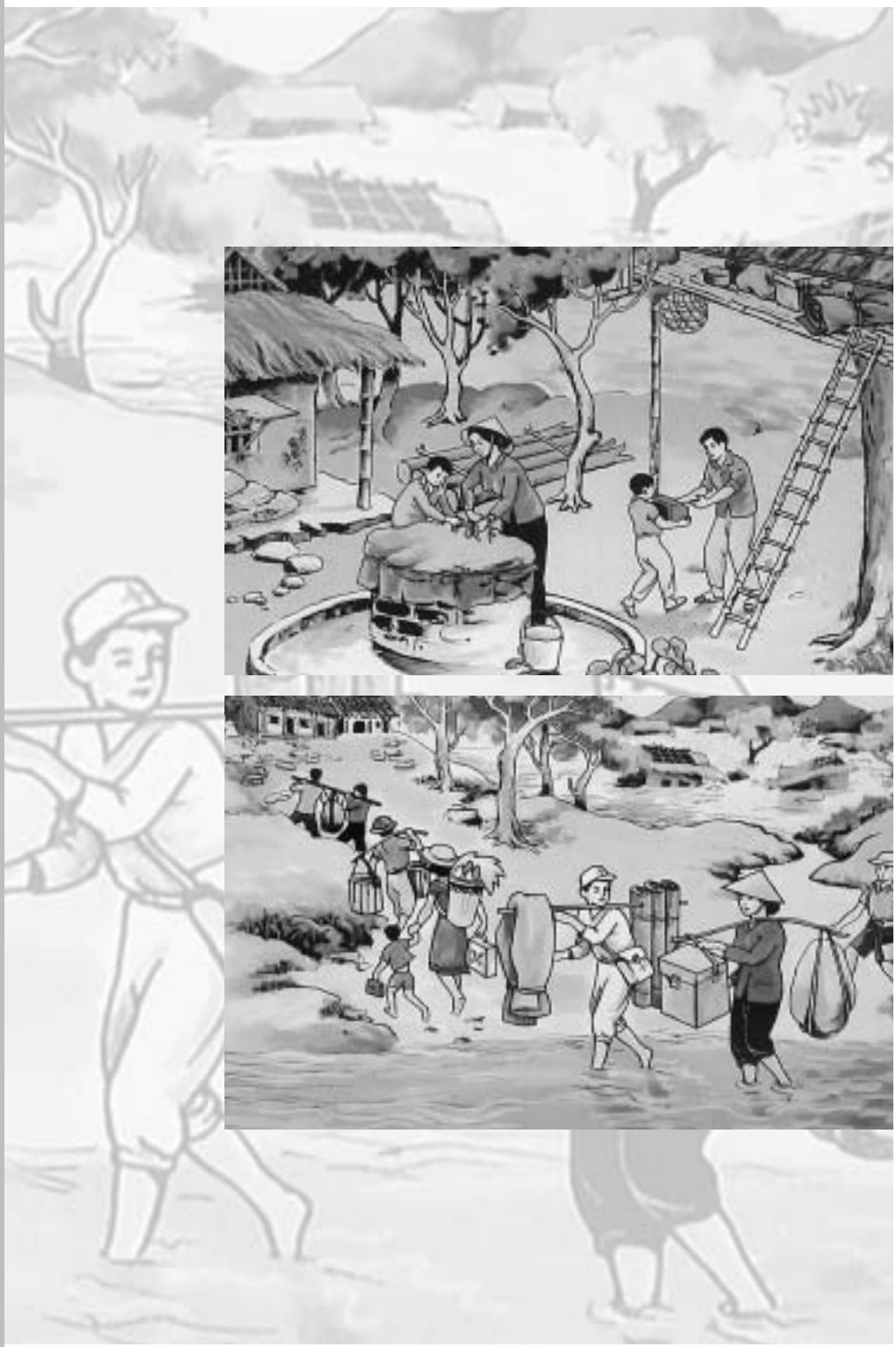
across the world, with major implications for the communities who live downstream. In the Himalayas, the risks posed by Glacial Lake Outburst Floods (GLOFs) must be planned for and reduced. Equally, governments and National Societies operating in small island states and along low lying coastlines must plan now for the effects of sea level rise. Coastal zones need to be protected from erosion and storm surges. The mangrove reforestation project by Red Cross volunteers in Viet Nam for example, protect coastal dykes from the destructive power of high waves, saving lives and improving livelihoods.

