United Nations
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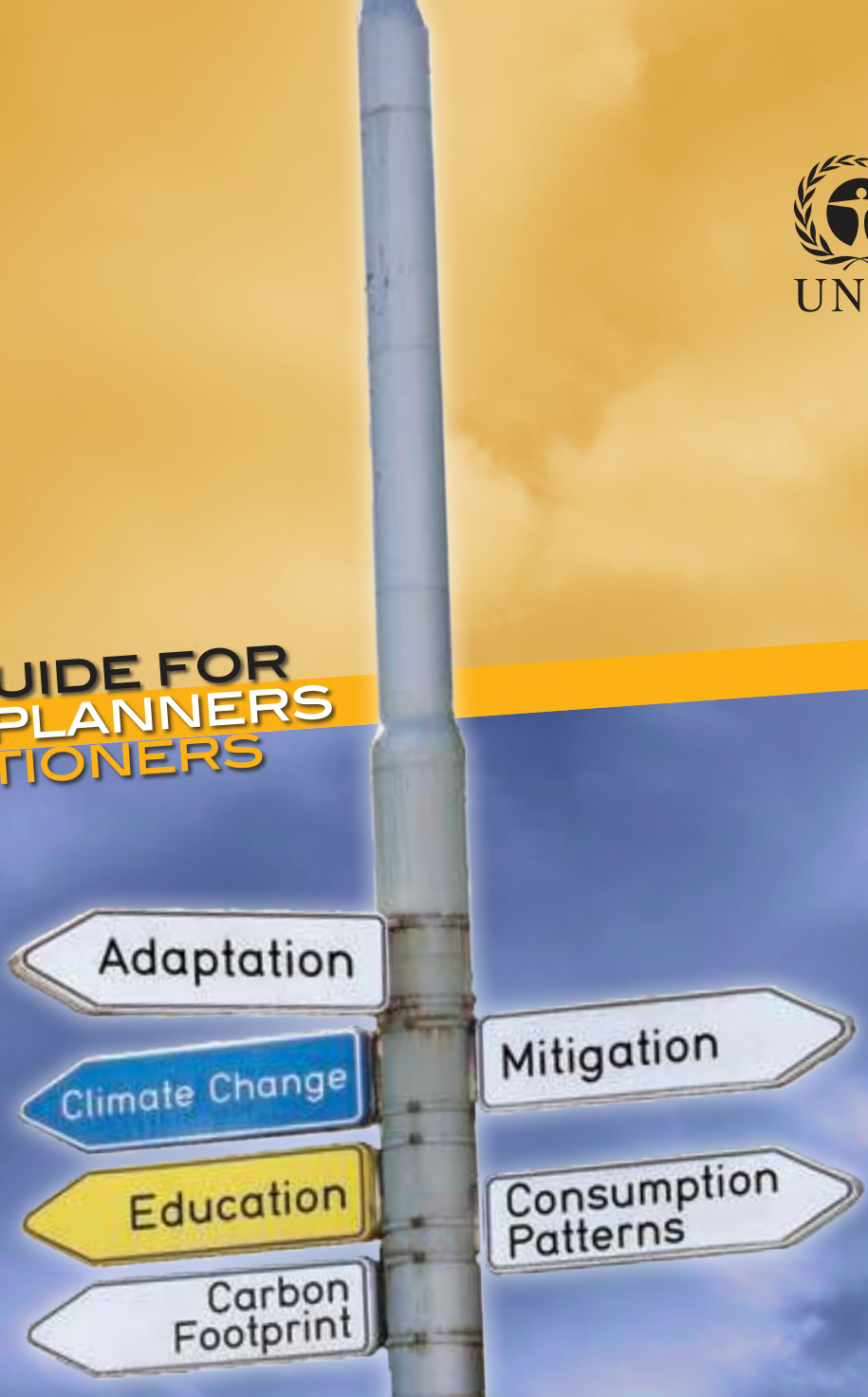
UNEP

AN ISSUES GUIDE FOR
EDUCATION PLANNERS
AND PRACTITIONERS



CLIMATE CHANGE STARTER'S GUIDEBOOK

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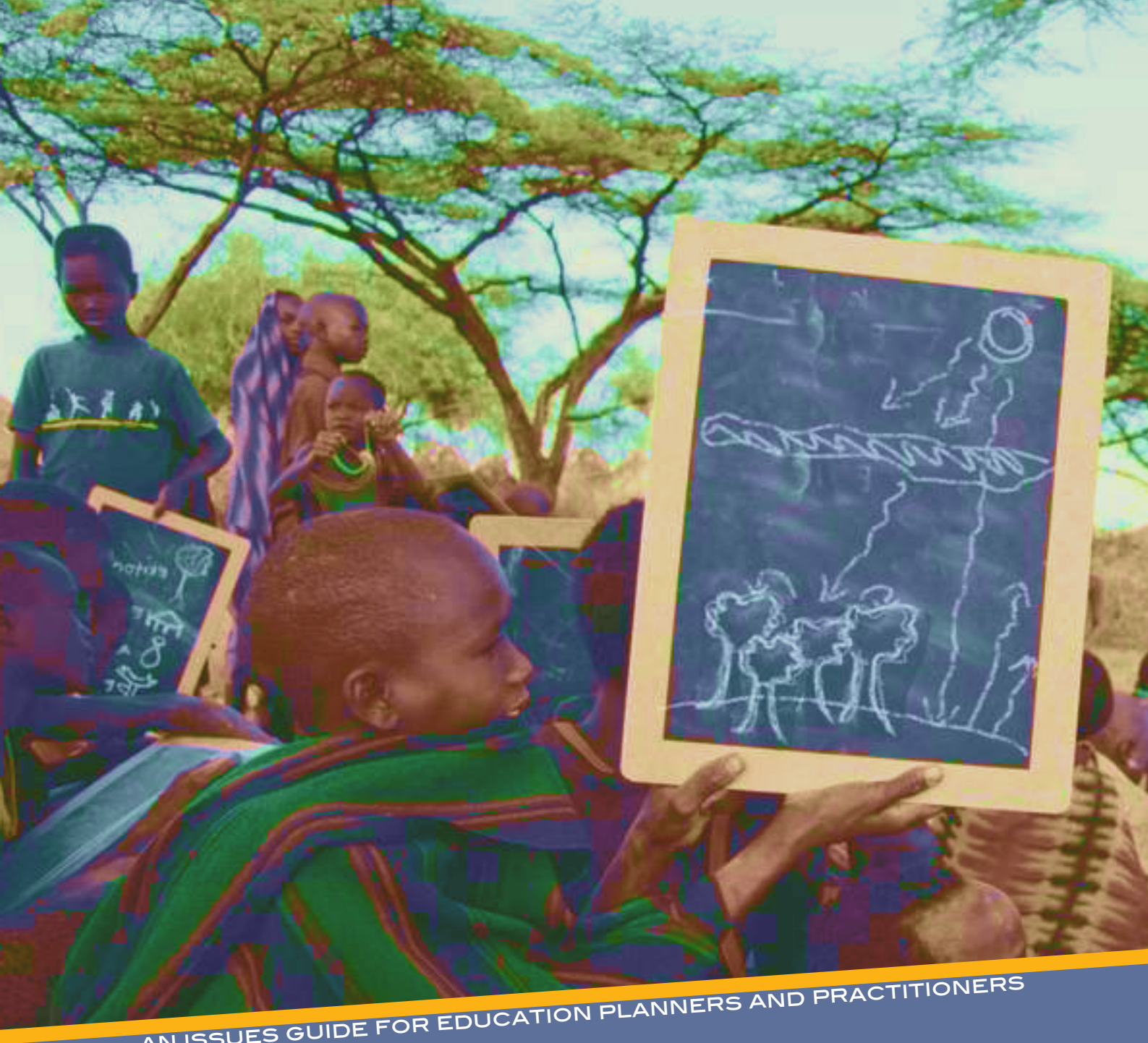


AN ISSUES GUIDE FOR EDUCATION PLANNERS AND PRACTITIONERS

CLIMATE CHANGE STARTER'S GUIDEBOOK

FOREWORD

Few issues over the past two decades have brought with them as many challenges as that of climate change. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. While climate change is global, its negative impacts are more severely felt by poor people and poor countries. Without drastic action today, adapting to these impacts in the future will be more difficult and costly, undermine national development efforts and hinder progress towards the Millennium Development Goals.

With the greater awareness about the unfolding impact of climate change on our countries and communities, citizens and politicians are turning to the education community as part of the response to climate change.

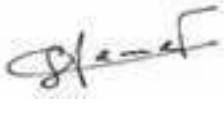
Teachers and education planners are increasingly being called upon to include climate change in their programmes in order to help inform the next generations and to better equip them to respond to the climate-related challenges ahead. However, teaching climate change in an interdisciplinary manner poses challenges to educators. Teachers are called upon to understand the complex emerging science and to communicate it to the next generations.

This guidebook is intended to support educators in developing their understanding of the science of climate change, observed and anticipated impacts, and different possible responses. The guidebook also covers the impacts on society, as well as political and educational responses to climate change.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) provides its expertise and know-how in areas such as education, culture, and the social sciences. In particular, UNESCO emphasises the role of education in support of climate change adaptation and mitigation in providing skills and capacities but also through shaping the values, attitudes and behaviours needed to put the world on a more sustainable path.

The United Nations Environment Programme (UNEP) works with countries to strengthen their ability to adapt to climate change, move towards low-carbon growth, reduce emissions from deforestation and forest degradation, improve understanding of climate science, and raise public awareness of the changing climate. UNEP is supporting countries to seize the opportunities of moving towards low-carbon growth, while improving human health and well-being, generating green jobs and moving towards a green economy.

With this publication, the two organizations have embarked on a collaboration on climate change education that we are committed to building upon and expanding in the period ahead.



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GUIDEBOOK OVERVIEW

The Climate Change Starter's Guide provides an introduction and overview for education planners and practitioners on the wide range of issues relating to climate change and climate change education, including causes, impacts, mitigation and adaptation strategies, as well as some broad political and economic principles.

The aim of this guide is to serve as a starting point for mainstreaming climate change education into school curricula. It has been created to enable education planners and practitioners to understand the issues at hand, to review and analyse their relevance to particular national and local contexts, and to facilitate the development of education policies, curricula, programmes and lesson plans.

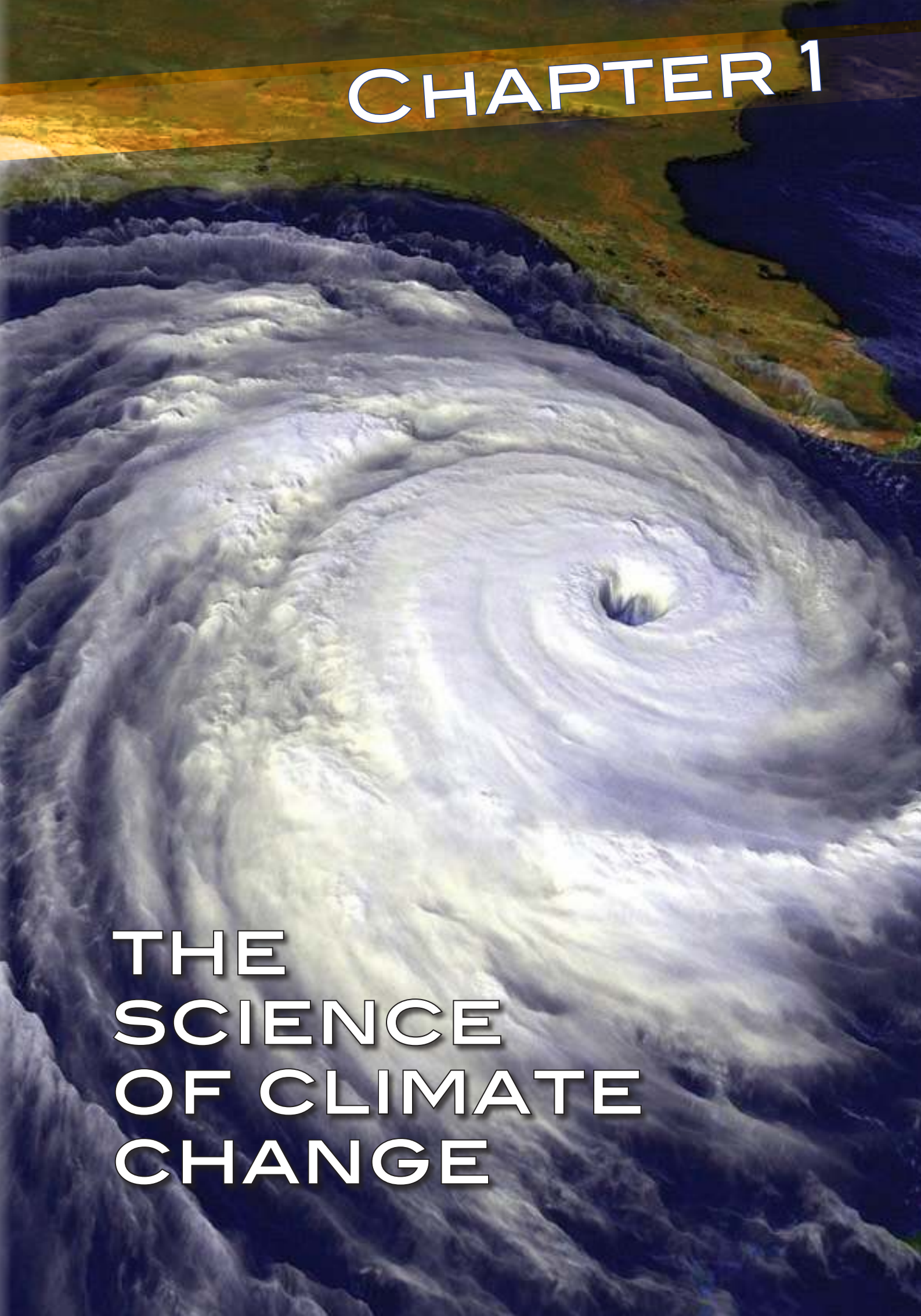
The guide covers four major thematic areas:

1. the science of climate change, which explains the causes and observed changes;
2. the social and human aspects of climate change including gender, health, migration, poverty and ethics;
3. policy responses to climate change including measures for mitigation and adaptation; and
4. education approaches including education for sustainable development, disaster reduction and sustainable lifestyles.

A selection of key resources in the form of publication titles or websites for further reading is provided after each of the thematic sections.

Taking the next step

Should lessons be focused on preparing students for changes in their immediate environment by stressing climate change adaptation, as might be the case in low-lying coastal areas? Or is it more appropriate to address unsustainable consumption behaviours and patterns as a contribution to climate change mitigation? This guide helps educators to strike an informed balance between an emphasis on adaptation and mitigation, and provides assistance to tailor the scope and content to their local context, their education system framework, and their particular role.



Chapter 1

The Science of Climate Change

CHAPTER 1

Climate can be defined as 'average weather' and is described in terms of the mean and variability of relevant characteristics such as temperature, precipitation and wind over a period of time ranging from months to thousands or millions of years. Climate reflects how weather behaves over the long-term, and as such needs to be distinguished from weather which is a particular meteorological condition that we experience daily, characterized by precipitation, temperature, wind, and so on.

Meteorological conditions, like the annual average temperature at the Earth's surface, change over time. Small changes in these conditions can result in ice ages, or warm periods. Over the past century an increase of the Earth's average surface temperature of about +0.76°C has been observed.

There are several natural factors that can influence the climate, such as changes in the Earth's orbit around the sun, volcanic eruptions, or even periods of heightened or diminished solar activity. However, the current warming trend we are experiencing has been primarily linked to an increased concentration of heat-trapping greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) in the atmosphere.

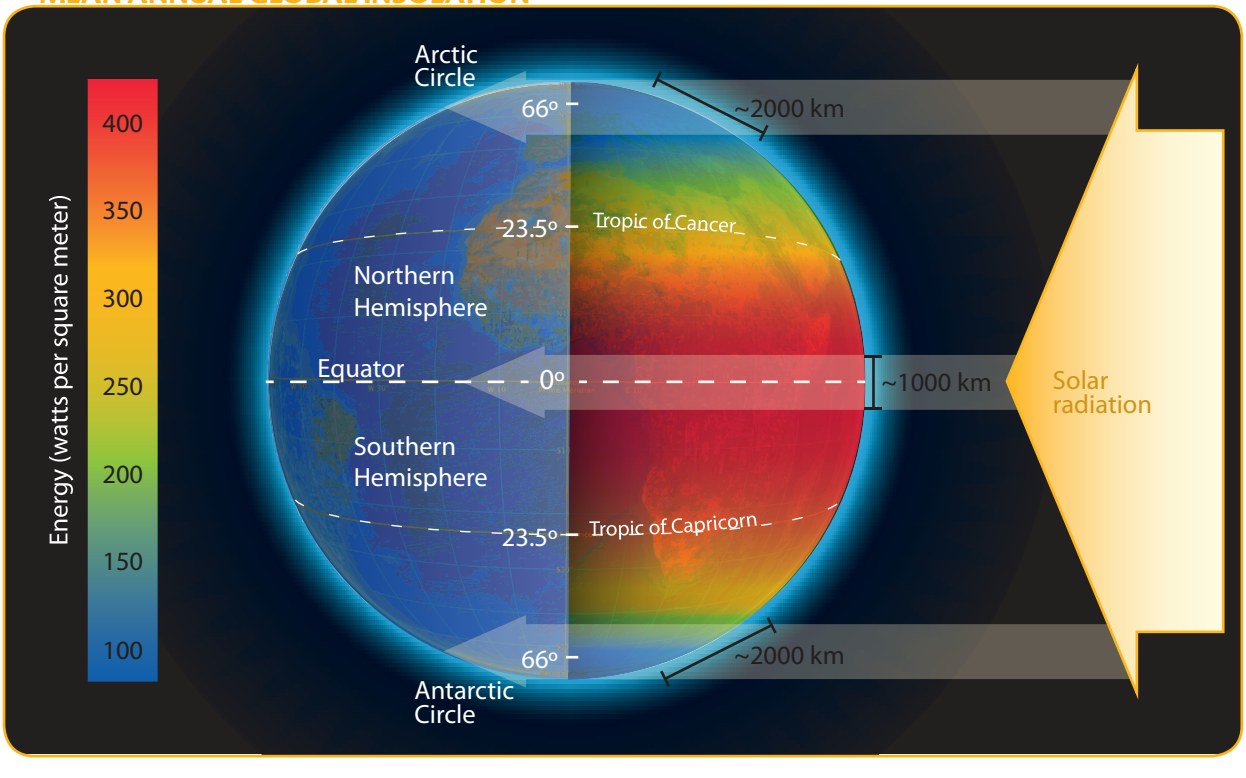
The 2007 Intergovernmental Panel on Climate Change (IPCC) Assessment Report confirms that the warming of the global climate is unequivocal and that it is very likely due to human activities (also known as **anthropogenic** activities) and has been increasing since the dawn of the industrial age (circa 1750). These activities include, among others, the burning of fossil fuels (coal, oil and gas), clearing of forests, and agricultural practices that lead to increased GHG concentration in the atmosphere.