At the same time, reducing people's vulnerability to drought by investing in rainwater harvesting or improving the use of early warning systems could be part of the long-term strategy for regions such as southern Africa and central and south Asia. A five years drought across northern India affected 300 million people last year – climate change may make such disasters more frequent and more severe.

Health and care in the community

As many parts of the world are likely to get warmer, disease-bearing mosquitoes and tsetse flies may increase their range, spreading malaria, dengue, and leishmaniasis[14]. Robert T. Watson, formerly Chair of the IPCC, warned that: "Projected changes in climate could lead to an increase in the number of people at risk of malaria of the order of tens of millions annually"[15]. More flooding will increase the risk of water-borne diseases such as cholera, dysentery and hookworm. Countries already suffering health and sanitation problems will be hit hardest by these changes. Meanwhile, heat waves will result in additional heat stress mortality, and increases in droughts and extreme events would add to stresses on water resources and flood security.

[14]IPCC TAR Working Group II, Impacts, Adaptation and Vulnerability, Chapter 9 (Human Health).
[15]Presentation at the Sixth Conference of Parties to the United Nations Framework Convention on Climate Change , November 13, 2000.



3. Way forward: seven steps towards better risk reduction

In order to start reducing the risks associated with climate change, action needs to be taken now by all actors including governments, international organizations, the business community and NGOs. The International Federation, through the National Societies, can make a great contribution to these efforts, particularly in the core areas of Strategy 2010. In particular, this study recommends the following seven steps in risk reduction.

I Preliminary climate risk assessment

Governments and National Societies (particularly those in high-risk areas) should make a preliminary assessment of the projected impacts of climate change and the implications for their role and activities. This assessment needs to include both scientific inputs and community consultations, to learn whether local people perceive any changes in risk and to assess how a changing climate would affect everyday lives. An assessment of climate change-related risks could form part of a broader Vulnerability and Capacity Assessment (VCA).

II Assess priorities and plan follow-up

In some cases, the conclusion of the risk assessment may be that climate change is not yet a priority issue. In other countries however, such an assessment could raise important concerns that would need to be prioritized. Follow-up activities could be initiated by the government with the National Society and in partnership with other national or regional organizations.

III Raise awareness

The preliminary climate risk assessment should lead to a programme to raise awareness about climate change and possible impacts on vulnerable people. If climate change is identified as a priority, the next step would be to integrate climate change into ongoing education activities with local communities. In the National Society context, this could be done through First Aid programmes, Community-based disaster preparedness and risk reduction, Health and Care in the Community, or during VCAs (Vulnerability and Capacity Assessments).

Photo opposite page:
School education tool for disaster preparedness by Viet Nam Red Cross Society.

IV Establish and enhance partnerships

The preliminary climate risk assessment will involve various experts (scientists, meteorologists etc.). It is advised that these contacts are maintained and strengthened, to provide updates on future impacts of climate change and possible adaptation strategies. Equally, scientific organizations could learn from the International Federation's and National Societies' field experience of disaster risk reduction. The National Societies' contact with communities and households puts them in a strong position to help bridge the gaps between national and local actors.

V Highlight climate-related vulnerability with other actors

People's vulnerability to climate change needs to be kept on the agenda during the regular dialogue between National Societies and governments and other actors. This could involve injecting a humanitarian perspective into development issues such as: the management of coastal zones and natural resources, policy development for heat waves in urban areas, or land-use planning in flood-prone areas. By raising such concerns, National Societies could also help integrate disaster risk reduction into development strategies.

VI Document and share experiences and information

The impacts of climate change are in many cases uncertain and unpredictable. Governments and National Societies across the world will have to relate to the "thousand faces" of climate change and find innovative approaches to deal with new uncertainties. It will be important to learn from each others' experiences of assessing and responding to climate-related risks. Lessons in disaster preparedness and risk reduction should be documented and shared between National Societies, within the International Federation and with other organizations involved in adapting to climate change.

VII Advocacy: shape the global response to climate change

Climate change is a global issue with local impacts. The International Federation is a global organization with local branches. In other words: the issue fits the structure of the organization. As the world's largest humanitarian network, the International

Federation is uniquely placed to relate the vulnerabilities and capacities of exposed communities to the wider arena of international humanitarian and development policy. This makes the International Federation potentially a key player in contributing to the local, national, regional and international responses to climate change.

We must bring the concerns and experiences of vulnerable people in the face of climate change to the attention of policy makers, both within the Federation and in other relevant international forums, including the United Nations' Framework Convention on Climate Change (UNFCCC). We also have a responsibility to call on all governments to address the problem driving climate change – the emission of greenhouse gases.

4. Conclusions

According to IPCC, our climate will warm in a way not seen for at least 10,000 years – the entirety of modern human history. This threatens – if unchecked – to destabilize the world's weather systems with adverse consequences for society and undermining the very foundations of sustainable development. Weather-related disasters are on the increase – affecting two and a half billion people and inflicting over US$ 400 billion dollars of damage in the past decade alone[16].

The worst droughts in living memory have recently afflicted south and central Asia. Disease and drought claim millions of African lives each year. Throughout 2003, floods have brought havoc in China, Sri Lanka and the Himalayas. In the US, tornadoes reached record numbers in May, while Europe sweltered under a heat wave for much of the summer. We cannot say these disasters are definitely caused by climate change. But we can say that such disasters are consistent with a warmer and more unstable global climate. As the world warms up, such disasters will become more frequent, more severe and more long-lasting and affect more vulnerable people across the globe. According to the World Meteorological Organization: "New record extreme events occur every year somewhere in the globe, but in recent years the number of such extremes has been increasing[17]." For many, climate change remains a remote risk. But it has the potential to act as a negative catalyst – exaggerating the effects of disasters we see taking place today, from extreme events such as windstorms, droughts and floods to more chronic crises such as coastal erosion, disease, crop failure and parched or polluted water sources. Whatever the effects, it will be the world's poorest who suffer most.

The threats posed by climate change cut across many different sectors – humanitarian aid, development, health, livelihoods. Yet few countries or donors have succeeded in adapting their programmes to these threats in a way that integrates disaster response, sustainable development, vulnerability and poverty reduction. Effective response to the challenges identified in this study will require action by everyone, from governments, the business sector as well as all members of the humanitarian and development community. The International Federation, as an organization which spans all these sectors, is ideally positioned to advocate for and to pursue a policy of reducing the risks of weather-related disasters across all its programmes.

Photo opposite page:
1998:
Mitch was Central America's worst storm in the 20th century, affecting more than 6.5 million people. Nicaragua was after Honduras the worst hit country with 2447 people killed and 885 missing, 730.000 people affected, 36.000 houses destroyed and a damage to the infrastructure of US$ 1 billion.

[16]World Disasters Report 2003.
[17]Press release July 2, 2003 – WMO #695 'Extreme Weather Events Might Increase', www.wmo.ch.

We have a choice: to ignore the warning signs, to argue environmental issues fall outside our humanitarian mandate, to stick to business-as-usual. Or to take precautions now, to assume the worst and start planning for it, to act in partnership with governments, the business sector and with the world's most vulnerable people – so that they don't suffer the consequences of our inaction.

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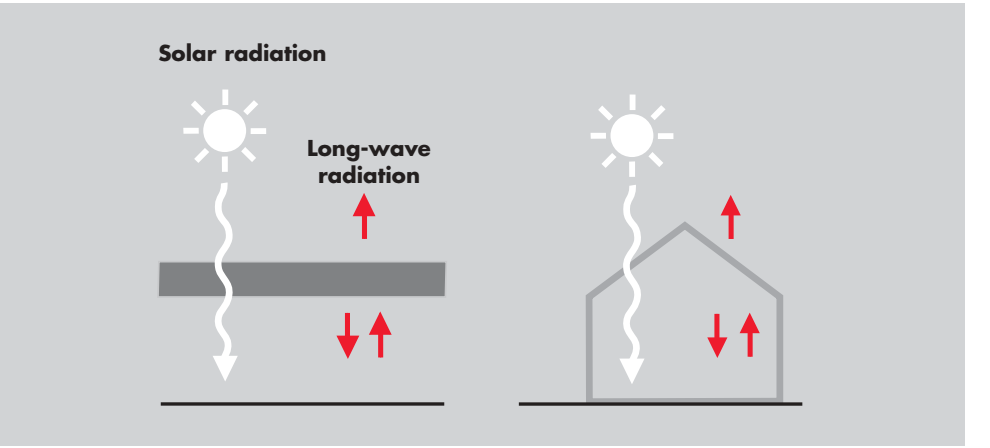
Annex 1