The impacts of global warming are already apparent today in melting glaciers, increased frequency of extreme weather events such as droughts, cyclones or heavy rainfalls, sea level rise, and changes in plant growth affecting agriculture and food production. These and other observed changes are expected to intensify and inflict a significant impact on human societies and the environment around the world especially if no drastic efforts are undertaken to reduce the emissions of GHGs into the atmosphere.

This chapter explains the components of the climate system, outlines the underlying factors of observed climate change, and concludes by presenting the climate change impacts that can be observed today.

FIGURE 1

MEAN ANNUAL GLOBAL INSOLATION



1.1 What is 'Climate'?

Weather vs. climate

In order to define 'climate' it is important to distinguish it from 'weather'. The weather that we experience on a day-to-day basis is a momentary atmospheric state characterized by temperature, precipitation, wind, and so on, and seems to vary in an irregular way, not following any particular pattern.

When one considers longer time scales, weather can be seen to vary in a recurrent way, be it on global, regional or local scale. This is what we refer to as climate. In contrast to the instantaneous conditions described by weather, climate is described with average values (e.g. annual average, or mean, temperature), but also typical variability (e.g. seasonal maximum/minimum temperatures) and frequency of extremes such as monsoons/hurricanes/cyclones. The timescale upon which climate statistics are calculated is typically thirty years (e.g. 1981—2010).

The function of Earth's climate system

An enormous amount of energy from the Sun in the form of solar radiation hits the Earth between the tropics of Capricorn and Cancer (see Figure 1). Without any way to move this energy away, the equator would be incredibly hot and inhospitable to life. On the other hand, because the Earth is a sphere, at the north and south poles less solar radiation is being received and more radiation is being reflected or released back into space. Without any additional energy input, these regions would be far too cold to support any kind of life whatsoever. However, both these regions remain liveable to human, animal, and plant species.

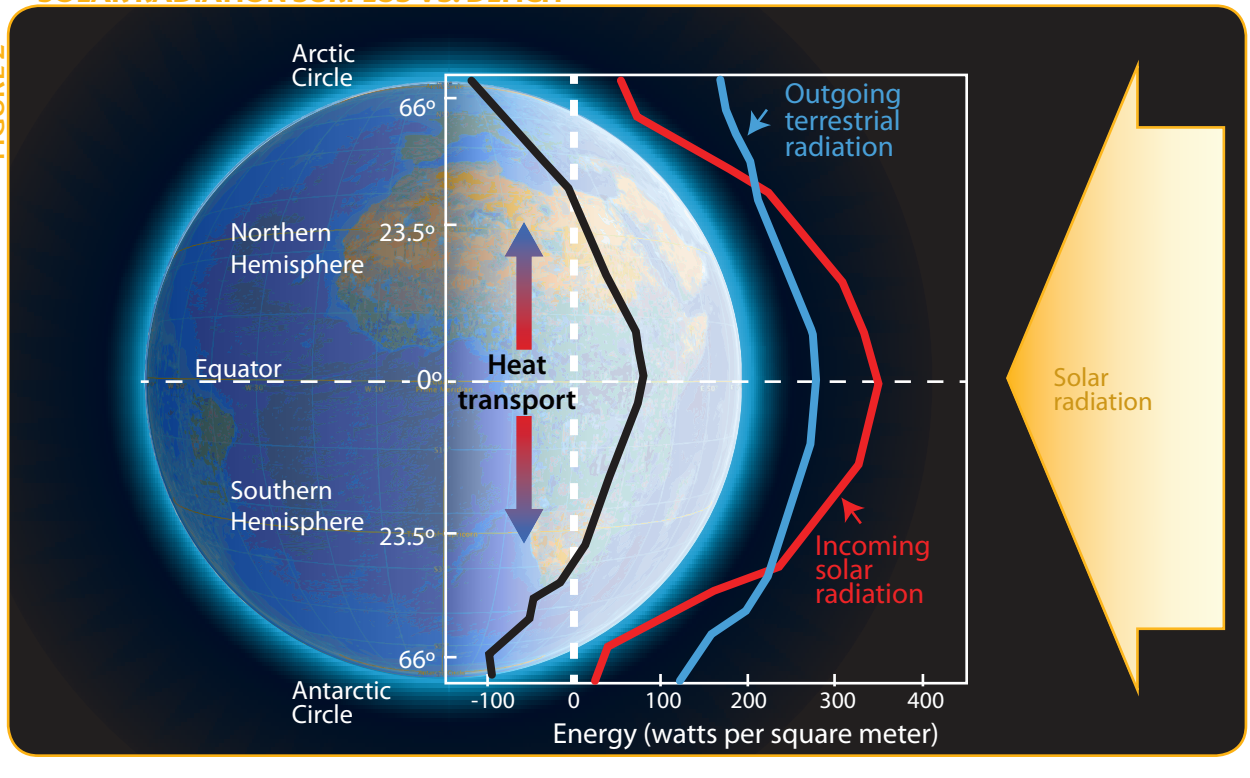
It can thus be said that the equator region has a constant surplus of solar radiation (which makes it hot) and the poles have a constant deficit (making it cold). The Earth's climate system provides the means to balance out the surplus and deficit of energy and heat. It uses the air and vapour in the atmosphere and water of the oceans to transport the energy around the globe to somewhat balance out the regional energy imbalance within the system (see Figure 2).

Generally speaking, the climate remains stable over long periods of time if the various elements within the system remain stable. However, if one or more of the components of the system is altered, the stability of the whole system is compromised and can lead to uncharacteristic behaviour and give rise to weather which is outside the usual range of expectations. This situation can be described as climate change.

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate

FIGURE 2

SOLAR RADIATION SURPLUS VS. DEFICIT



change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural variability observed over comparable time periods."

Additional Resources

1. 'The Climate System: An Overview', A.P.M Baede, E. Ahlonsou, Y. Ding and D. Schimel, Chapter 1 of the Working Group 1 Report of the IPCC Third Assessment Report (TAR) Climate Change 2001: The Scientific Basis. Cambridge University Press, 2001. http://www.grida.no/climate/ipcc_tar/wg1/pdf/TAR-01.pdf
2. Intergovernmental Panel on Climate Change. http://www.ipcc.ch/
3. WMO home page for basic climate information for young people. http://www.wmo.int/youth/climate_en.html
4. WMO page on climate. http://www.wmo.int/pages/themes/climate/index_en.php#

1.2 What causes Climate Change?

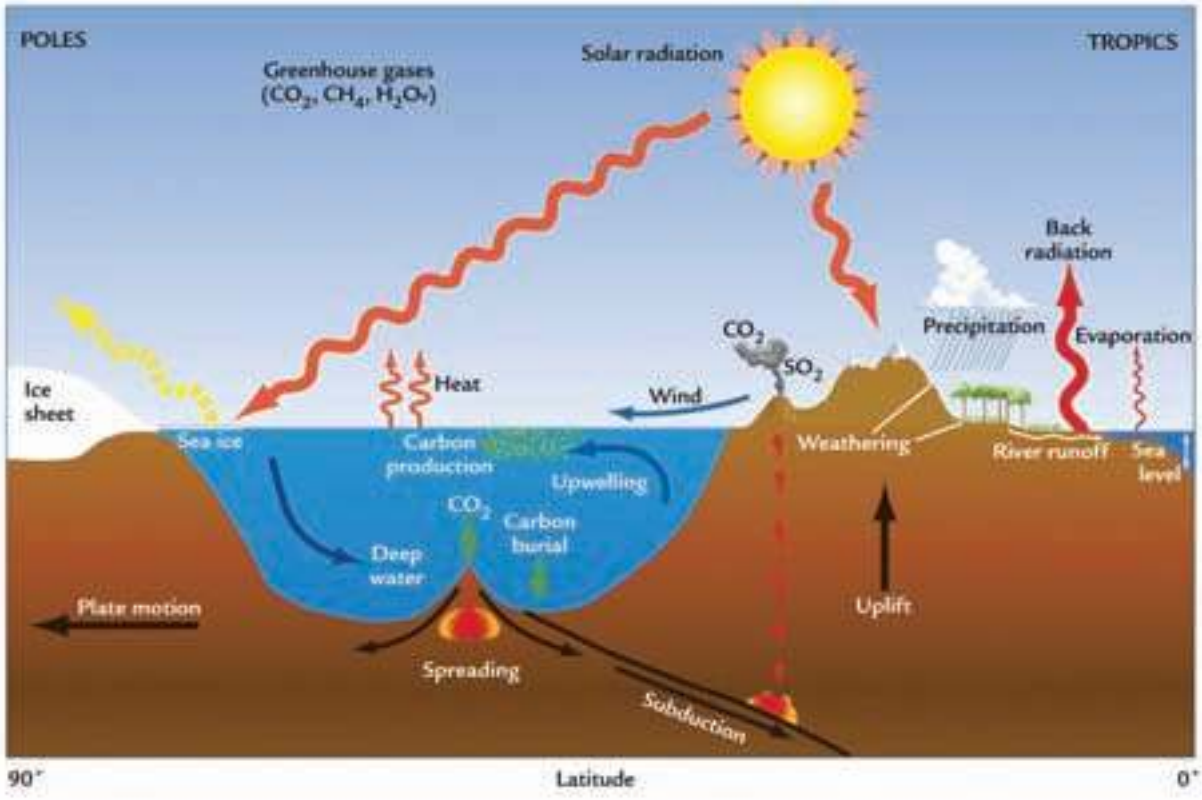
How the climate works and how we know it is changing

In recent centuries, there has been much debate over the influences and triggers of the Earth's radical climatic shifts from ice age to humid period and back again. Modern scientists have long suspected that human activity is capable of affecting the climate, and until recently, a comprehensive understanding of the complex processes that affect both the Earth's energy balance and the energy flows within the global climate system remained elusive.

Fortunately, the last few decades have seen significant strides in Earth system science as scientists have made advances in quantifying the energy and material fluxes that determine the dynamics of these systems. This has enabled them to obtain a clearer understanding of how the climate functions, as well as a clearer picture of the factors that influence changes in the global climate system (see Figure 3).

FIGURE 3

THE EARTH'S CLIMATE SYSTEM COMPONENTS



Clark College, 2003.

The Earth's climate is affected by a myriad of drivers that operate over different time scales and result in different changes over various geographical scales and geological eras. The movement of heat around the Earth is accomplished via the global climate system, which comprises the atmosphere, the oceans, the ice sheets, the biosphere (all living organisms) and soils, sediments and rocks. The climate system is made up of numerous subsystems with many processes occurring within and between each subsystem. These complex interactions result in intermittent and constantly changing phenomena (e.g. El Niño and the North Atlantic Oscillation (see text box below).

The state of the Earth's climate is determined by the amount of energy stored by the climate system, and especially the balance between energy received from the Sun and the portion of this energy which the Earth releases back to space. This global energy balance is regulated in large part by the flows of energy within the global climate system.

There are four main known influences of larger long-term changes in the Earth's climate. These are: (i) changes in the Earth's orbit around the Sun, (ii) variations in the output of energy from the Sun, (iii) changes in ocean circulation resulting mainly from fluctuations in the upwelling of deep cold waters in the tropical Pacific Ocean, and (iv) changes in the composition of the atmosphere. Though the first three influences are beyond the control of humankind, the composition of the atmosphere has been altered by human activities for over 200 years.

El Niño / La Niña (ENSO) and the North Atlantic Oscillation

El Niño/La Niña-Southern Oscillation, or **ENSO**, is a climate pattern that occurs across the tropical Pacific Ocean roughly every five years. It is characterized by variations in the temperature of the surface of the tropical eastern Pacific Ocean—warming or cooling known as El Niño and La Niña respectively—and air surface pressure in the tropical western Pacific—the Southern Oscillation. Mechanisms that cause the oscillation remain under study.

ENSO causes extreme weather (such as floods and droughts) in many regions of the world. The frequency and intensity of ENSO are potentially subject to dramatic changes as a result of global warming, and is a target for research in this regard.

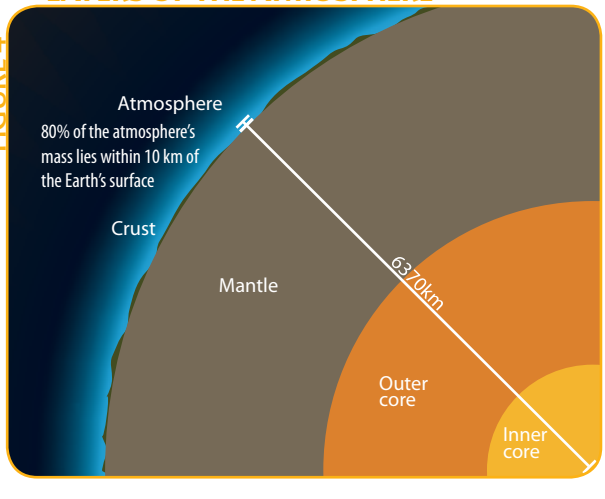
North Atlantic Oscillation: A permanent low-pressure system over Iceland (the Icelandic Low) and a permanent high-pressure system over the Azores (the Azores High) control the direction and strength of westerly winds into Europe. The relative strengths and positions of these systems vary from year to year and this variation is known as the North Atlantic Oscillation.

Composition of the atmosphere

The atmosphere is a comparatively thin layer of gases which fades rapidly away with altitude and does not have a definite top[1]. About 80% of the mass of the atmosphere in contained below 10 km of altitude (see Figure 4). Compared with the Earth's radius (6370 km) the atmosphere is just one sixth of one percent. Yet it is an extremely important multifunctional layer composed of numerous gases in varying proportions in different regions, and which serve different functions. It is predominantly made up of nitrogen (78%) and oxygen (21%). Besides water vapour, several other gases are also present in much smaller amounts (Carbon monoxide (formula CO), Carbon dioxide (CO_2), Neon (Ne), Oxides of nitrogen, Methane (CH_4), Krypton (Kr), and Ozone (O_3)).

This mix of gases facilitates the multifunctional nature of the atmosphere, on the one hand allowing a portion of the solar radiation directed at the Earth to reach the surface, and on the other, inhibiting the escape of longwave radiation (in the form of heat) back out into space. This heat trapping function is what is known as the 'greenhouse effect' and is what keeps the Earth's

FIGURE 4 LAYERS OF THE ATMOSPHERE

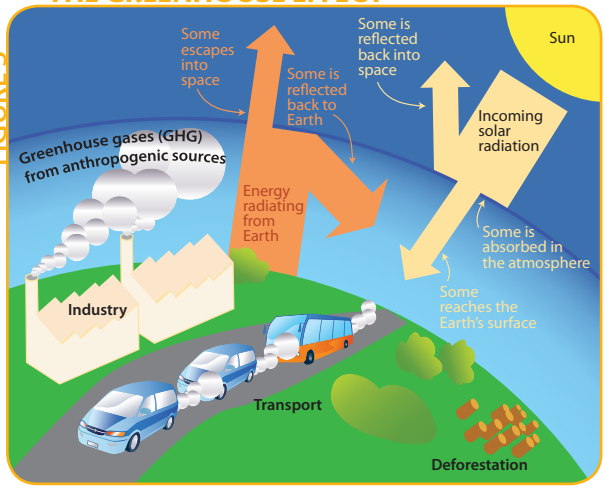


1 If one considers the size of a standard classroom globe, the atmosphere would be approximately as thick as a coat of paint on its surface.

surface in a suitable temperature range to sustain life as we know it (see Figure 5). After water vapour, the most important 'greenhouse gases' (GHG) are carbon dioxide, methane, and ozone.

THE GREENHOUSE EFFECT

FIGURE 5

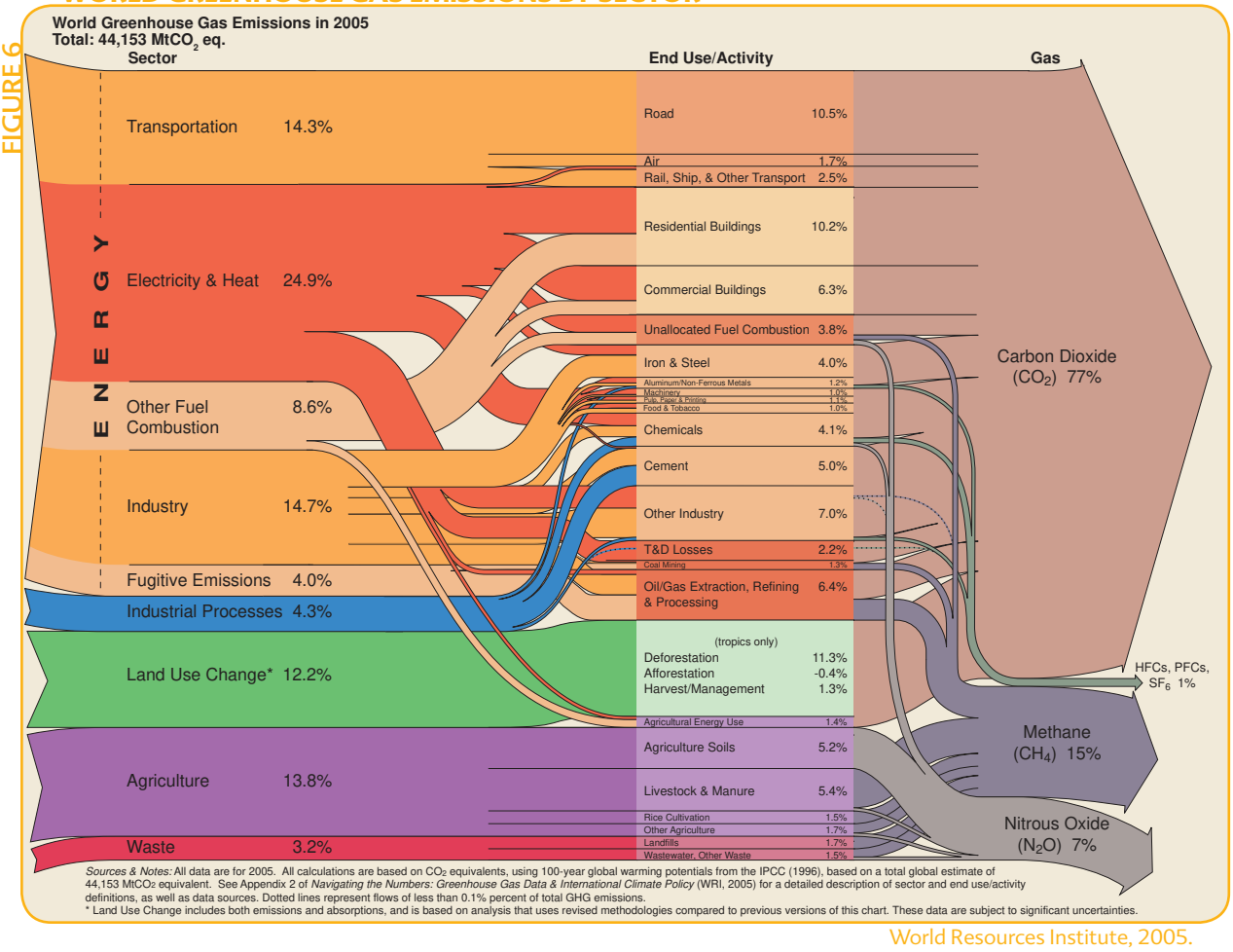


These GHGs remain active in the atmosphere over long periods of time (see Table 1). Over shorter periods, gases and particles emitted in large volcanic eruptions, such as Mt. Pinatubo in 1991, can also affect the global climate (see 'The Effects...' text box). In contrast, the relative position and movement of continents, among other factors, also affects global climate but over millions of years.