The greenhouse effect[1]

The figure below schematically illustrates the greenhouse effect. The temperature rise caused by greenhouse gases in the atmosphere (left) is similar to the warming inside a greenhouse (right). Radiation from the Sun travels through the atmosphere and warms the earth's surface. The incoming energy from the Sun is balanced by the so-called long-wave radiation (infrared) that leaves the surface. On its way out through the atmosphere, this long-wave radiation is absorbed by greenhouse gases that act as a blanket over the earth, keeping it warmer. The principal greenhouse gases are water vapour, carbon dioxide and methane. Increasing the amount of these gases increases the greenhouse effect and thus increases the average temperature at the earth's surface: global warming.



Since the end of the industrial revolution, concentrations of carbon dioxide, which is produced by burning fossil fuels (coal, oil, natural gas), have risen by about 30 per cent, while methane has approximately doubled.

Carbon dioxide levels now stand at about 370 parts per million (ppm), as compared to a pre-industrial concentration of about 280 ppm. This rate of increase is unprecedented in at least the past 20,000 years. If we carry on burning fossil fuel in a "business as usual" way, carbon dioxide concentrations will rise to 600 or 700 parts per million by the year 2100. Even if the whole world decided to work very hard indeed to limit emissions, carbon dioxide concentrations are unlikely to stabilize below 450 parts per million, higher than ever in the past millions of years.

[1] IPCC briefing on the contribution of Working Group I and II to the TAR, at the Conference of the Parties to the UNFCCC, July 17, 2001.

Annex 2

Examples of impacts resulting from projected changes in extreme climate events[2]

The likelihood of the extreme climate events in this table refers to judgmental estimates of confidence used by the Working Group 1 of the Third Assessment Report of the IPCC (2001):
very likely (90-99 per cent chance); likely (66-90 per cent chance). Unless otherwise stated, information on climate phenomena is taken from the Summary for Policymakers, TAR WGI.

Projected changes during the 21st century in extreme climate phenomena and their likelihood	Representative examples of projected impacts (all high confidence of occurrence in some areas)
Simple extremes	
Higher maximum temperatures; more hot days and heat waves over nearly all land areas (very likely)	■ Increased incidence of death and serious illness in older age groups and urban poor ■ Increased heat stress in livestock and wildlife ■ Shift in tourist destinations ■ Increased risk of damage to a number of crops ■ Increased electric cooling demand and reduced energy supply reliability
Higher (increasing) minimum temperatures; fewer cold days, frost days, and cold waves over nearly all land areas (very likely)	■ Decreased cold-related human morbidity and mortality ■ Decreased risk of damage to a number of crops, and increased risk to others ■ Extended range and activity of some pest and disease vectors ■ Reduced heating energy demand

[2] IPCC, table TS2, www.grida.no/climate/ipcc_tar/wg2/tabts2.

More intense precipitation events (very likely over many areas)	■ Increased flood, landslide, avalanche, and mudslide damage ■ Increased soil erosion ■ Increased flood runoff could increase recharge of some floodplain aquifers ■ Increased pressure on government and private flood insurance systems and disaster relief

Complex extremes

Increased summer drying over most mid-latitude continental interiors and associated risk of drought (Likely)	
Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities (Likely over some areas)	■ Decreased crop yields ■ Increased damage to building foundations caused by ground shrinkage ■ Decreased water resource quantity and quality ■ Increased risk of forest fire
Intensified droughts and floods associated with El Niño events in many different regions (Likely) (see also under droughts and intense precipitation events)	■ Decreased agricultural and rangeland productivity in drought- and flood-prone regions ■ Decreased hydro-power potential in drought-prone regions
Increased Asian summer monsoon precipitation variability (Likely)	■ Increased flood and drought magnitude and damages in temperate and tropical Asia
Increased intensity of mid-latitude storms (little agreement between current models)	■ Increased risks to human life and health ■ Increased property and infrastructure losses ■ Increased damage to coastal ecosystems