Many GHG-emitting activities are now essential to the global economy and form a fundamental part of modern life. Carbon dioxide from the burning of fossil fuels is the largest single source of GHG emissions from human activities. The supply and use of fossil fuels accounts for about 80 percent of mankind's carbon dioxide (CO_2) emissions, one fifth of the methane (CH_4), and a significant quantity of nitrous oxide (N_2O). In summary, the main contributing sectors to anthropogenic GHG emissions are electricity and heat (24.9%), industry (14.7%), transportation (14.3%) and agriculture (13.8%) (see Figure 6).

WORLD GREENHOUSE GAS EMISSIONS BY SECTOR

FIGURE 6



World Resources Institute, 2005.

Measuring temperature changes

Since the late nineteenth century, various land and sea instruments have been used to measure, in a fairly accurate manner, the air temperature near the surface of the Earth. Over the last forty years, the addition of satellite instruments has provided extremely accurate temperature readings. Given that such direct measurements and records of temperature and other climate variables exist for only a fraction of the Earth's history, longer perspectives on the evolution of climate must be studied through climate-dependent natural phenomena, the clues of which can be found in tree rings, ice cores and sea floor sediments (see Figure 7).

During the twentieth century, the accelerated rate of discoveries and controversies surrounding Earth System complexities provoked increasing interest among scientists, particularly regarding a significant trend in global warming. Scientists began investigating the extent to which human activity could have provoked this and other large changes in the Earth's system. For the last twenty-five years, tens of thousands of researchers and leading scientists have lent their expertise toward the intensive investigation and scientific analysis of these phenomena — facilitated and inspired by the Intergovernmental Panel on Climate Change — in an attempt to determine the sources of GHG, monitor ongoing changes to the global climate, and understand their potential environmental and socio-economic impacts.

Over the past century, the Earth's surface and the lowest part of the atmosphere have witnessed a warming of about +0.76˚C. In fact, since records began in the early 1860s — the height of the industrial revolution — globally averaged surface temperatures have been continuously rising. In the past two decades, the pace at which average global temperatures have risen has accelerated to an equivalent rate of 1.0˚C per century. Nine of the warmest years on record have occurred in the last decade (see Figure 8, next page). During this period of recorded global warming, the concentration of greenhouse gases in the atmosphere has also increased. This increase is directly associated with human activities, namely the burning of fossil fuels for energy and transportation, as well as deforestation and other land-use changes. In the last twenty years, concern has grown that these two phenomena are, at least in part, highly correlated. The warming of the Earth's surface that has taken place since the 1970s is

The Effects of Volcanic Eruptions

In 1990, Mt. Pinatubo injected 20 million tons of sulfur dioxide into the stratosphere, which was observed around the globe in the equatorial region. The result of this was that average hemispheric temperatures dropped by 0.2-0.5˚C for a period of 1-3 years.

FIGURE 7

ICE CORE SAMPLES

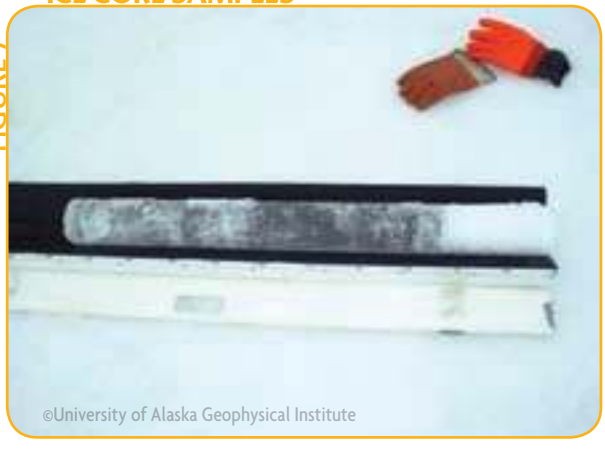


TABLE 1

RELATIVE CONTRIBUTIONS OF MAJOR GHGS TO THE GREENHOUSE EFFECT AND ATMOSPHERIC LIFETIMES

GHG	Contribution (%)	Mean lifetime
Water vapour	36% to 66%	9 days
Carbon dioxide	9% to 26%	Tens of thousands of years
Methane	4% to 9%	12 years
Ozone	3% to 7%	9—11 days

Note: 'The determination of CO_2's atmospheric lifetime is often grossly underestimated because it incorrectly ignores the balancing fluxes of CO_2 from the atmosphere to other reservoirs — as it is removed by mixing into the ocean, photosynthesis, or other processes. It is the net concentration changes of the various GHG by all sources and sinks that determines atmospheric lifetime and not simply the removal processes.' From: D. Archer, 'Fate of fossil fuel CO_2 in geologic time', Journal of Geophysical Research 110(C9): C09S05.1—5.6, 2005.

now considered explicable only as the result of humanity's greenhouse gas emissions.

Current scientific consensus

In 2003, the American Geophysical Union concluded that 'It is scientifically inconceivable that — after changing forest into cities, putting dust and soot into the atmosphere, putting millions of acres of desert into irrigated agriculture, and putting greenhouse gases into the atmosphere — humans have not altered the natural course of the climate system.'[2] While the subject of climate change remains a very complex and highly debated matter (both publicly and politically), global warming is an undeniable fact. Moreover, the balance of evidence now firmly indicates that there is a discernible human influence on the global climate; put simply, humans have contributed to observed global warming.[3] The current consensus of the scientific community is that the following fundamental conclusions provide only a glimpse of the changes that future generations will have to accept and face:

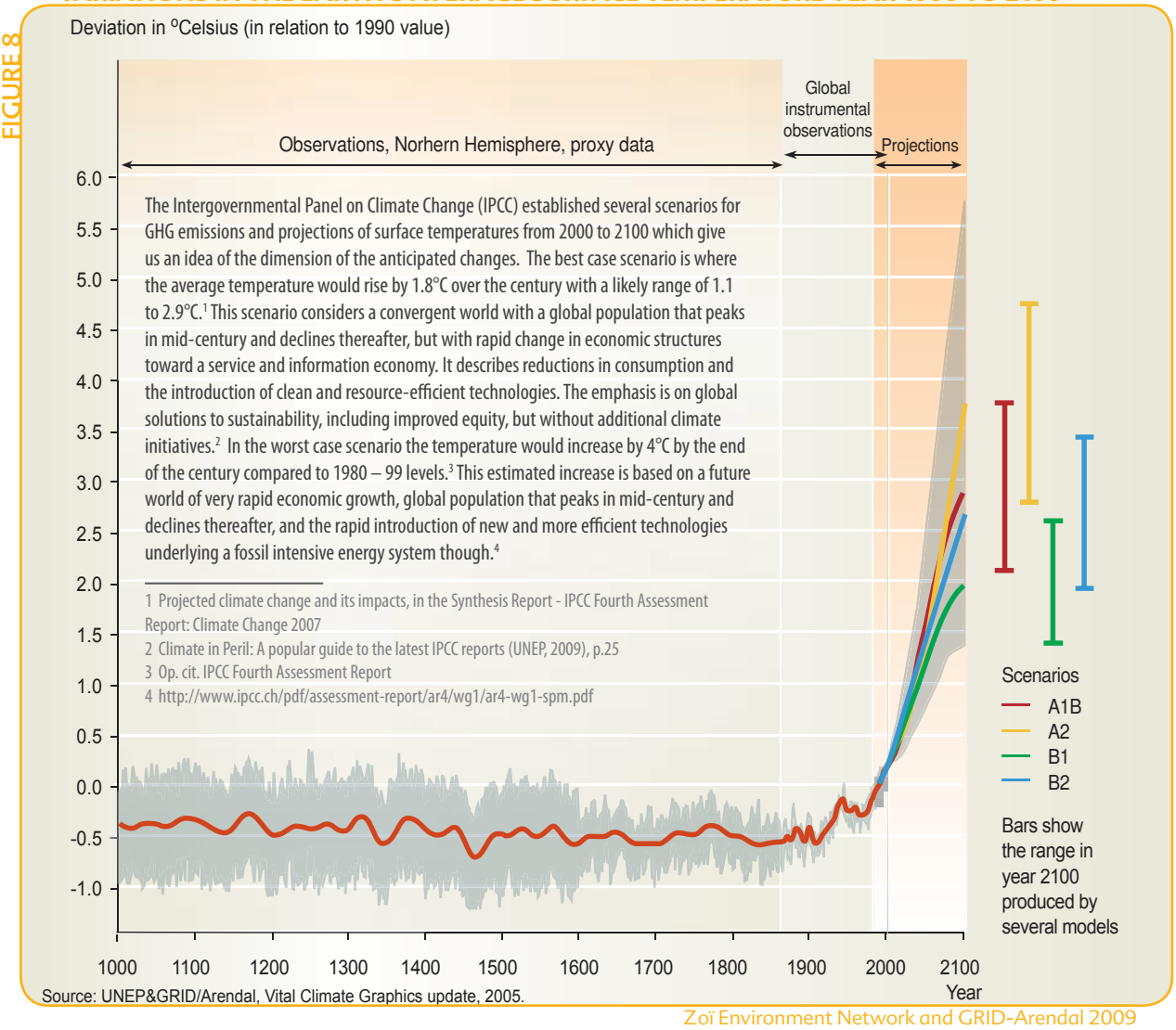
- The planet is warming due to increased concentrations of heat-trapping gases in our atmosphere.
- Most of the increase in the concentration of these gases over the last century is due to human activities, especially the burning of fossil fuels and deforestation.

2 American Geophysical Union, Eos 84(51), 574 (2003).

3 R.K. Pachauri and A. Reisinger (eds) Climate Change 2007: Synthesis Report, IPCC, p. 104.

FIGURE 8

VARIATIONS IN THE EARTH'S AVERAGE SURFACE TEMPERATURE YEAR 1000 TO 2100



Zoï Environment Network and GRID-Arendal 2009

- Natural causes always play a role in changing Earth's climate, but are now being overwhelmed by human-induced changes.
- Warming the planet will cause many other climatic patterns to change at speeds unprecedented in modern times, including increasing rates of sea level rise and alterations in the hydrologic cycle. Rising concentrations of carbon dioxide are also making the oceans more acidic.
- Climate change impacts are already being observed, including more frequent and extreme weather patterns, changes in plant growth affecting agriculture and food production, loss of plant and animal species unable to adapt or migrate to changing conditions, changes in the spread of infectious diseases in terms of the rate and the expansion of ranges, changes in the flow of ocean currents, and changes in seasons.
- The combination of these complex climate changes threatens coastal communities and cities, our food and water supplies, marine and freshwater ecosystems, forests, high mountain environments, and far more.[4]

Additional Resources

1. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, 2007.
2. Climate Change Science Compendium 2009, C. McMullen and J. Jabbour (eds) United Nations Environment Programme, EarthPrint, 2009. http://www.unep.org/compendium2009/
3. Understanding Climate Change: A Beginner's Guide to the UN Framework Convention and its Kyoto Protocol. UNEP, 1999. http://www.unep.org/dec/docs/info/ccguide/beginner-99.htm

1.3 What has changed so far?

Observations show that warming of the climate is unequivocal. The global warming of the past fifty years is due primarily to human-induced increases of greenhouse gas (GHG) emissions. These emissions come mainly from the burning of fossil fuels (coal, oil and gas), with additional contributions from the clearing of forests, agricultural practices, and other activities.

4 'Climate Change and the Integrity of Science', J. Sills, Science 328: 691—92, 2010.

The effects of human activities have also been identified in many other aspects of the climate system, including changes in ocean heat content, precipitation, atmospheric moisture and Arctic sea ice.

This conclusion rests on multiple sources of evidence. First, the examination of records of climate changes over the last 1,000 to 2,000 years show that global surface temperatures over the last several decades were higher than at any time during at least the past 400 years (1,000 years for the Northern Hemisphere). A second source of evidence is our increased understanding of how GHGs trap heat, how the climate system responds to increases in GHGs, and how other human and natural factors influence climate. As result of this knowledge, there is a broad qualitative consistency between observed changes in climate and the computer model simulations of how climate would be expected to change in response to human activities. Finally, there is extensive statistical evidence. The community of scientists reporting to the IPCC in 2007 identified 765 significant observed changes in the physical system (snow, ice and frozen ground, hydrology and coastal processes) of which 94 per cent were consistent with climate change. Similarly, observations of biological systems (terrestrial, marine and fresh water) produced 28,671 significant observed changes with a 90 per cent agreement with expected impacts of climate change.

Increasing warming

As already mentioned, the global average surface temperature has risen by about 0.76°C since the year 1900, with much of this increase occurring since 1970. The estimated change in the Earth's average surface temperature is based on measurements from thousands of weather stations, ships and buoys around the world, as well as from satellites. These measurements are independently compiled, analysed and processed by different research groups. The warming trend that is apparent in all of these temperature records is confirmed by other independent observations, such as the melting of Arctic sea ice (see Figure 9, next page), the retreat of mountain glaciers on every continent, reductions in the extent of snow cover, increased melting of the Greenland and Antarctic ice sheets, and earlier blooming of plants in spring.

The temperature increase is spread across the globe and is greater at higher northern latitudes. Average Arctic temperatures have increased at almost twice the global average rate in the past

100 years. Land regions have warmed faster than the oceans. Observations show that the average temperature of the global ocean has increased to depths of at least 3,000 metres and that the ocean has been taking up over 80 per cent of the heat being added to the climate system. Satellite measurements of air temperatures at high elevations show warming rates similar to those observed in surface temperature.

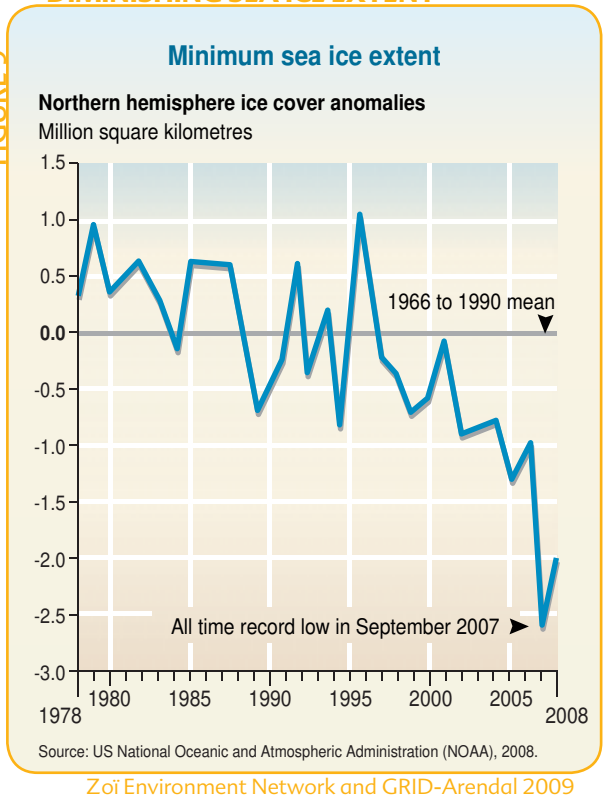
Changing precipitation patterns

Globally, precipitation shows a minor upward trend with most of the increase taking place during the rainy season. On a regional basis, increases in annual precipitation have occurred in the higher latitudes of the Northern Hemisphere and southern South America and northern Australia. Decreases have occurred in the tropical region of Africa, and southern Asia. The measured changes in precipitation are consistent with observed changes in river flows, lake levels and soil moisture (where data are available and have been analysed) (see Figure 10).

Scientists have also noted changes in the amount, intensity, frequency and type of precipitation.

FIGURE 9

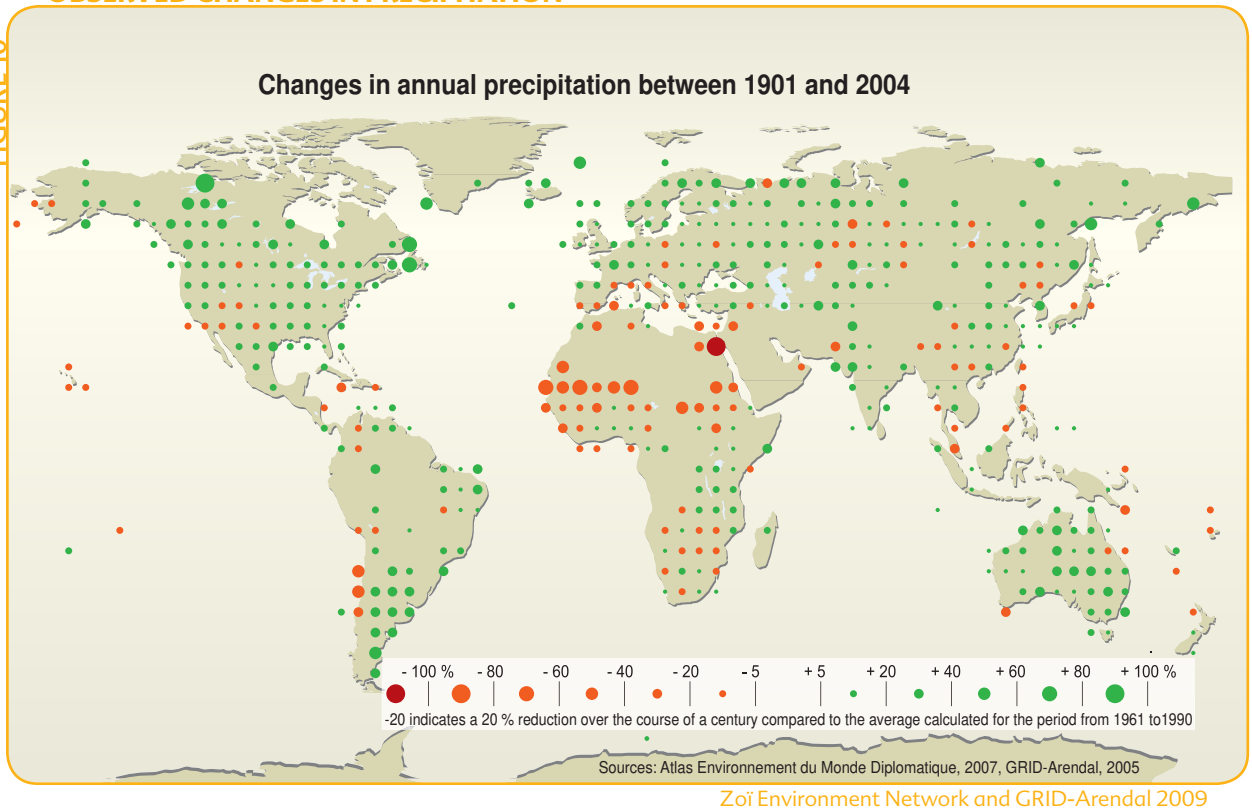
DIMINISHING SEA ICE EXTENT



Zoï Environment Network and GRID-Arendal 2009

FIGURE 10

OBSERVED CHANGES IN PRECIPITATION



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Pronounced increases in precipitation over the past 100 years have been observed in eastern North America, southern South America, Asia and northern Europe. Decreases have been seen in the Mediterranean, most of Africa and southern Asia. The amount of rain falling in the heaviest downpours has increased approximately 20 per cent on average in the past century, and this trend is very likely to continue, with the largest increases in the wettest places. Evidence of increasing cyclone and hurricane strength has been documented and linked to rising sea surface temperatures and warming air (see Figure 11).

Changes in the geographical distribution of droughts and flooding have been complex. In some regions, there have been increases in the occurrence of both droughts and floods. As the world warms, northern regions and mountainous areas are experiencing more precipitation falling as rain rather than snow. Widespread increases in heavy precipitation events have occurred, even in places where total rain amounts have decreased.

Widespread water concerns

Climate change has already altered the water cycle, affecting where, when and how much water is available for all uses. Further, it will likely be the case that there will be too little water in some places, too much water in other places, and degraded water quality — and some locations are expected to be subject to all of these conditions during different times of the year. Water cycle changes are expected to continue and to adversely affect hydroelectricity production, drinking water availability, human health, transportation, agriculture and ecosystems.[5]

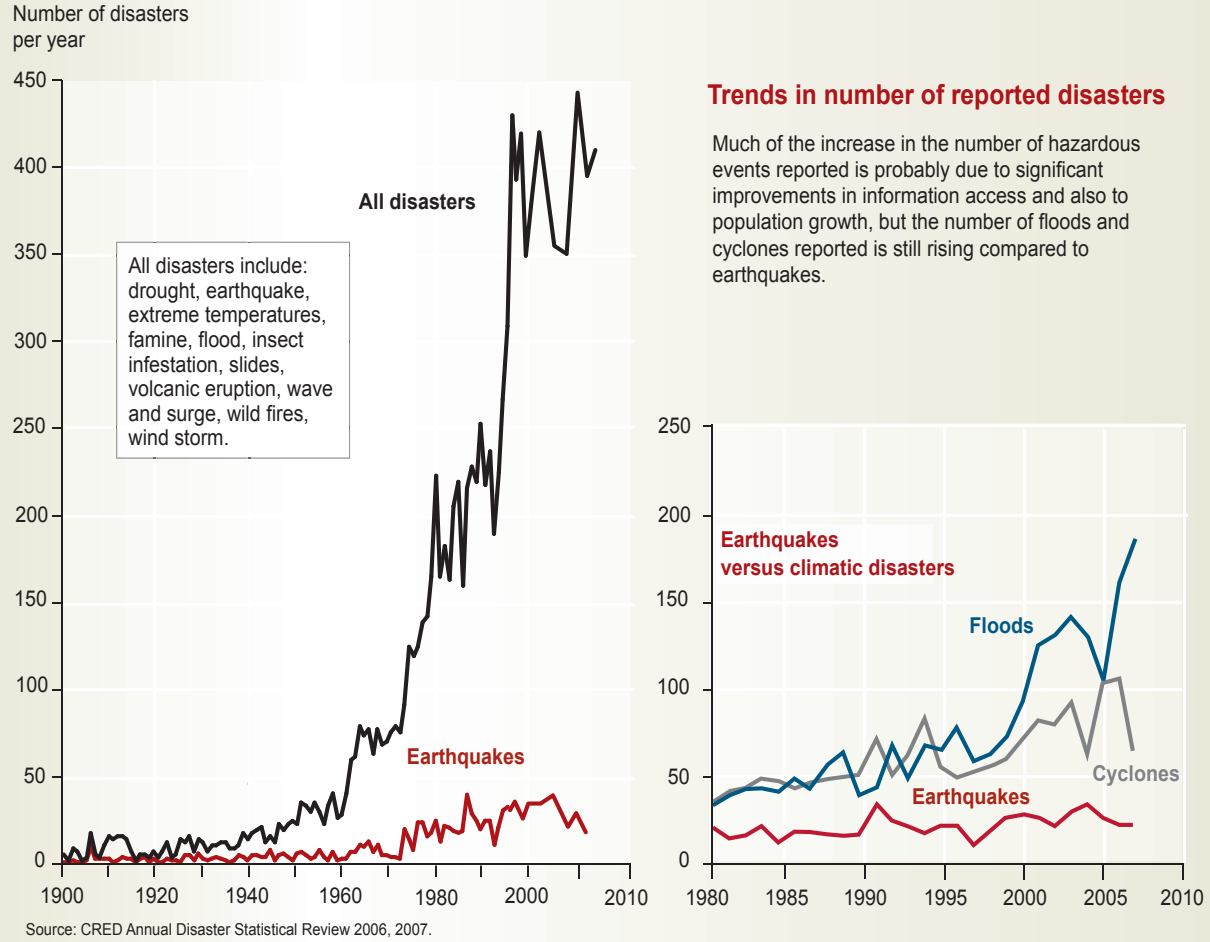
Vulnerable ecosystems

Climate change is affecting many ecosystems around the world. Perhaps the most publicized of all the impacts of global warming are Arctic ecosystems that rely on sea ice, which is vanishing

5 These changes are associated with the fact that warmer air holds more water vapour evaporating from the world's oceans and land surface. This increase in atmospheric water vapour has been observed from satellite measurements.

FIGURE 11

INCREASED NUMBER OF WEATHER-RELATED DISASTERS



Source: CRED Annual Disaster Statistical Review 2006, 2007.

Zoï Environment Network and GRID-Arendal 2009

rapidly and is projected to disappear entirely in summertime within the twenty-first century. Algae that bloom on the underside of the sea ice form the base of a food web linking microscopic animals and fish to seals, whales, polar bears and people. As the sea ice disappears, so too do these algae. The ice also provides a vital platform for ice-dependent seals (such as the ringed seal) to give birth, nurse their pups and rest. Polar bears use the ice as a platform from which to hunt their prey. The walrus rests on the ice near the continental shelf between its dives to eat clams and other shellfish. As the ice edge retreats away from the shelves to deeper areas, there will be no clams nearby.

Observed and documented impacts of climate change include sea level rise that threatens coastal habitats and human settlements; increased sea surface temperature with more frequent ocean heat waves that cause coral bleaching and death (see Figure 12); ocean acidification (due to increased absorption of carbon dioxide (CO_2) by sea surface waters) hampering shell formation and coral reefs (see Figure 13); melting of glaciers and snow caps, including rapid retreat of tropical glaciers and loss of natural water regulation function (see Figure 14); higher frequency of forest fires; spread of disease and pests to areas naturally protected by climate conditions; changes in plant productivity and potential mismatch of interlinked symbiotic life cycles and many more.

Forests: Climate change beneficiaries?

The climate has a strong influence on the processes that control growth and development in ecosystems. Increases in temperature generally speed up plant growth, rates of decomposition, and the speed at which the cycling of nutrients occurs, although other factors, such as whether sufficient water is available, also influence these rates. Forest growth has risen over the past several decades as a consequence of a number of factors: young forests reaching maturity, temperature increases, an increased concentration of CO_2 in the atmosphere, a longer growing season, and increased deposition of nitrogen from the atmosphere. Separating the effects of each factor remains a challenge.

A higher concentration of atmospheric CO_2 causes trees and other plants to capture more carbon from the atmosphere, but experiments show that trees convert much of this extra carbon into producing fine roots and twigs rather than new wood. The effect of CO_2 in increasing growth thus seems to be relatively modest, and is generally seen most strongly in young forests on fertile soils where there is also sufficient water to sustain this growth. Wherever droughts increase, forest productivity will decrease and tree death will increase.

Additional observed impacts

Other changes that are consistent with the warming observed over the past several decades and which are not mentioned above include:

- Reductions in lake and river ice
- Changes in soil moisture and runoff

FIGURE 12

CORAL BLEACHING

FIGURE 13

GLOBAL OCEAN ACIDIFICATION

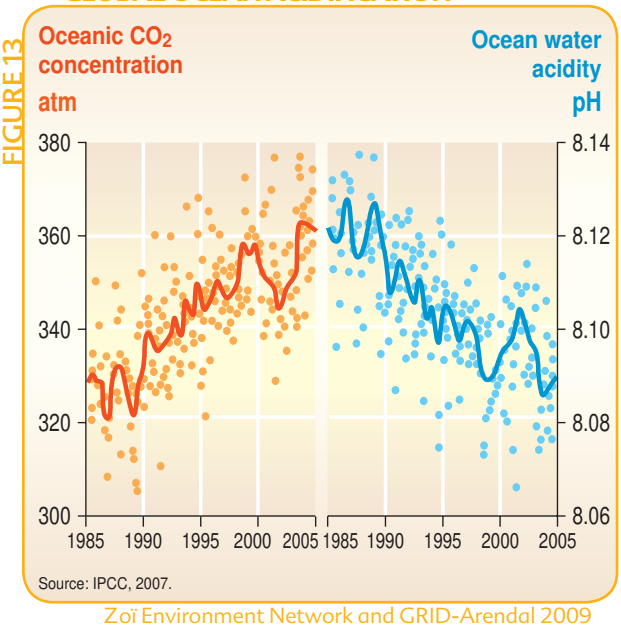


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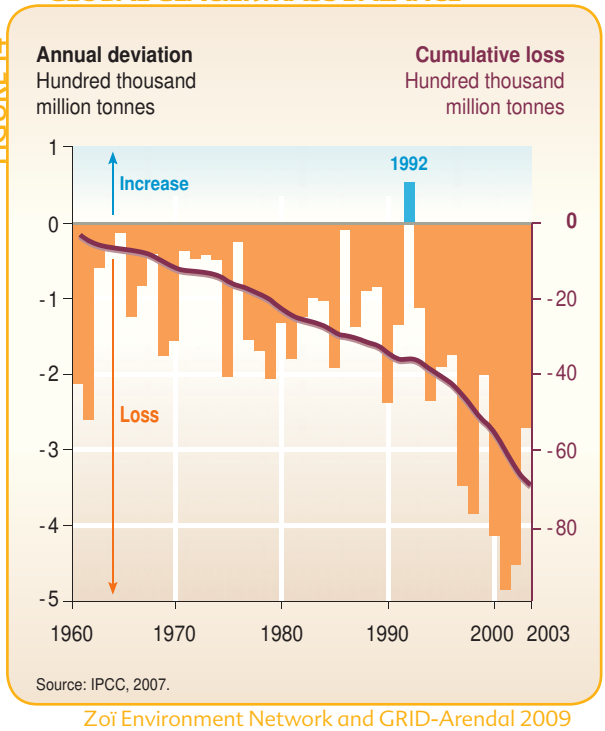
FIGURE 14

GLOBAL GLACIER MASS BALANCE



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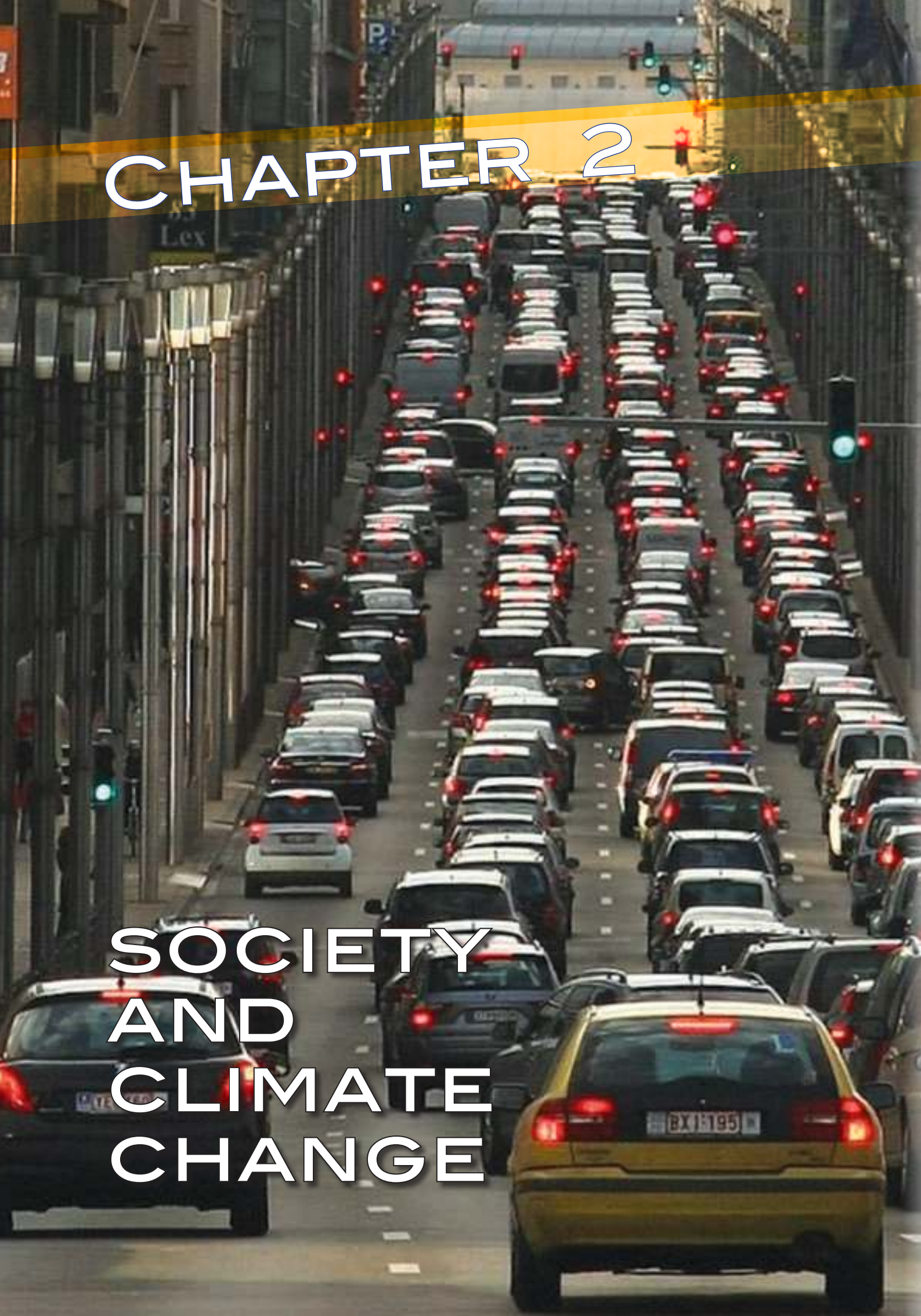
- Changes in the extent of permafrost
- Changes in food chains in marine ecosystems
- Massive extinction of species
- Early flowering
- Increase weather variability.

Though many uncertainties remain and surprises are expected, it is evident that each of the impacts listed above are not occurring in isolation. Each one has consequences that can and likely will induce a chain of impacts, small or large, between the interlinked ecosystems in every region and on every continent. Similar to tracking disruptions upward in the food chain, these consequences will filter their way up through the flora, fauna and diverse species to ultimately exert their combined impact on human society. The question remains as to how humankind will react to the climate change threat and what preparations will be made to meet the challenges posed by an uncertain and unpredictable future climate.

Additional Resources

1. National governments have reported local observations of climate change, as well as their vulnerabilities to the effects of global warming, to the United Nation Framework Convention on Climate Change (UNFCCC). http://unfccc.int/national_reports/items/1408.php
2. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds.) IPCC, Geneva, Switzerland. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm
3. Climate in Peril: A Popular Guide to the Latest IPCC Reports. UNEP/GRID Arendal, 2009. http://www.grida.no/publications/climate-in-peril/



CHAPTER 2

SOCIETY AND CLIMATE CHANGE

SOCIETY AND CLIMATE CHANGE

Rising temperatures, changes in sea level, changing precipitation patterns, altered seasons and other environmental shifts brought about by climate change have already begun to impact human societies in numerous and diverse ways. In some cases these phenomena impose new challenges and make existing challenges more difficult. Rising sea levels, for example, pose a direct threat to settlements in low-lying coastal areas, while the growing frequency of storms and floods affect communities across the globe.

More specifically, climate change exacerbates problems such as poverty, disease and gender inequalities that already afflict — albeit to varying degrees — individuals, communities and in some cases whole nations. Article 1 of the UNFCCC states that the adverse effect of climate change will not only be felt in natural and managed ecosystems, but also have "significant deleterious effects" on the "operation of socio-economic systems or on human health and welfare". The impact of climate change also constitutes an opportunity to leverage positive social transformation with a particular focus on the needs of the most vulnerable within a comprehensive sustainable development framework.

For policy-makers, the challenge is to ensure that climate-related policies and measures simultaneously provide better living conditions for society and translate into more decent work, better health, adequate housing, education, gender equality, food security, protection of human rights, social protection for the most vulnerable, and ultimately contribute to poverty reduction and sustainable development, ensuring equitable low-carbon development processes.

Developing Country Vulnerability

The Stern Review, prepared for the British government by economist Sir Nicholas Stern, argues that developing countries are particularly vulnerable because of their topical geography, their high population growth, heavy dependence on agriculture and rapid urbanisation, their weak infrastructures and lack of resources.

http://www.direct.gov.uk/en/Nl1/Newsroom/DG_064854

There are inextricable links that exist between climate change and issues of poverty and underdevelopment. The world's poor, whilst contributing least to the causes of climate change, are already the hardest hit by its impacts. Poor people are less equipped to adapt to climate change, more vulnerable to impacts such as famine and disease, and more likely to be physically displaced.