Annex 3

Regional adaptive capacity, vulnerability, and key concerns[3]

Region	Adaptive capacity, vulnerability, and key concerns
Africa	■ Adaptive capacity of human systems in Africa is low due to lack of economic resources and technology, and vulnerability high as a result of heavy reliance on rain-fed agriculture, frequent droughts and floods, and poverty. ■ Grain yields are projected to decrease for many scenarios, diminishing food security, particularly in small food-importing countries (medium to high confidence). ■ Major rivers of Africa are highly sensitive to climate variation; average runoff and water availability would decrease in Mediterranean and southern countries of Africa (medium confidence). ■ Extension of ranges of infectious disease vectors would adversely affect human health in Africa (medium confidence). ■ Desertification would be exacerbated by reductions in average annual rainfall, runoff, and soil moisture, especially in southern, North, and West Africa (medium confidence). ■ Increases in droughts, floods, and other extreme events would add to stresses on water resources, food security, human health, and infrastructures, and would constrain development in Africa (high confidence). ■ Significant extinctions of plant and animal species are projected and would impact rural livelihoods, tourism, and genetic resources (medium confidence). ■ Coastal settlements in, for example, the Gulf of Guinea, Senegal, Gambia, Egypt, and along the East-Southern African coast would be adversely impacted by sea-level rise through inundation and coastal erosion (high confidence).
Asia	■ Adaptive capacity of human systems is low and vulnerability is high in the developing countries of Asia; the developed countries of Asia are more able to adapt and less vulnerable. ■ Extreme events have increased in temperate and tropical Asia, including floods, droughts, forest fires, and tropical cyclones (high confidence).

[3] IPCC, Table SPM2, www.grida.no/climate/ipcc_tar/wg2/017.htm.

- Decreases in agricultural productivity and aquaculture due to thermal and water stress, sea-level rise, floods and droughts, and tropical cyclones would diminish food security in many countries of arid, tropical, and temperate Asia; agriculture would expand and increase in productivity in northern areas (medium confidence).
- Runoff and water availability may decrease in arid and semi-arid Asia but increase in northern Asia (medium confidence).
- Human health would be threatened by possible increased exposure to vector-borne infectious diseases and heat stress in parts of Asia (medium confidence).
- Sea-level rise and an increase in the intensity of tropical cyclones would displace tens of millions of people in low-lying coastal areas of temperate and tropical Asia; increased intensity of rainfall would increase flood risks in temperate and tropical Asia (high confidence).
- Climate change would increase energy demand, decrease tourism attraction, and influence transportation in some regions of Asia (medium confidence).
- Climate change would exacerbate threats to biodiversity due to land-use and land-cover change and population pressure in Asia (medium confidence). Sea-level rise would put ecological security at risk, including mangroves and coral reefs (high confidence).
- Poleward movement of the southern boundary of the permafrost zones of Asia would result in a change of thermokarst and thermal erosion with negative impacts on social infrastructure and industries (medium confidence).

Australia and New Zealand

- Adaptive capacity of human systems is generally high, but there are groups in Australia and New Zealand, such as indigenous peoples in some regions, with low capacity to adapt and consequently high vulnerability.
- The net impact on some temperate crops of climate and CO_2 changes may initially be beneficial, but this balance is expected to become negative for some areas and crops with further climate change (medium confidence).
- Water is likely to be a key issue (high confidence) due to projected drying trends over much of the region and change to a more El Niño-like average state.
- Increases in the intensity of heavy rains and tropical cyclones (medium confidence), and region-specific changes in the frequency of tropical cyclones, would alter the risks to life, property, and ecosystems from flooding, storm surges, and wind damage.
- Some species with restricted climatic niches and which are unable to migrate due to fragmentation of the landscape, soil differences, or topography could become endangered or extinct (high confidence). Australian ecosystems that

are particularly vulnerable to climate change include coral reefs, arid and semi-arid habitats in southwest and inland Australia, and Australian alpine systems. Freshwater wetlands in coastal zones in both Australia and New Zealand are vulnerable, and some New Zealand ecosystems are vulnerable to accelerated invasion by weeds.