Impoverished women and children are particularly vulnerable. With less income than their male counterparts, more household-oriented responsibilities, and less access to education and information, women are often in a weaker position to adapt to climate change. Children also suffer disproportionately, especially with regard to climate change-related famine and disease. Efforts to help communities prepare for and adapt to climate change should therefore not overlook issues of gender inequality and children's needs. Women and children are not only victims, but can also be key actors. Children can be effective agents of change, using both their energy and ideas to find and implement solutions.

This chapter explores the social impacts of climate change, with a focus on migration, highlighting poverty, health, gender, and ethics.

Human Rights and Forced Migration

In May 2008, Cyclone Nargis struck the Irrawaddy Delta region in Myanmar, severely affecting 2.4 million people and leading to the displacement of 800,000 people. The resulting increase in population densities of neighbouring regions contributed to spread disease, while health and education services were largely inadequate for accommodating the sudden influx of people, depriving them of basic rights.

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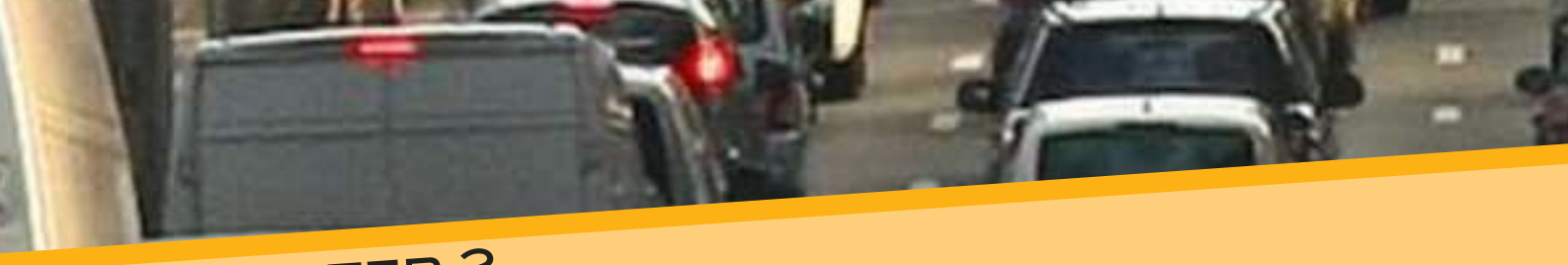


CHAPTER 2

The Scale of Displacement

Migration, rising populations, unsustainable use of resources, poverty and civil war all contribute to vulnerability in the face of natural and weather-related disasters. The UN Office for the Coordination of Humanitarian Affairs (OCHA) and the Internal Displacement Monitoring Centre (IDMC) examined 2008 data and found that at least 36 million people were displaced by "sudden-onset natural disasters", of which more than 20 million were displaced owing to the sudden onset of weather-related disasters, including about 6.5 million people because of floods in India. "Research from other sources suggests that many millions of people are also displaced annually as a result of slow-onset climate-related disasters such as drought," it adds.

2.1 Migration - Undermining development and uprooting people?

Climate change has both intermittent - but increasingly frequent - extreme impacts (such as large storms and heat waves), and slow on-set, cumulative effects (such as extinction of life forms and sea level rise). Both kinds of effects may have a role in disrupting livelihoods and displacing human populations (see 'The Scale...' text box).

Climate change manifestations such as sea level rise, desertification and growing water scarcity, and extreme climate variability and events such as cyclones and floods do not take place in a vacuum. They can lead to millions of people being displaced by shoreline erosion, coastal

Human Rights and Climate Change

Selected articles from the **Universal Declaration of Human Rights** of relevance to climate change impacts.

Article 3.
Everyone has the right to life, liberty and security of person.

Article 6.
Everyone has the right to recognition everywhere as a person before the law.

Article 13.
(1) Everyone has the right to freedom of movement and residence within the borders of each state.

(2) Everyone has the right to leave any country, including his own, and to return to his country.

Article 21.
(1) Everyone has the right of equal access to public service in his country.

Article 22.
Everyone, as a member of society, has the right to social security and is entitled to realization, through national effort and international co-operation and in accordance with the organization and resources of each State, of the economic, social and cultural rights indispensable for his dignity and the free development of his personality.

Article 23.
(1) Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment.

Article 25.
(1) Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

(2) Motherhood and childhood are entitled to special care and assistance. All children, whether born in or out of wedlock, shall enjoy the same social protection.

Article 26.
(1) Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

See http://www.un.org/en/documents/udhr/index.shtml

flooding and agricultural disruption.[6] Scientists are increasingly confident about the identified impacts of climate change on the environment. Upon viewing these data through a human rights lens, it is clear that projected impacts threaten the effective enjoyment of a range of human rights, such as the right to safe and adequate water and food, the right to health and to adequate housing (see 'Human Rights...' text box). Equally, the human rights perspective brings into focus that climate change is set to hit the poorest countries and communities the hardest.

The relationship between climate change and displacement is complex and context-dependent. There are often several underlying economic, political and other social factors. Nationally and regionally, climate change has the potential to sharply intensify human displacement bringing communities into increasing competition for finite natural resources, and with world-wide repercussions for the stability of the global economy.

The issues affecting environmental migrants are multidimensional, including economic and human development, human rights, conflict, public health, gender, as well as governance questions.

A large population movement in response to a change in the environment raises development concerns in at least four ways:

1. through increased pressure on urban infrastructure and services;
2. by undermining economic growth;
3. by increasing the risk of conflict; and
4. by leading to worse health, educational and social indicators among migrants themselves.

Increased pressure on urban infrastructure and services

The services provided by urban infrastructure systems include flood control, water supply, drainage, waste water management, solid and hazardous waste management, energy, transportation, providing constructed facilities for residential, commercial, and industrial activities, communication, and recreation. The real value of infrastructure is that the socio-economic and environmental services it provides are essential; without them, the economy could not function and many human and environmental systems could collapse.

If, as a consequence of climate change, sea levels rise by one metre, the infrastructure and inhabitants of many coastal cities and populations will be under threat. For example, megacities under threat include Buenos Aires, Rio de Janeiro, Los Angeles, New York, Lagos, Cairo, Karachi, Mumbai, Kolkata, Dhaka, Shanghai, Osaka-Kobe, and Tokyo. Many smaller coastal cities will suffer under the same effects.

Undermined economic growth

Cyclones and floods not only damage machinery and other physical assets, but also disrupt the availability of the human resources and capacity required to drive the production and consumption of the economy.

Mass migration of "human capital" disrupts production systems and undermines domestic markets through the loss of the required labour force

Desertification leads to Migration

In Nigeria, 3,500 km^2 (1,350 miles^2) of land transform into desert each year, making desertification the country's primary problem. As the desert advances, farmers and herdsmen are forced to move, either squeezing into the shrinking area of habitable land or migrating to already overcrowded cities.

Mexico has a long history of international migration and is the second largest migrant sending country in the world (OECD, 2007). In 2005 alone, 164 million migrants left the country. It is also a country subject to extreme climate variability in the form of droughts in the country's northern and central regions. In Zacatecas, for example, about 85 per cent of the crops were destroyed by droughts in 2005 and 2006 according to the Mexican media. In addition, desertification affecting Mexico's dryland regions leads 600,000 to 700,000 people to migrate from these areas annually (IOM, 2008).

6 Migration and Climate Change, IOM Migration Research Series, No. 31, p. 9

and investment in education. This can establish a self-reinforcing pattern of limited economic opportunity that contributes to future migration. The so-called "brain drain" phenomenon is already a concern for developing countries that struggle to keep hold of their highly educated population. This key segment of the functioning economy is more likely to be able to afford to migrate out of an area that is under constant threat from climate change-induced weather events.

Threats to security

Climate change is best viewed as a threat multiplier, exacerbating existing vulnerabilities and changing the distribution and supply of resources, rather than being the direct cause of conflicts. Changes in climate can, however, play an indirect role in generating the conditions for conflict at different levels (see Figure 15). The impacts of climate change will furthermore be magnified or mitigated by underlying conditions of governance, poverty and resource management as well as the nature of impact at local and regional levels.

Three areas are of particular concern when looking at the links between climate change and security:

1. Sea level rise accompanied by storm surges and other extreme weather events represent a key threat to security let alone the future viability of low small island states and low lying coastal zones;
2. Natural disasters challenge food security in a number of ways — loss of productive land from sea level rise, destruction of crops and damage to food distribution networks;
3. Competition over scarce land and water exacerbated by regional changes in climate are already a key factor in local level conflicts (i.e. Darfur) — when livelihoods are threatened by declining resources, people either innovate, flee ("environmental refugees"), or can be brought into conflict.[7] (see 'Desertification leads...' text box, previous page);

However, the way climate change affects security issues is not direct but through a long causal chain. Studies of past and recent conflicts have not yielded proof that they were rooted in environmental impacts resulting from climate change.[8]

Diminished health, educational and social indicators

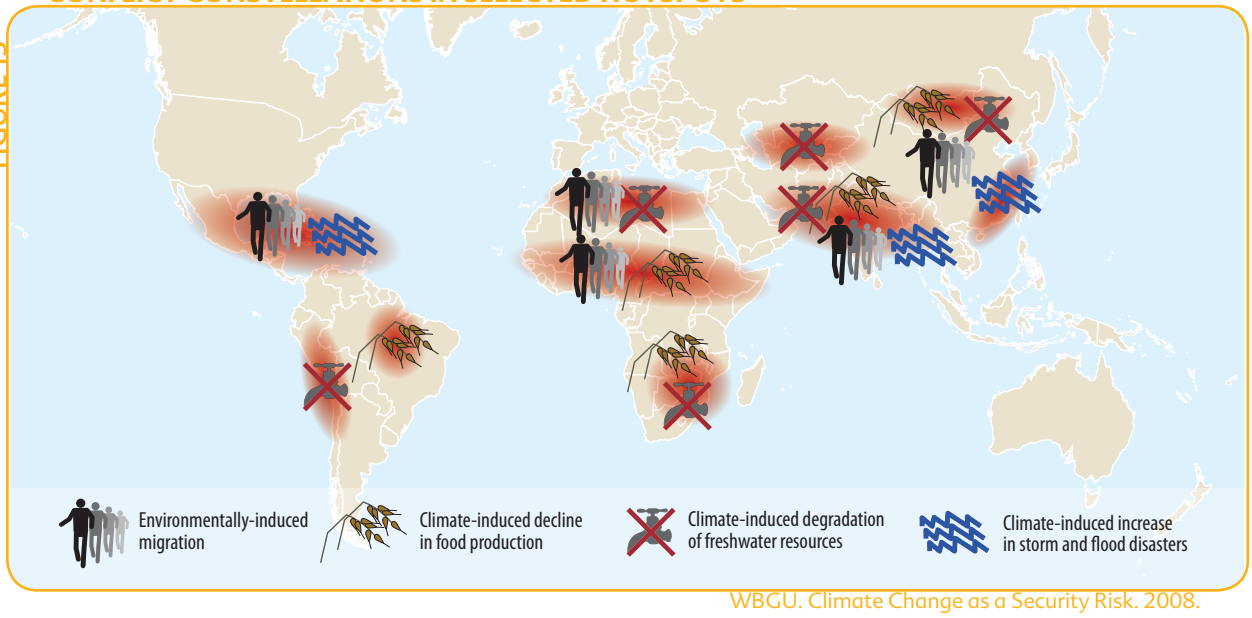
Population displacement undermines the provision of medical care and vaccination programmes, making infectious diseases

7 Address by UN Under-secretary-General and UNEP Executive Director Achim Steiner at UN Security Council debate on The Impact of Climate Change on Maintaining International Peace and Security, 20 July 2011.

8 Ragnhild Nordås and Nils Petter Gleditsch. Climate Change and Conflict. 2007.Centre for the Study of Civil War (CSCW) at the International Peace, Research Institute, Oslo (PRIO) and Department of Sociology and Political Science, Norwegian University of Science and Technology, Trondheim

FIGURE 15

CONFLICT CONSTELLATIONS IN SELECTED HOTSPOTS



WBGU. Climate Change as a Security Risk. 2008.

harder to deal with and more deadly. It is well documented that refugee populations suffer worse health outcomes than settled populations.[9] Forced migrants are also at greater risk of sexual exploitation, human trafficking and sexual and gender-based violence.

Migration in response to climate stresses can also spread epidemic disease. Visceral leishmaniasis (VL) is one example. VL is a widespread parasitic disease with a global incidence of 500,000 new human cases each year. In north-eastern Brazil, periodic epidemic waves of VL have been associated with migrations to urban areas after long periods of drought.[10]

Environmental changes affecting household livelihoods such as droughts can negatively impact the levels of schooling of affected populations. To cope with acute food shortages driven by droughts, families may be pushed to engage in economic activities and strategies that focus on meeting the immediate food requirements of the household. A common strategy is pulling children out of school to seek work.[11] The impacts of climate change on children and adolescents in terms of their access to education should be considered as an integral part of all international frameworks established to address global climate change.

Social inclusion considerations of environmental change also pose major challenges to environmental migrants. As with other marginalized groups, they are usually outsiders in their new environment and thus have a reduced support network to help them cope, putting them at a disadvantage to adapt to new living conditions and in new cultures. They are at greater risk of chronic stresses as forced displacement is associated with a range of health and social issues, including social isolation and mental disorders.

<<Migration affects women differently than men. See section 2.4 for more details.>>

International protection of environmental migrants: the challenges

To understand the impact of climate change on migration, it is necessary to disentangle the different kinds of mobility that may be connected to environmental factors. Indeed, notions such as 'displacement', 'mobility' or 'migration' (and the associated predicted numbers of people concerned) refer to situations that range from a few hours spent in a temporary shelter in fear of a hurricane to the relocation of whole communities whose land has disappeared following sea level rise. Various terms which appear in official and unofficial discourse include: environmental migrant[12]; environmental refugee[13]; environmentally induced population movement (EIPM); environmentally displaced person (EDP) (with three subgroups: environmental migrant, environmental displacee and development displacee); and refugee.[14]

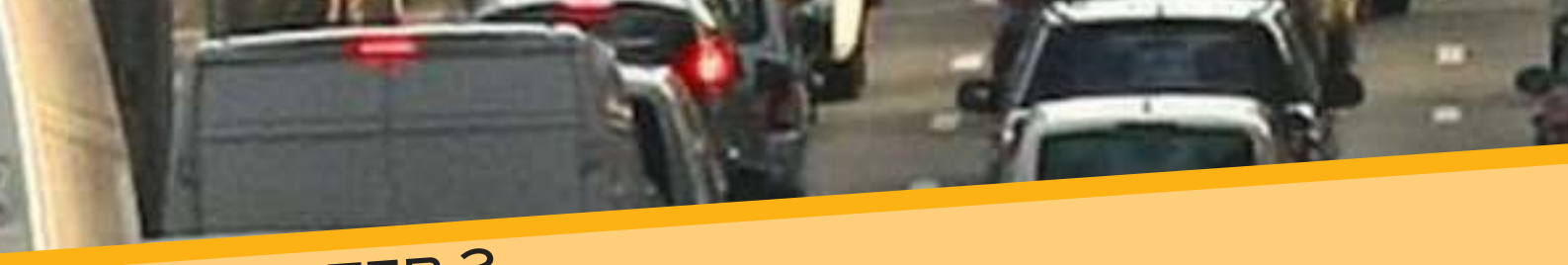
Conceptual issues are a major source of confusion in the debate on climate change and migration. One of the difficulties in recognising environmental migrants as an official status is that forced migration emanating from environmental reasons is not a new phenomenon, but has long been an adaptive strategy for individuals and communities. It is also at times difficult to distinguish between migration for environmental and economic reasons.

Up to now, the scale of the problem has not been duly recognized. However, given the increasing number and impact of extreme environmental changes being attributed to climate change, the number and scale of migrations to come imply that challenges lie ahead for migrant destinations.

This raises the question of how to best protect environmental migrants (i.e. their legal status) and the responsibilities of the international community towards them. Environmental migrants fall through the cracks of international refugee and immigration policy — and there remains considerable resistance to the idea of expanding the definition of political refugees to incorporate 'climate refugees'. Participants in the international debate on environmental migration share core concerns, including multi-causality and the recognition of the social construction of vulnerability. Nevertheless, more research is required to build a better understanding of the challenges environmental migrants face, accompanied by more informed adaptation strategies and policies to protect their human rights.

9 Migration and Climate Change. International Organization for Migration, Geneva, 2008. p. 34.
10 Ibid. p. 34.
11 Carvajal, Liliana (2007). Impacts of Climate Change on Human Development. Human Development Report 2007-2008, "Fighting Climate Change: Human Solidarity in a Changing World" (available at http://hdr.undp.org/en/reports/global/hdr2007-8/papers/Liliana-Carvajal-revised.pdf)

12 Term used by the International Organization for Migration (IOM).
13 MC/INF/288 background paper presented at the 94th IOM Council in 2007.
14 United Nations Geneva Convention, 1951. Environmental references are absent from this definition.



CHAPTER 2

Nonetheless, some progress has been made on this issue as demonstrated in the 'enhanced action on adaptation' text of the agreement of the UNFCCC COP 16 in Cancun. The text invites Parties to enhance action on adaptation by undertaking measures for understanding, coordination and cooperation with regard to climate change-induced displacement, migration and planned relocation at the national, regional and international levels.[15]

The way forward for policy: Address poverty

Climate change as a policy area may be relatively recent, but most of the issues presented in this chapter represent long-standing challenges for states and the international community. It follows that policies focusing on the climate change-migration nexus must be accompanied by renewed efforts to combat the context that makes people vulnerable in the first place — that of poverty.

In general, the impacts and responses to climate change should be evaluated and integrated into poverty reduction strategy papers and conflict reduction strategies. Policy-makers need to recognise that sustainable adaptation measures must be context specific, and that policy responses need to integrate the participation of local stakeholders and use community-focused approaches. Development policies addressing the potential migratory impacts of climate change should stress coping capacities, adaptation and sustainability. Development and poverty reduction programmes and projects should incorporate resilience elements in its strategies[16].

Additional Resources

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13. IOM Migration Research Series No. 33 (2008) "Climate Change and Migration: Improving Methodologies to Estimate Flows".

15 UNFCCC. Cancun Adaptation Framework. Paragraph 14f, 2010.

16 Forced Migration Online. Environmentally displaced people: understanding the linkages between environmental change, livelihoods and forced migration. http://repository.forcedmigration.org/show_metadata.jsp?pid=fmo:4960

2.2 Poverty - Why are the world's poorest the most vulnerable?

One can find people living in poverty in both developed and developing countries, among the young and old, among women and men. Depending on which combination of the above characteristics applies, the vulnerability of a person or community to climate change is quite varied. Common to all, however, is the fact that the impacts of climate change will make the lives of people living in poverty more difficult.