Europe

- Adaptive capacity is generally high in Europe for human systems; southern Europe and the European Arctic are more vulnerable than other parts of Europe.
- Summer runoff, water availability, and soil moisture are likely to decrease in southern Europe, and would widen the difference between the north and drought-prone south; increases are likely in winter in the north and south (high confidence).
- Half of alpine glaciers and large permafrost areas could disappear by end of the 21st century (medium confidence).
- River flood hazard will increase across much of Europe (medium to high confidence); in coastal areas, the risk of flooding, erosion, and wetland loss will increase substantially with implications for human settlement, industry, tourism, agriculture, and coastal natural habitats.
- There will be some broadly positive effects on agriculture in northern Europe (medium confidence); productivity will decrease in southern and eastern Europe (medium confidence).
- Upward and northward shift of biotic zones will take place. Loss of important habitats (wetlands, tundra, isolated habitats) would threaten some species (high confidence).
- Higher temperatures and heat waves may change traditional summer tourist destinations, and less reliable snow conditions may impact adversely on winter tourism (medium confidence).

Latin America

- Adaptive capacity of human systems in Latin America is low, particularly with respect to extreme climate events, and vulnerability is high.
- Loss and retreat of glaciers would adversely impact runoff and water supply in areas where glacier melt is an important water source (high confidence).
- Floods and droughts would become more frequent with floods increasing sediment loads and degrade water quality in some areas (high confidence).

- Increases in intensity of tropical cyclones would alter the risks to life, property, and ecosystems from heavy rain, flooding, storm surges, and wind damages (high confidence).
- Yields of important crops are projected to decrease in many locations in Latin America, even when the effects of CO_2 are taken into account; subsistence farming in some regions of Latin America could be threatened (high confidence).
- The geographical distribution of vector-borne infectious diseases would expand poleward and to higher elevations, and exposures to diseases such as malaria, dengue fever, and cholera will increase (medium confidence).

North America

- Adaptive capacity of human systems is generally high and vulnerability low in North America, but some communities (e.g. indigenous peoples and those dependent on climate-sensitive resources) are more vulnerable; social, economic, and demographic trends are changing vulnerabilities in subregions.
- The rate of biodiversity loss would increase (high confidence).
- Coastal human settlements, productive activities, infrastructure, and mangrove ecosystems would be negatively affected by sea-level rise (medium confidence).
- Some crops would benefit from modest warming accompanied by increasing CO_2, but effects would vary among crops and regions (high confidence), including declines due to drought in some areas of Canada's Prairies and the U.S. Great Plains, potential increased food production in areas of Canada north of current production areas, and increased warm-temperate mixed forest production (medium confidence). However, benefits for crops would decline at an increasing rate and possibly become a net loss with further warming (medium confidence).
- Snowmelt-dominated watersheds in western North America will experience earlier spring peak flows (high confidence), reductions in summer flows (medium confidence), and reduced lake levels and outflows for the Great Lakes-St. Lawrence under most scenarios (medium confidence); adaptive responses would offset some, but not all, of the impacts on water users and on aquatic ecosystems (medium confidence).
- Unique natural ecosystems such as prairie wetlands, alpine tundra, and cold-water ecosystems will be at risk and effective adaptation is unlikely (medium confidence).
- Sea-level rise would result in enhanced coastal erosion, coastal flooding, loss of coastal wetlands, and increased risk from storm surges, particularly in Florida and much of the U.S. Atlantic coast (high confidence).

- Weather-related insured losses and public sector disaster relief payments in North America have been increasing; insurance sector planning has not yet systematically included climate change information, so there is potential for surprise (high confidence).
- Vector-borne diseases – including malaria, dengue fever, and Lyme disease – may expand their ranges in North America; exacerbated air quality and heat stress morbidity and mortality would occur (medium confidence); socioeconomic factors and public health measures would play a large role in determining the incidence and extent of health effects.

Polar

- Natural systems in polar regions are highly vulnerable to climate change and current ecosystems have low adaptive capacity; technologically developed communities are likely to adapt readily to climate change, but some indigenous communities, in which traditional lifestyles are followed, have little capacity and few options for adaptation.
- Climate change in polar regions is expected to be among the largest and most rapid of any region on the Earth, and will cause major physical, ecological, sociological, and economic impacts, especially in the Arctic, Antarctic Peninsula, and Southern Ocean (high confidence).
- Changes in climate that have already taken place are manifested in the decrease in extent and thickness of Arctic sea ice, permafrost thawing, coastal erosion, changes in ice sheets and ice shelves, and altered distribution and abundance of species in polar regions (high confidence).
- Some polar ecosystems may adapt through eventual replacement by migration of species and changing species composition, and possibly by eventual increases in overall productivity; ice edge systems that provide habitat for some species would be threatened (medium confidence).
- Polar regions contain important drivers of climate change. Once triggered, they may continue for centuries, long after greenhouse gas concentrations are stabilized, and cause irreversible impacts on ice sheets, global ocean circulation, and sea-level rise (medium confidence).

Small Island States

- Adaptive capacity of human systems is generally low in small island states, and vulnerability high; small island states are likely to be among the countries most seriously impacted by climate change.
- The projected sea-level rise of 5 mm/yr for the next 100 years would cause enhanced coastal erosion, loss of land and property, dislocation of people, increased risk from storm surges, reduced resilience of coastal ecosystems, saltwater intrusion into freshwater resources, and high resource costs to respond to and adapt to these changes (high confidence).

- Islands with very limited water supplies are highly vulnerable to the impacts of climate change on the water balance (high confidence).
- Coral reefs would be negatively affected by bleaching and by reduced calcification rates due to higher CO_2 levels (medium confidence); mangrove, sea grass bed, and other coastal ecosystems and the associated biodiversity would be adversely affected by rising temperatures and accelerated sea-level rise (medium confidence).
- Declines in coastal ecosystems would negatively impact reef fish and threaten reef fisheries, those who earn their livelihoods from reef fisheries, and those who rely on the fisheries as a significant food source (medium confidence).
- Limited arable land and soil salinization makes agriculture of small island states, both for domestic food production and cash crop exports, highly vulnerable to climate change (high confidence).
- Tourism, an important source of income and foreign exchange for many islands, would face severe disruption from climate change and sea-level rise (high confidence).

Annex 4

Climate change and disaster preparedness: five assessments

Disaster preparedness is one of the four core areas of the International Federation of Red Cross and Red Crescent Societies' *Strategy 2010*. Disaster preparedness is defined in this document as:
'The readiness to reduce the impact of disasters, and where possible, predict and even prevent disasters occurring'.

The main focus of existing disaster preparedness programmes are generally on preparedness to respond adequately to disasters. However, there is a growing acknowledgement within the Red Cross and Red Crescent Movement about the need to pay more attention to disaster mitigation: policies and measures to reduce the detrimental impacts of disasters.

In a parallel development, there is an increasing awareness about the necessity of nations to adapt to the impacts of climate change and extreme weather events. Structures are being set up, and studies made about the vulnerabilities of regions and sectors to the expected increase of extreme weather events and climate change.

The Netherlands Red Cross established, in close cooperation with the International Federation, in June 2002, the Red Cross/Red Crescent Centre on Climate Change and Disaster Preparedness (Climate Centre).
The activities of the Climate Centre are based on a triple A principle:

Awareness: Information and educational activities, about climate change and extreme weather events, directed at the Red Cross and Red Crescent Movement and among the general public.

Action: Support the development of concrete climate adaptation activities within the existing context of disaster preparedness programmes.

Advocacy: Raising concerns about the impacts of climate change on vulnerable people and offering practical examples of climate adaptation and disaster preparedness programmes within the International Federation and with policy and political leaders globally.

The Climate Centre was established on the assumption that there are new opportunities to integrate growing knowledge about climate change, its impacts and policies to adapt to it within existing disaster preparedness programmes. The Climate

Centre also promotes, within the humanitarian community, the importance of disaster preparedness programmes as part of the development of effective climate change adaptation programmes.