The international community has been working to address poverty for several decades now, and has created the Millennium Development Goals framework to drive the process forward. Achieving these goals will also help to alleviate some of the future suffering that climate change will levy on the world's poorest citizens. As with strategies and actions to address poverty, the strategies to address climate change impacts must also take into account the characteristics of people living in poverty listed above — there is no 'silver bullet' solution adequate to address all the diverse groups at once. Tailored approaches to local situations, gender and age differences are needed.

Who can be considered a person living in poverty?

At the UN's World Summit for Social Development (1995), the Copenhagen Declaration described poverty as "a condition characterised by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information." When people are unable to eat, go to school, or have any access to health care, then they can be considered to be in poverty, regardless of their income.

Different capacities to cope

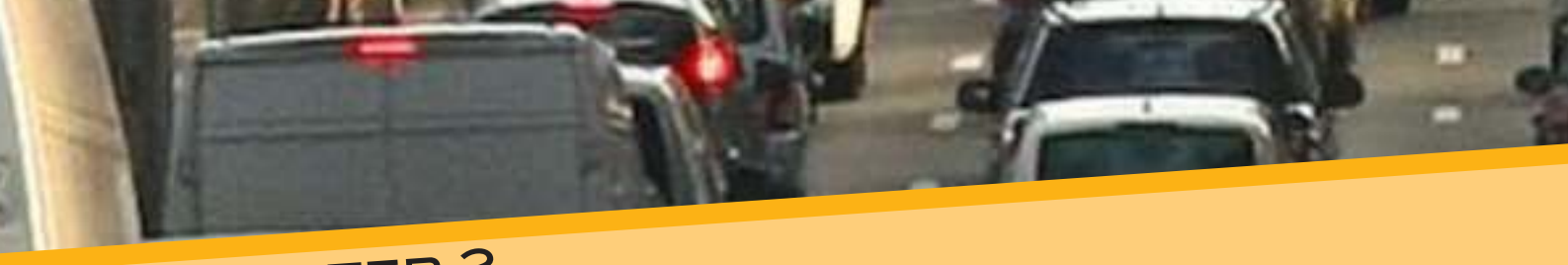
The capacity of a country or region to successfully cope with climate change is highly dependent on its level of economic and human development. Disparities in development worldwide mean that countries are affected unequally by climate change impacts. According to the Fourth Assessment Report of the IPCC (2007), developing countries are expected to suffer most from the negative impacts of climate change. Asia, Africa and many Small Island Developing States would be more vulnerable due to projected changes in annual average river runoff and water availability, decreases in crop productivity in dry and tropical regions, exposure of coastal areas to cyclones, storm surges, erosion, coastal subsidence and sea level rise (see 'The Case...' text box). Hence, the countries with the fewest resources are likely to bear the greatest burden of climate change in terms of loss of life and their related impacts on investment and the economy. Often, extreme weather events set back the development process for decades.

Even though developing countries are predicted to face the most severe impacts of climate change, they are less prepared and thus less able to confront the challenges than developed countries. For example, climate change-related weather disasters (e.g. floods, cyclones) are likely to cause substantial loss of life in developing countries, in particular amongst the most vulnerable populations who often dwell in precarious geographic areas and in sub-standard dwellings. The institutional capacity

The Case of Bangladesh

The case of Bangladesh is a good illustration of a society severely affected by climate change. The country has a low-lying coastline, high population density and an economy highly dependent on agriculture. Frequent cyclones and their associated effects, such as saltwater intrusion, render agricultural lands unproductive and threaten the lives and livelihoods of Bangladesh's people. In addition, the country frequently experiences major floods. In 1998, about 68% of the country's geographical area was flooded, affecting more than 30 million people. These climatic events have generated a significant loss of human life, reduced access to safe drinking water, and have had a negative impact on food security.

From **Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation** (see reference at the end of the chapter).



to successfully deal with such weather events is comparatively low. Indeed, over 96% of disaster-related deaths in recent years have taken place in developing countries.[17]

Developing countries are less prepared to cope with sea level rise, water shortages, increased extreme events, or the negative effects on agriculture resulting from climate change. All of these impacts put increased pressure on the capacities of the governments of those countries.

Why does climate change more severely affect the lives and livelihoods of poor populations in the developing world?

A combination of circumstances

People living in poverty usually lack the natural, social, human, and physical assets or resources, and also face limited access to financial resources that would allow them to better cope with rapidly changing conditions that have a detrimental impact on their lives and livelihoods. When living in poverty is coupled with living in a developing country, there may also be inadequate institutional capacity to cope with any rapidly changing conditions that affect the country's environmental, economic and social stability. That is to say, the government of a developed country can likely help the poorest of its affected population get back on their feet after a hurricane or flood. A developing country's government is not usually in the same position.

Physical location

Many of the world's poorest populations live in and around marginal land such as deserts, flood plains, and low-lying areas. Living in these environments renders them vulnerable to precarious environmental, geographical, socio-economic, institutional and political living conditions, even before considering climate change-induced threats. Extreme weather events are more likely to have a detrimental effect on their already precarious lives.

Lack of livelihood diversification

Changes in longer-term climatic conditions, such as an increase in mean temperature and the occurrence of frequent and more intense droughts, also have heightened negative effects on people living in poverty. In areas where livelihood choices are limited, a temperature rise can reduce the availability of drinking water sources, threatening the lives of populations and their livestock, which also frequently constitute the basis of their livelihood. Severe droughts reduce crop yields and can trigger famines. During such periods, people may be compelled to sell physical assets such as land and farming implements, undermining the sustainability of their livelihoods over the longer term. This threat is greatest in Africa, Asia and Latin America. Reduced access to drinking water and the threat to food security are therefore two of the main concerns relating to the impact of climate change on poverty.

<<Women form the majority of the poor in the world who rely on the environment, particularly to meet household energy, water and nutrition needs. For more details on gender, poverty and climate change, see section 2.4.>>

The urban poor

The urban poor are among the most vulnerable to climate change impacts for many reasons:

- greater exposure to hazards (e.g. through living in makeshift housing on unsafe sites and areas with high vulnerability to landslides and extreme weather events)
- lack of hazard-reducing infrastructure (e.g. drainage systems, roads allowing emergency vehicle access)
- less adaptive capacity (e.g. the ability to move to better quality housing or less dangerous sites)
- less state provision for assistance in the event of a disaster (indeed, state action may increase exposure to hazards by limiting access to safe sites for housing)
- less legal and financial protection (e.g. a lack of legal tenure for housing sites, lack of assets, and insurance)
- less income diversification options.

17 Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation, African Development Bank, Asian Development Bank, DfID (United Kingdom), Directorate-General for Development (European Commission), Federal Ministry for Economic Cooperation and Development (Germany), Ministry of Foreign Affairs Development Cooperation (The Netherlands), OECD, UNDP, UNEP, The World Bank, 2003. http://siteresources.worldbank.org/INTCC/817372-1115381292846/20480623/PovertyAndClimateChangeReportPart12003.pdf

Impacts on the urban poor include:

- direct impacts such as more frequent and more hazardous floods;
- less direct impacts such as the reduced availability of freshwater supplies available to poorer groups;
- indirect impacts such as climate change-related weather events that increase food prices or damage poorer households' asset bases.[18]

How can we tackle poverty and climate change?

The importance of mainstreaming adaptation in poverty reduction programmes

Climate change is already compromising the abilities and efforts of developing countries to reduce poverty. Climate change and poverty cannot be addressed separately — actions need to be comprehensive and embrace both issues considering, in particular, the impacts on agriculture, water resources, waterborne disease patterns and prevalence, and infrastructure.

Strengthening the adaptive capacity of governments, communities and households to climate change impacts is vital to decreasing the impact on vulnerable populations and increasing their resilience. A poverty-reduction strategy should increase the resilience of livelihoods, assets, and infrastructure. However, such a strategy should incorporate existing knowledge and coping strategies of vulnerable populations and should be designed with the targeted communities' participation, allowing them to have access to climate information. Social inequities can affect such access and hinder the adoption of an appropriate adaptation strategy.

From a human rights perspective, the identification of the proportion of poor people in the population is not sufficient. It is necessary to identify specific groups — in terms of various characteristics such as gender, geographical location, ethnicity, religion, age or occupation — in which poverty is entrenched, so that the problem of poverty can be addressed at as disaggregated a level as possible (see 'Disaggregated data...' text box). Second, special efforts must be made to identify those among the poor who are particularly deprived and vulnerable to climate change effects. When resource constraints call for the setting of priorities, it is the entitlement of these groups that should receive prior attention. This is necessary for the sake of equality, which is an essential principle of the human rights approach. Moreover, knowledge on how climate change affects vulnerable populations is crucial for successful planning, implementation and evaluation of low-carbon and climate-resilient poverty reduction and development strategies.

18 Ibid.

Climate change and the Millennium Development Goals (MDGs)

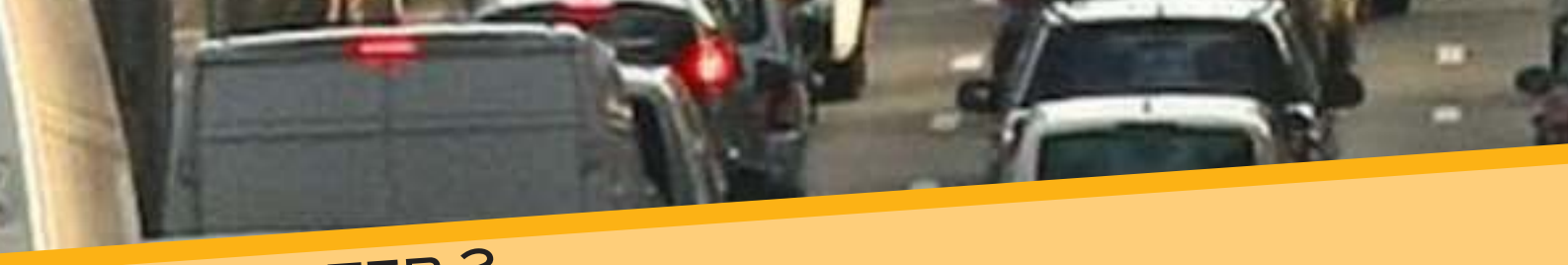
One of the core initiatives created by the international community to address poverty is known as the Millennium Development Goals (MDGs). The MDGs were launched on September 2000 by the leaders of 189 nations at the United Nations General Assembly (see MDG text box, next page).

The first goal (MDG1) aims to eradicate extreme poverty and hunger. Agricultural production and food security, access to clean and abundant water resources and gainful employment that underpin the solution to extreme poverty and hunger are vulnerable to climate change.

Disaggregated data in poverty reduction strategies: A need for 'climate sensitive' policies

Precise and disaggregated information is still required to monitor the success or inadequacy of development or poverty reduction strategies and how climate change is affecting vulnerable populations. Still, in the case of Latin America very few MDG Reports provided disaggregated data showing disparities and situations affecting, for instance, rural and coastal communities and indigenous peoples who can be severely affected by climate change.

As noteworthy exceptions, Mexico and Bolivia have national offices of statistics that collect official disaggregated data. In Mexico, for example, United Nations agencies are able to use disaggregated data because national censuses contain questions related to ethnic belonging and language. In Bolivia, efforts are made at the national level to disaggregate data collected in the census by asking questions related to the language spoken and self-identification as indigenous. However more substantive research is needed in order to use the collected disaggregated data and properly address poverty in the context of climate change.



CHAPTER 2

Millennium Development Goals

MDG1: Eradicate extreme poverty and hunger
Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than$1 a day.

Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger.

MDG2: Achieve universal primary education
Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.

MDG3: Promote gender equality and empower women
Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015.

MDG4: Reduce child mortality
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate.

MDG5: Improve maternal health
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio.

MDG6: Combat HIV/AIDS, malaria and other diseases
Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS.

Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.

MDG7: Ensure environmental sustainability
Target 9: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources.

Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation.

Target 11: Have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers.

MDG8: A global partnership for development
Target 12. Develop further an open, rule-based, predictable, nondiscriminatory trading and financial system (includes a commitment to good governance, development, and poverty reduction?both nationally and internationally).

Target 13. Address the special needs of the Least Developed Countries (includes tariff- and quota-free access for Least Developed Countries' exports, enhanced program of debt relief for heavily indebted poor countries [HIPCs] and cancellation of official bilateral debt, and more generous official development assistance for countries committed to poverty reduction).

Target 14. Address the special needs of landlocked developing countries and small island developing states (through the Program of Action for the Sustainable Development of Small Island Developing States and 22nd General Assembly provisions).

Target 15. Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term.

MDG2 - 'Achieve universal primary education' — is linked to the impacts of climate change in that climate change stresses pose additional burdens on agricultural production and other subsistence activities like water collection, which may burden families enough to remove children from school. Livelihood activities must become more resilient to future climate for education goals to be met. Climate change also threatens to destroy infrastructure, force temporary closure (e.g. schools) and increase the displacement and migration of families, thus disrupting and limiting education opportunities.

Climate change is also linked to MDG7, 'Ensure Environmental Sustainability'. Climate change threatens environmental sustainability because it will cause fundamental alterations in ecosystem relationships, change the quality and quantity of available natural resources, and reduce ecosystem productivity. The poor depend on these resources for their day-to-day survival and livelihoods in many parts of the developing world.

The impact of climate change on access to safe drinking water and the loss of environmental resources due to climate phenomena, such as salinity intrusion, droughts, and floods, are closely linked to MDG7. Furthermore, climate change not only affects the attainment of MDG1, MDG2 and MDG7, but is also linked to other MDGs associated with health, food security, human rights, governance and gender equality.

Additional Resources

1. Annual Report of the United Nations High Commissioner for Human Rights and Reports of the Office of the High Commissioner and The Secretary-General Report of the Office of the United Nations High Commissioner for Human Rights on the relationship between climate change and human rights, A/HRC/10/61, 15 January 2009.
2. Biodiversity Conservation and Response to Climate Change Variability at the Community Level, IUCN, UNEP, UNU, 2009.
3. Climate Change Adaptation: Enabling people living in poverty to adapt, K. Pettengell, Oxfam Research Report, 2010.
4. The Costs to Developing Countries of Adapting to Climate Change: New Methods and Estimates / The Global Report of the Economics

of Adaptation to Climate Change Study (Consultation Draft), The World Bank, 2010.

5. Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: Impacts, Adaptation and Vulnerability, UNEP, GRID Arendal, 2001.
6. Poverty and Climate Change: Assessing Impacts in Developing Countries and the Initiatives of the International Community, C. McGuigan, R. Reynolds and D. Wiedmer, London School of Economics (Consultancy project for the Overseas Development Institute), 2002.
7. Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation, African Development Bank, Asian Development Bank, DfID (United Kingdom), Directorate-General for Development (European Commission), Federal Ministry for Economic Cooperation and Development (Germany), Ministry of Foreign Affairs Development Cooperation (The Netherlands), OECD, UNDP, UNEP, The World Bank, 2003.

2.3 Health - Will climate change make you sick?

Researchers have long observed the close links between climate and human health. There was consequently little surprise when the scientific community concluded that changes to the global climate would affect the fundamental requirements for good health everywhere: clean air, safe drinking water, sufficient food and secure shelter.

Climate change is already having a negative effect on health worldwide. The World Health Organization (WHO) estimated that global warming between the 1970s and 2004 has caused over 140,000 additional deaths annually,[19] and is making serious infectious diseases like malaria and diarrhea more challenging to control. These trends are likely to worsen in the near future, regardless of current efforts to cut greenhouse gas (GHG) emissions and mitigate climate change.[20] Depending on the specific area affected, a warmer and more variable climate is also likely to increase the frequency and intensity of heat waves, elevate the levels of some air pollutants, increase transmission of diseases through contaminated water and food, compromise agricultural production, and increase the hazards of extreme weather events. The threats that climate change

19 Global health risks: Mortality and burden of disease attributable to selected major risks. WHO, 2009.
20 Climate and health factsheet. WHO, 2005.

TABLE 2

POTENTIAL HEALTH CONCERNS CAUSED BY CLIMATE CHANGE

Weather Events	Impacts on Human Health
Warm spells, heat waves and stagnant air masses	• Heat stroke, affecting mainly children and the elderly • Increase in respiratory diseases • Cardiovascular illnesses
Warmer temperatures and disturbed rainfall patterns	• More exposure to vector-borne diseases like malaria, Japanese encephalitis and other diseases carried by vectors such as mosquitoes, rodents and ticks
Heavy precipitation events	• Increased risk of diseases related to contaminated water (water-borne) and to unsafe food (food-borne). Depletion of safe water supplies and poor sanitation will increase the incidence of diarrhoeal diseases such as cholera.
Droughts	• Malnutrition and starvation particularly affecting children's growth and development. • Reduced crop yields causing stress for farmers and their families (known as "psychosocial stress"), who may be unable to pay their debts during extended and repeated droughts.
Intense weather events (cyclones, storms)	• Loss of life, injuries, life-long handicaps. • Damaged public health infrastructure such as health centers, hospitals and clinics. • Loss of life, property and land, displacement and forced migration due to disasters will bring about psychosocial stress affecting mental health.
Sea level rise and coastal storms	• Loss of livelihoods and disappearance of land will trigger massive migration and cause potential social conflicts, affecting mental health.

poses to health may vary in different places and across time. For example, cities that periodically suffer from heat spells could expect more intense heatwaves, while areas prone to malaria could experience an increase in outbreaks. Table 1 lists some of the most likely health concerns caused by climate change.