In order to promote greater understanding and knowledge exchange, five assessments of the disaster preparedness capacities and needs of National Red Cross and Red Crescent Societies in response to climate change were conducted in selected developing countries. The assessments took place in Viet Nam, Nicaragua, Ethiopia, Mozambique and the Pacific between June 2002 (Viet Nam) and August 2003 (Pacific).

The aim of the assessments was to:

- *Review the ongoing disaster preparedness programme of Red Cross and Red Crescent Societies, and assess its relevance for climate change adaptations.*
- *Assess the current disaster preparedness capacity of National Societies, its potential for development and need for additional support. Identify organizational constraints adversely affecting the further expansion of the disaster preparedness programme.*
- *Identify the keyactors in the area of climate change in the country. Assess the current capacity of these actors and existing links towards disaster preparedness. Review the current national/regional mechanisms of seasonal weather forecasting, early warnings of extreme weather events and disaster preparedness.*
- *Assess the need and feasibility for incorporation of seasonal and long-term climate change issues within National Societies disaster preparedness programmes, and identify the interest of key stakeholders.*

The assessments were implemented by a two-person team: one expert in climate change issues and one in disaster and development issues. They studied available documents, such as programme descriptions, progress and evaluation reports on National Society disaster preparedness programmes, documents related to climate change impacts and current national policies to adapt to these impacts, and other documents and studies related to either climate change or disaster preparedness in the country. They also interviewed the main stakeholders in the area of climate change and disaster management at the national and in the Pacific at the regional level.

Main conclusions:

What was found in the final assessment for the Pacific is illustrative for all countries that were part of the evaluation. *"The main focus of high level government and donor initiatives in the Pacific was on research, monitoring and mainstreaming climate change into government planning and policies, with only limited work being done in providing risk management and adaptation assistance to vulnerable communities. In their independent but auxiliary function to governments, the Red Cross National Societies can*

best augment the government climate change initiatives through public awareness and long term disaster planning services to communities ascertained as most vulnerable. This partnership role was most welcomed by the national governments departments and regional agencies, such as SPREP and SOPAC, who are dealing most closely with Pacific climate change and disaster management initiatives."

And *"In order to be most effective in addressing the new climate change issues the Red Cross National Societies ascertained that they need to firstly be well educated in the science and trends of climate change. Secondly, they need to interact closely with other players in the climate change and disaster preparedness sector, and thirdly, they needed to strengthen their skills and methods in participatory community based preparedness planning and action."*

All five assessments lead to programme proposals on how these and related assessments could be implemented. In Viet Nam and Nicaragua these programmes are currently in development.

Annex 5

Sources for further information

The Red Cross/Red Crescent Climate Centre (based at the Netherlands Red Cross)
http://www.climatecentre.org
PO Box 28120
2502 KC The Hague
The Netherlands
Telephone: +31 (0)70 4455837
Fax: +31 (0)70 4455712
e-mail: climatecentre@redcross.nl

Intergovernmental Panel on Climate Change (IPCC)
http://www.ipcc.ch
The IPCC website includes the full reports of the current scientific consensus on climate change.

United Nations Framework Convention on Climate Change (UNFCCC)
http://www.unfccc.org
The UNFCCC is the international mechanism for negotiations on climate change. All negotiating documents can be found at their website.

National Climate Change reports
http://unfccc.int/resource/natcom/nctable.html
These so-called National Communications are submitted to the UNFCCC by national governments. They mostly focus on greenhouse gas emissions, but also discuss impacts, vulnerability and adaptation.

World Meteorological Organisation (WMO)
http://www.wmo.ch
The WMO coordinates global scientific activity on issues like weather prediction, climate change, the depletion of the ozone layer, and air pollution. The website contains links to weather and climate forecasts, and a list of addresses of national Weather Services in a large number of countries.

Provention Consortium
http://www.proventionconsortium.org/
The ProVention Consortium, currently based at the International Federation in Geneva, is a global coalition of governments, international organizations, academic institutions, the private sector and civil society organizations dedicated to increasing

the safety of vulnerable communities and to reducing the impact of disasters in developing countries.

United Nations International Strategy for Disaster Reduction (UNISDR)
http://www.unisdr.org
The UN body that promotes disaster risk reduction.