<<Climate change health impacts affect men and women differently. See section 2.4 for more details.>>

Unfair distribution of risks

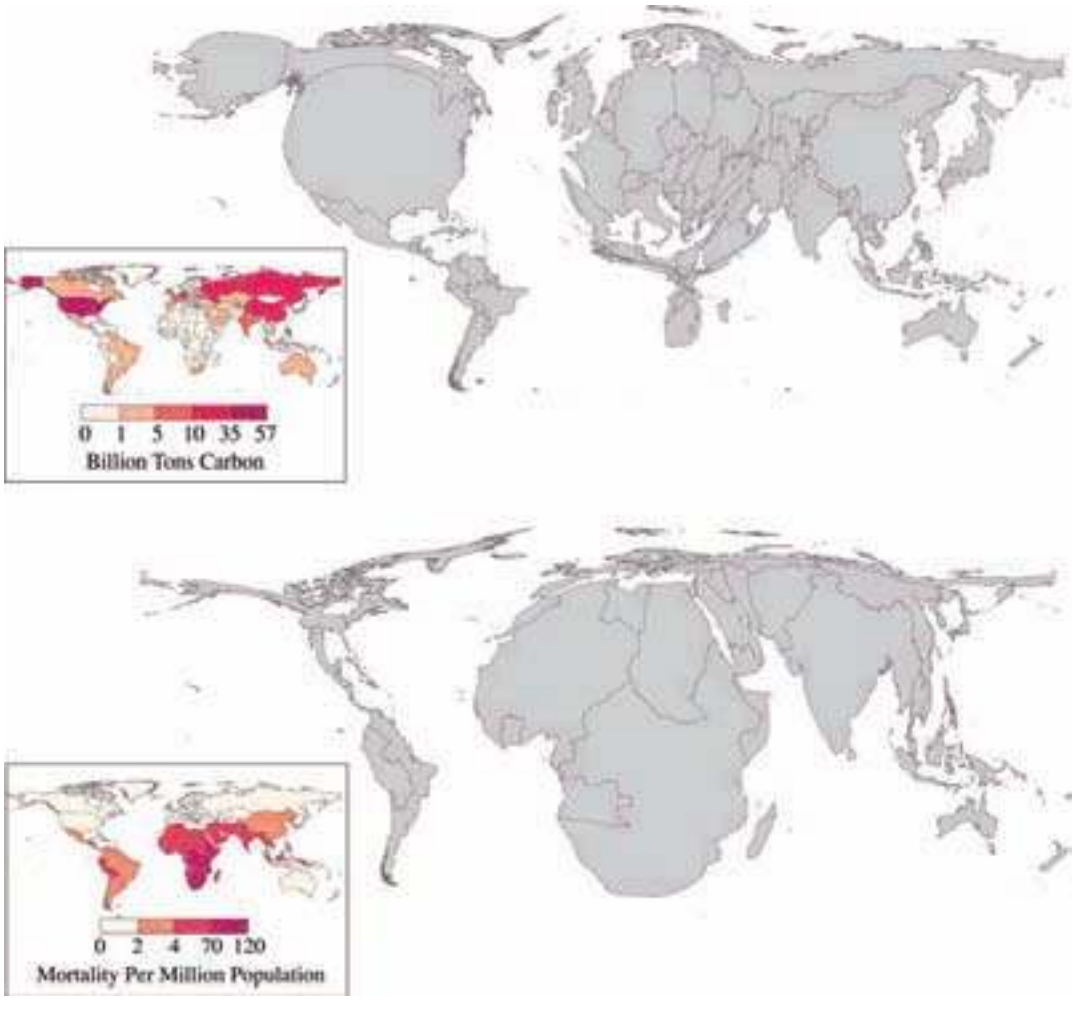
As with other foreseeable climate change impacts, the potential negative effects of climate change on health are also unfairly distributed, affecting mainly the world's poorest countries, social groups and individuals. People living in small island developing states (SIDS) and other coastal regions, megacities, and mountainous and polar regions are particularly vulnerable. Health systems and populations in these regions as well as in the developing countries will have to adapt to new climate conditions and cope with additional needs ranging from injuries and non-communicable conditions to food-borne, water-borne and vector-borne infectious diseases. Areas with weak health infrastructure — mostly in developing countries — will be the least able to cope (see Figure 16).

Additional resources

1. Climate and health factsheet. World Health Organization (WHO), 2005. http://www.who.int/globalchange/publications/factsheets/fsclimandhealth/en/index.html

FIGURE 16

HIGH EMISSION COUNTRIES VS. HIGH HEALTH IMPACT COUNTRIES



Patz, Jonathan et al. Climate Change and Global Health: Quantifying a Growing Ethical Crisis, as published in EcoHealth 4, 397–405, 2007.

2. Fourth Assessment Report, Intergovernmental Panel on Climate Change, Working Group II, Section 8 (human health). http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch8.html
3. Global health risks: Mortality and burden of disease attributable to selected major risks. WHO, 2009. http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf
4. Protecting health from climate change. Messages to different groups and sectors (Young people, 16—24 years old). WHO, 2008. http://www.who.int/globalchange/publications/factsheets/WHD2008_young_people_2.pdf
5. WHO Manual for Students (South Asia Regional Office). http://www.searo.who.int/LinkFiles/World_Health_Day_2008_Toolkit-Student-Manual.pdf
6. WHO Manual for Teachers (South Asia Regional Office). http://www.searo.who.int/LinkFiles/World_Health_Day_2008_TeacherManual.pdf
7. WHO portal on climate change and health. http://www.who.int/globalchange/en/

2.4 Gender - Are men and women equally affected?

What is gender?

The concept of gender describes the roles and responsibilities of women and men that are created in our families, societies and cultures. It also includes the expectations held about the characteristics, aptitudes and likely behaviours of both women and men, referred to as femininity and masculinity.[21]

Gender roles and expectations are learned. They can change over time and vary within and between cultures. Gender roles are neither biologically predetermined nor immutable.

Women and girls are not vulnerable because they are 'naturally weaker' — they are more vulnerable and face different vulnerabilities due to their specific social roles.

21 UNESCO Gender Mainstreaming Implementation Framework 2002—2007, UNESCO, 2003.

The links between gender and climate change

An examination of the historic gender-poverty interrelationship reveals how lack of access to education, health, water, sanitation, food, and exposure to HIV results in differing vulnerabilities and adaptive capacities of men and women towards impacts of climate change, disasters, and poor environmental management.

Climate change tends to exacerbate these differences, and places a larger burden on women and girls. This reinforcing interrelationship therefore increases the effects of climate change on women in several ways as described below.

Migration

Environmentally displaced women who migrate in search of a job will face challenges of finding employment, housing and appropriate social services, but with the added impairment of gender discrimination. Another possible scenario is in rural, agriculture-dependent households, where the male breadwinner may migrate to the city for work as a result of limited resources. In the absence of the male partner, women may experience greater autonomy and have enhanced decision-making power if they become de facto heads of household. However, this is not always the case. For example, in many regions of Bangladesh and Pakistan, women may not be able to take major decisions that affect their families without permission from a male family member.

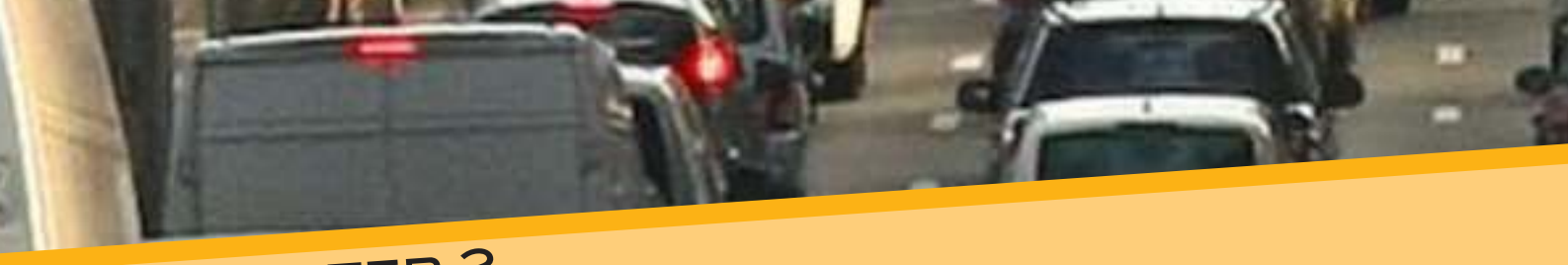
Climate change-induced disasters

A 2007 study[22] analysed disaster events in 141 countries and found that more women than men die from disasters when women's economic and social rights are not protected. In societies where both genders enjoy equal rights, disaster-related casualty statistics are similar among women and men[23] (see 'Limited Access...' text box, next page).

Agriculture

The management and use of natural resources can differ between women and men. For example, women and girls in rural areas of developing countries bear much of the responsibility of basic food production — an activity highly vulnerable to events linked to climate change such as drought

22 The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981—2002, E. Neumayer and T. Plümper, 2007.
23 Training Manual on Gender and Climate Change, IUCN, UNDP, GGCA, 2009.



or flood. As a consequence, these female farmers face significant risks for the security of their food production and thus their capacity to survive.[24] Thus, a loss of natural resources as a result of climate change greatly affects women and girls and has the potential to increase gender inequalities (see Figure 17).

Water

Women and men have different roles and bear different responsibilities regarding water, defined by their sex, age, traditions, religion, beliefs and customary laws. In most of the regions of the world, women and girls bear the responsibility of ensuring that there is sufficient water for daily domestic chores (drinking, cooking, cleaning, plant irrigation, etc.), and spend a significant amount of time collecting and using water. In areas affected by drought, desertification or erratic rainfall, the collection of water is especially burdensome and time-consuming, leaving less time for women and girls to engage in other activities such as education (see Figure 18). In 2007, young girls accounted for 54 per cent of the global out-of-school population, partly due to their responsibility for finding water for household use.[25]

Limited Access to Information in Disaster Situations is Deadly

It was demonstrated that in the 1991 cyclone disasters in Bangladesh, 90 per cent of the 140,000 people who died were women. Bangladesh society is highly sex-segregated and, in this particular case, early warning signals did not reach large numbers of women as the information was passed through market places to which many women do not have easy access.

From: Training Manual on Gender and Climate Change, (see reference at the end of this section).

Health

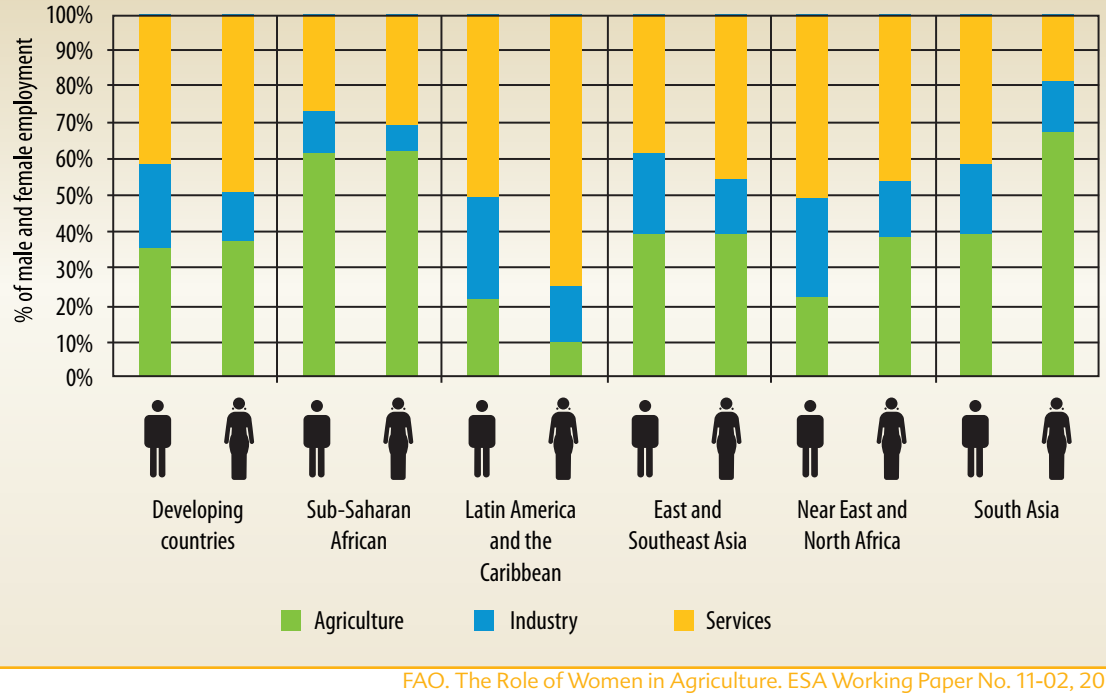
One key variable in determining direct and indirect impacts of climate change on health is gender. For example, studies have shown that women's and men's health risks differ during heat waves, due to both social and physiological

24 Resource Guide on Gender and Climate Change, UNDP, 2009.

25 Education for All Global Monitoring Report, UNESCO, 2010.

FIGURE 17

DISTRIBUTION OF MALE AND FEMALE EMPLOYMENT, BY SECTOR



FAO. The Role of Women in Agriculture. ESA Working Paper No. 11-02, 2011.

reasons. Socially-constructed gender roles also often render women more vulnerable than men during natural disasters, leading to higher mortality and morbidity rates. This is exacerbated in countries where women have lower education, awareness, and socioeconomic status compared with men, which limits their mobility and access to information.[26]

Consider also that women are the primary caregivers to the sick. When the health impact of climate change leads to increased levels of water-borne and vector-borne diseases, women will be called upon more frequently to tend to the sick. Again, this will leave less time for the other activities for which women are responsible, adding to their stress and workload.

Alleviating the negative impacts of climate change on women and girls

It is important to see women and girls not only as victims of climate change, but also as powerful agents of change. Supporting women and girls in the management of climate change risks is essential to limiting these risks and their impacts.

Possible solutions include:

- increasing the asset base of women to enable them to cope better with the consequences of climate change;
- improving access to education, skills, training and knowledge for women and girls to better and more effectively inform them of the risks associated with climate change; and
- developing specific strategies and responses for climate change disaster management and preparedness by factoring in the gender dimension as a key aspect of policies and programmes.

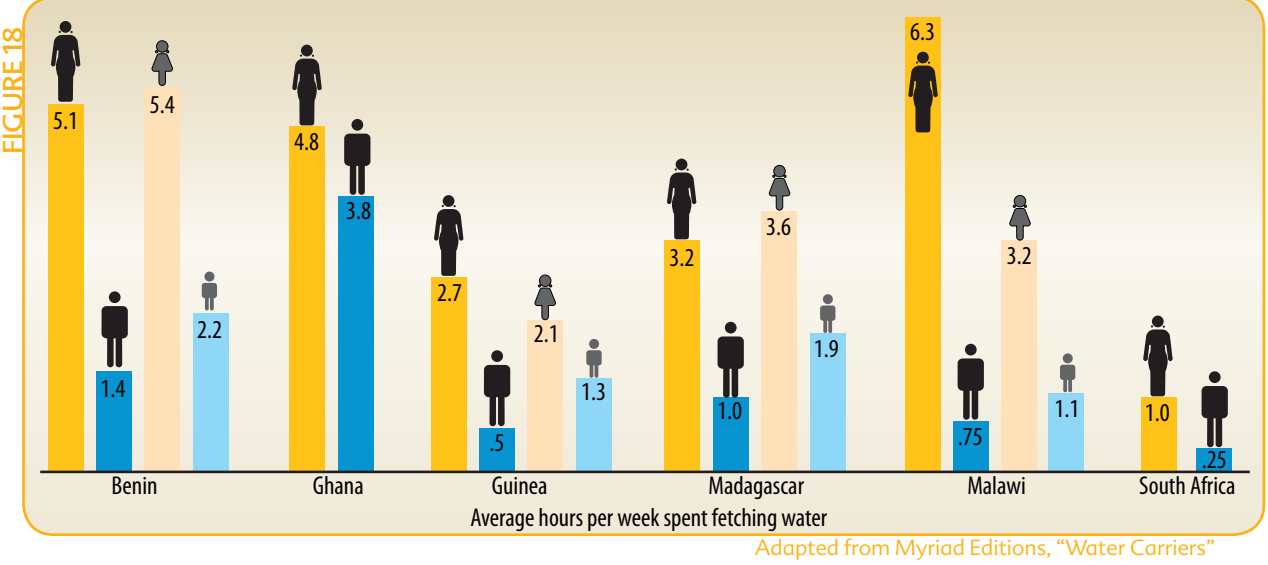
26 Bart W. Édes. Climate Change Impacts on Health and Migration. Asian Development Bank. Prepared Remarks for the Plenary Session on Vulnerability and Resilience in the Context of Climate Change Delhi Sustainable Development Summit, 5 February 2011.

Additional Resources

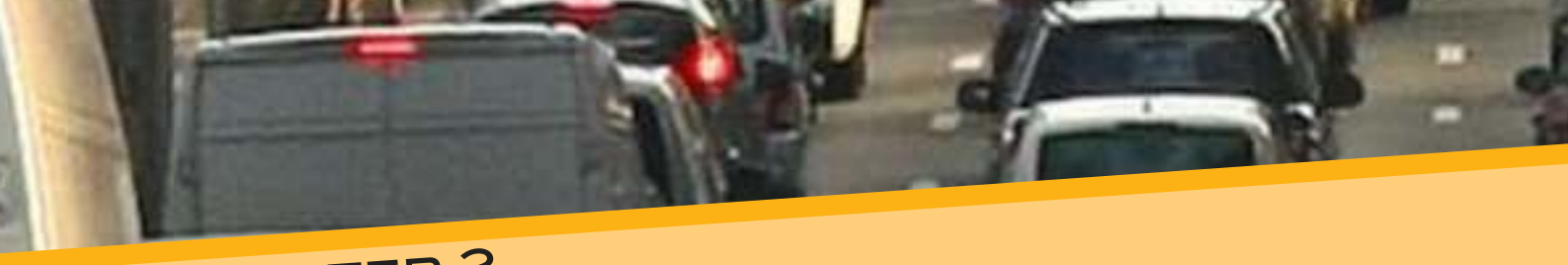
1. Resource Guide on Gender and Climate Change, UNDP, 2009. http://content.undp.org/go/cms-service/download/publication/?version=live&id=2087989
2. Training Manual on Gender and Climate Change, IUCN, UNDP, GGCA, 2009. http://www.gender-climate.org/pdfs/Training%20Manual%20on%20Gender%20and%20Climate%20Change.pdf
3. Gender, Climate Change and Community-based Adaptation, UNDP, 2010. http://www.beta.undp.org/undp/en/home/librarypage/womens-empowerment/gender-climate-change-and-community-based-adaptation.html
4. Women, Gender Equality and Climate Change, UN WomenWatch, 2009. http://www.un.org/womenwatch/feature/climate_change/downloads/Women_and_Climate_Change_Factsheet.pdf
5. Gender and Climate Forum, UNESCO, 2009. http://unesdoc.unesco.org/images/0018/001863/186309e.pdf

FIGURE 18

AVERAGE TIME SPENT FETCHING WATER (1998-2005)



Adapted from Myriad Editions, "Water Carriers"



6. Gender and Climate Change: Mapping the Linkages - A Scoping Study on Knowledge and Gaps, BRIDGE , 2008. http://www.bridge.ids.ac.uk/reports/Climate_Change_DFID.pdf

7. Education for All Global Monitoring Report, UNESCO, 2010. http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/efareport/reports/2010-marginalization/

8. Gender differences in human loss and vulnerability in natural disasters: A case study from Bangladesh, K. Ikeda, Indian Journal of Gender Studies, 2(2), 171–93, 1995.

9. UNESCO Gender Mainstreaming Implementation Framework 2002–2007, UNESCO, 2003. http://unesdoc.unesco.org/images/0013/001318/131854e.pdf

10. The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981–2002, E. Neumayer and T. Plümper, 2007.

2.5 Ethics - Who is responsible, and for what?

The best climate models currently available predict that the negative impacts of climate change, in spite of all mitigation efforts, will directly affect hundreds of millions of people within the 100 next years.[27] Taking into account the limitations of our scientific knowledge and the presence of irreducible uncertainties, this finding confronts humanity with the choice of whether to (a) develop an ethical approach to the analysis of and response to global climate change effects on people's lifestyles, choices and interactions with ecosystems, or (b) wait and hope for scientific and technological solutions, effectively ignoring the growing conflict between humans, their lifestyles and the resulting impact on the biosphere.

Ethics and climate change impacts

We have described in previous sections that global climate change imposes many challenges, including:

- threats to the lives of people, animals, and global and local ecosystems;
- disrupted livelihoods and food systems due to extreme weather events;
- health impact from migrating disease vectors caused by the displacement of insect pools;
- disappearance of unique cultural heritage and traditional ways of living.

The present and future occurrence of climate events or processes and the potential for a growing number of environmental migrants[28] whose lives are uprooted raise many ethical issues.

Who should be responsible for hosting people when the impacts of a disaster are widespread, for example, covering a whole country? A state may have all or part of its infrastructure undermined and be unable to help its own populations. Should neighbouring countries, or the entire international community shoulder the responsibility? Or should responsibility lie with those countries which have historically been the largest emitters of GHGs? Even more broadly, who should pay? And how should the burden of cost be distributed — amongst governments or private actors? Additionally, are we, as intellectual beings, also responsible to protect the animals and other species living on this planet since our activities provide the key to their survival or extinction?

These issues are complex, particularly due to the different underlying justice claims involved (often overlapping and conflicting), and can have corrective and substantive distributional dimensions or procedural and formal ones. A second factor is that climate change harms are very difficult to transfer in international law, which often appears powerless to cover climate cases in spite of existing established principles, in particular the responsibility for states 'to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction'.[29]

Existing normative instruments, such as the principle of common but differentiated

27 The Ethical Implications of Global Climate Change, World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), UNESCO, 2010. p. 12

28 The use of specific terminology may have strong repercussions regarding international law coverage. The term refugees provides better cover under international law; the term migrants is less covered. For more details on this topic see Migration and Climate Change, No. 31. IOM, 2008.

29 Cf. UNFCCC preamble, Principle 21 of the Stockholm Declaration (1972); Principle 2 of the Rio Declaration on Environment and Development (1992); and Article 3 of the Convention on Biological Diversity (1993).

responsibilities[30], need to be further explored to see if they are sufficient to articulate appropriate policy responses in real-life situations. Because the spectre of mass migration is growing with climate change, the risks have to be anticipated both at local and global levels, notably with regard to questions of justice and human rights.[31]

In the meantime, in addition to examining and analysing the ethical and societal implications of climate events or processes, it is important to act on adaptation and mitigation of climate change. This in itself is a way to limit many climate threats — and therefore their harmful consequences.

Ethics and climate change solutions

When examining possible responses to address greenhouse gas emissions, there are important ethical issues to address, as the following case demonstrates.

30 This principle, the seventh proclaimed in the Rio Declaration, was laid out narrowly in Article 3 of the UNFCCC. Unlike formal law, it incorporates issues of equity through the idea that substantive differences exist between equally sovereign states.

31 More details on that these topics can be found in Climate Change and Human Rights: A Rough Guide. International Council on Human Rights Policy, 2008. http://www.ichrp.org/files/reports/45/136_report.pdf

Geo-engineering

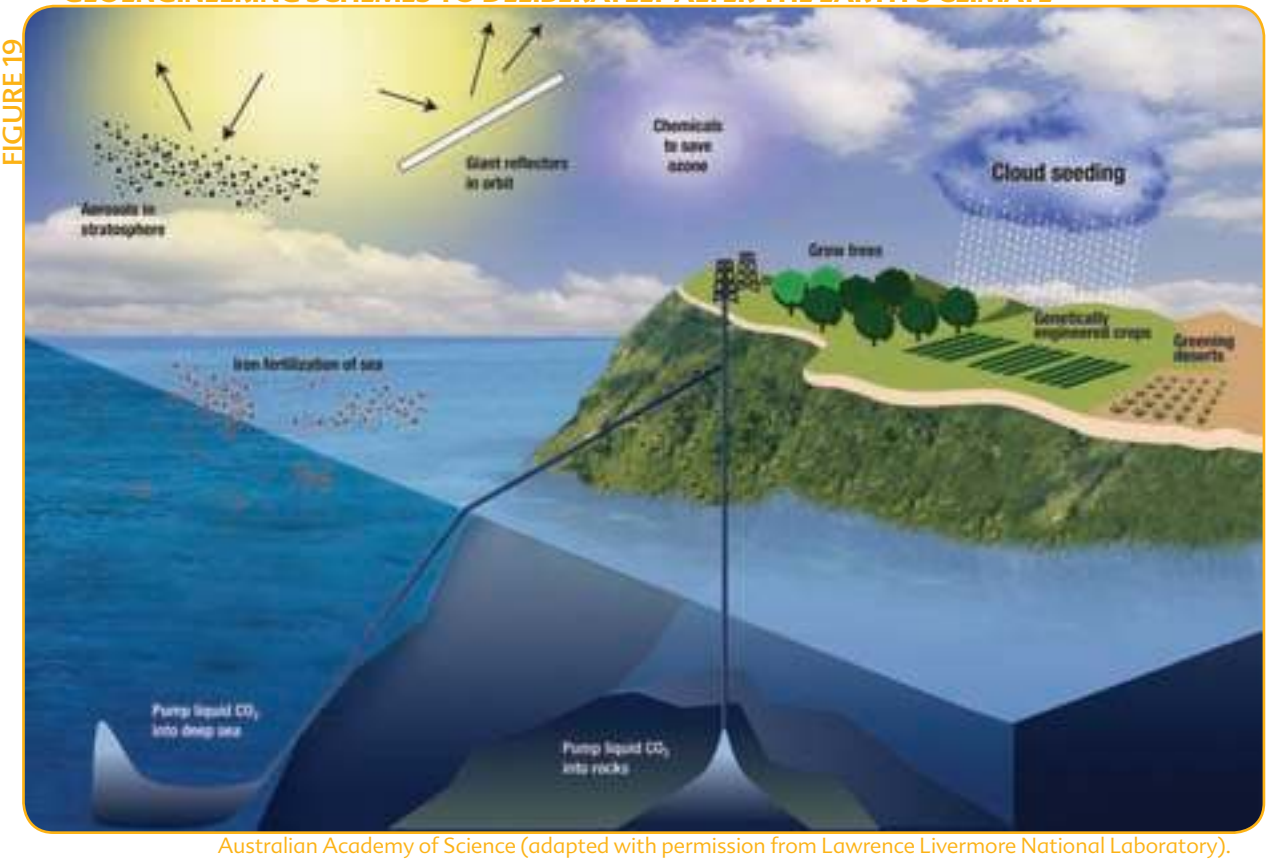
Geo-engineering involves the intentional manipulation of the global environment to limit global warming. Several techniques are under examination and experimentation (see Figure 19):

- the fertilization of oceans with iron to encourage the growth of plankton, which uses CO_2 from the atmosphere to produce organic matter. The resultant organic matter is also seen as a means to increase fish production and thus support the growing global population.
- Carbon Dioxide Removal (CDR), which typically involves CO_2 capture at point sources such as power plants and then sequestration underground.
- Solar Radiation Management (SRM) where large and long-time dissemination of particles in the stratosphere lead to cooling of the atmosphere by blocking incoming solar radiation.

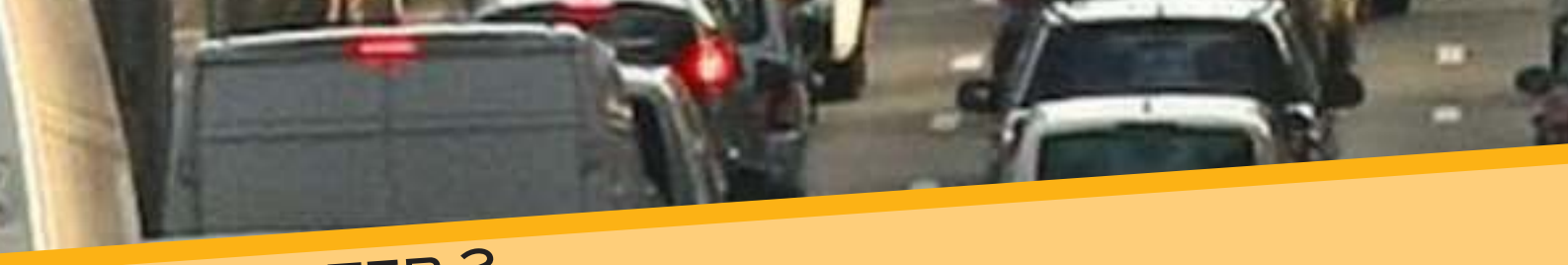
These techniques could be perceived as unethical insomuch as their successful application can be used to justify inaction on the human causes of climate change. Moreover, alterations of global systems like the atmosphere or oceans may engender irreversible effects and unknown consequences for life and ecosystems.

FIGURE 19

GEOENGINEERING SCHEMES TO DELIBERATELY ALTER THE EARTH'S CLIMATE



Australian Academy of Science (adapted with permission from Lawrence Livermore National Laboratory).



CHAPTER 2

Indirect ethical paths to overcoming ethical dilemmas

Even though agreement on how to cope with climate change is debated and decided largely at the international level, ethical approaches at the local level are crucial. In particular, ethical aims such as health or the satisfaction of basic human needs can help to focus attention on sustainable development patterns.[32] For example, an indirect ethical approach would be to prioritize enabling access to energy for all. Such approaches can drive solutions with positive consequences concerning climate change, leading to immediate implementation and social benefits. Indirect ethical paths tend to prove their efficiency by the fact that they provide responses to concrete daily problems. Therefore, such solutions are more likely to be accepted by people being asked to alter their way of life, and help them, in turn, to obtain better conditions of well-being.

Education is a key factor in promoting ethical approaches at the local level. It plays a significant role in increasing long-term behaviour changes and promoting participation among the general public. As such, it contributes to enhancing bottom-up solutions to a global problem that cannot be addressed by 'elites'. As an example, children often learn about natural risks at school and then pass this information onto their parents (see Figure 20). This is typically the case in developing countries — when such programmes exist, but also occurs in developed states.[33] Adults, once informed, are more able to participate in civil society and to influence decision-making in areas that affect them, particularly at the local level.

Many other ethical discussions and principles[34] in relation to climate change can be approached by formal or informal education, with potentially strong outcomes in terms of giving rise to critical reflection. Viewing climate change in ethical terms underlines the point that everyone's behaviour counts and contributes, even indirectly,

32 The right to development recognized by the Millennium Development Goals tends to provide a relevant framework to achieving human rights. This point of view has to be nuanced by the fact that some countries reject the broader concept of development as a culturally Occidental-biased notion.

33 Education also contributes in developing countries to saving lives by simply teaching children and women to swim or perform certain emergency procedures in the event of floods or other natural disasters.

34 For exploratory purposes, other important principles in relation to climate change can be quoted here: the principle of equitable access to medical, scientific and technological developments with the sharing of knowledge and benefits; the principle of safeguarding and promoting the interests of the present and the future generations; the polluter pays principle; the precautionary principle.

FIGURE 20 CHILDREN CAN LEARN ABOUT RISKS AND BRING KNOWLEDGE HOME TO PARENTS

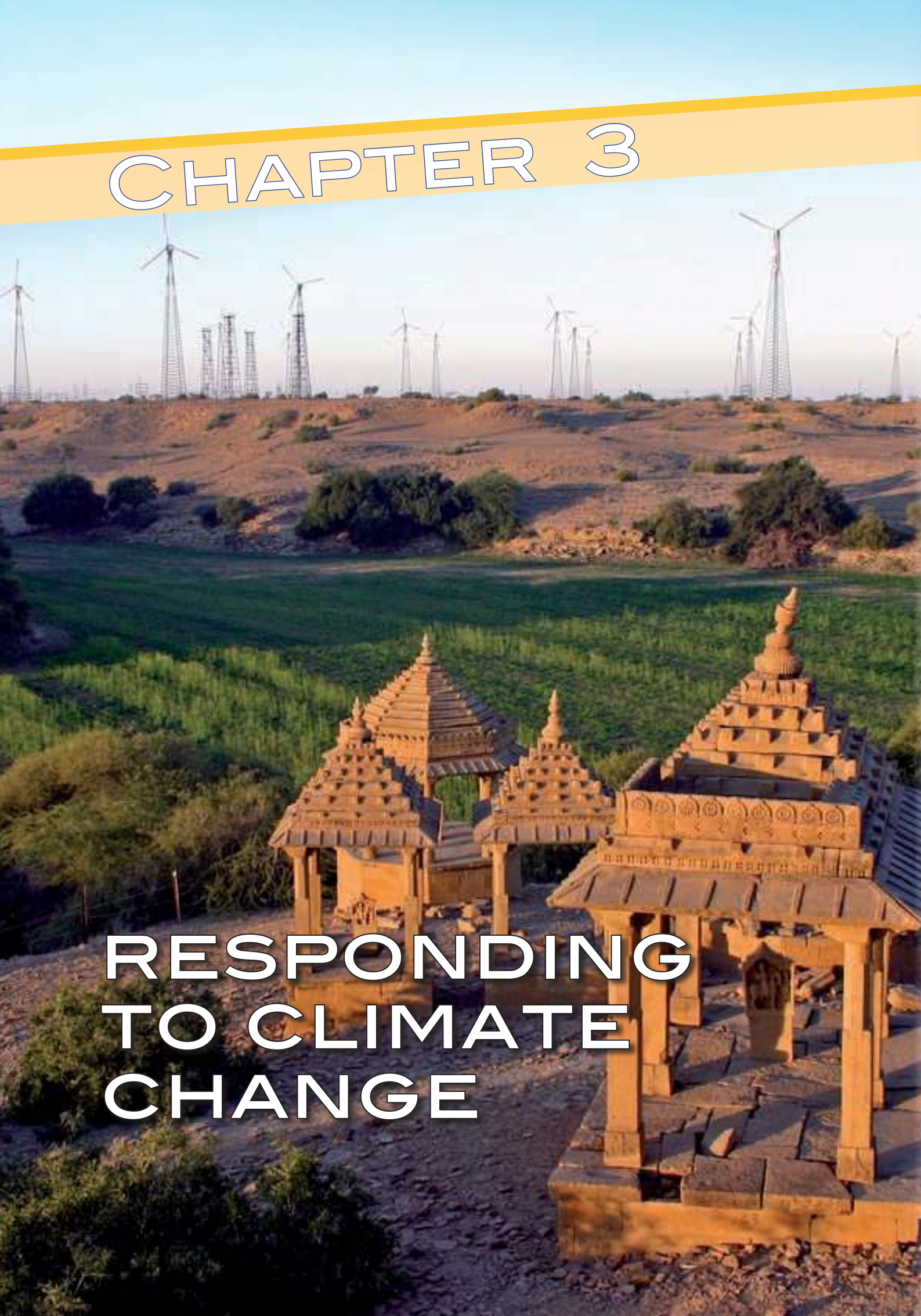
to influencing the trends of environmental and social systems. By thinking about and acting on our responsibilities, we share benefits within and among societies, but also between humans and plants, animals, ecosystems and the entire 'biotic community'.[35]

Additional Resources

1. The UNESCO climate change initiative: notably its Climate Change Education for Sustainable Development flagship programme and its research programme on the 'social, human, ethical and gender dimensions of climate change'. http://unesdoc.unesco.org/images/0018/001896/189620e.pdf
2. The Ethical Implications of Global Climate Change, World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), UNESCO, 2010.
3. Migration and Climate Change (No. 31), pp. 13–15, International Organisation for Migration, 2008. http://www.migrationdrc.org/publications/resource_guides/Migration_and_Climate_Change/MRS-31.pdf
4. Climate Change and Human Rights: A Rough Guide, International Council on Human Rights Policy, 2008. http://www.ichrp.org/files/reports/45/136_report.pdf
5. Environmental Education, Ethics and Action, UNEP, 2006. http://www.unep.org/training/downloads/PDFs/ethics_en.pdf

35 According to A. Leopold, (an American ecologist), 'a thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise', A Sand Country Almanach (1949).

Chapter 3



Responding to Climate Change

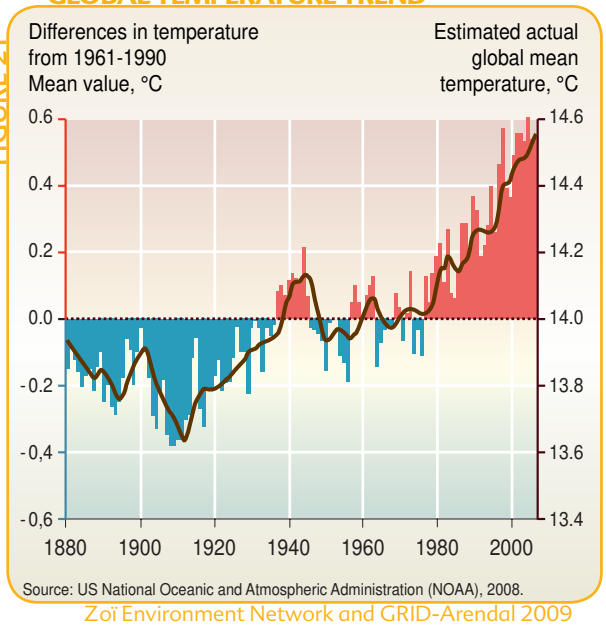
The observed increase of greenhouse gas (GHG) concentration since 1750 has most likely bound the world to a warming of 1.4 – 4.3 degrees Celsius above pre-industrial surface temperatures. Researchers suggest that 0.76 degrees Celsius of this committed warming has already occurred and that a further increase of 1.6 degrees Celsius will take place in the next fifty years and on throughout the twenty-first century (see Figure 21). Recent reports estimate a sea level rise of up to one metre occurring by the year 2100. Even with the most aggressive CO_2 mitigation efforts, further additions to warming can be limited but the associated climate change impacts to which we are already bound can no longer be reduced (see Figure 22).

The already observed and anticipated changes to the global climate necessitate a dual response strategy of mitigation and adaptation in order to address both the underlying causes and associated impacts. **Mitigation** actions seek to reduce the extent of climate change by reducing GHG emissions or increasing their removal from the atmosphere. More mitigation undertaken today means less adaptation will be necessary in the future. Insufficient mitigation now also increases the risk of catastrophic outcomes – a point at which the adaptation costs are unreasonably high or where adaptation capacities reach their utmost limits (e.g. the loss of the West Antarctic ice sheet implies a 5–15 metre sea level rise). **Adaptation** actions focus on improving our ability to cope with or avoid harmful impacts or take advantage of newly favourable conditions. The increased temperatures to which our world is already bound and the changes observable today as a consequence of climate change mean that adaptation strategies need to be put into action now.

This chapter looks at mitigation and adaptation strategies in more detail and presents various

FIGURE 21

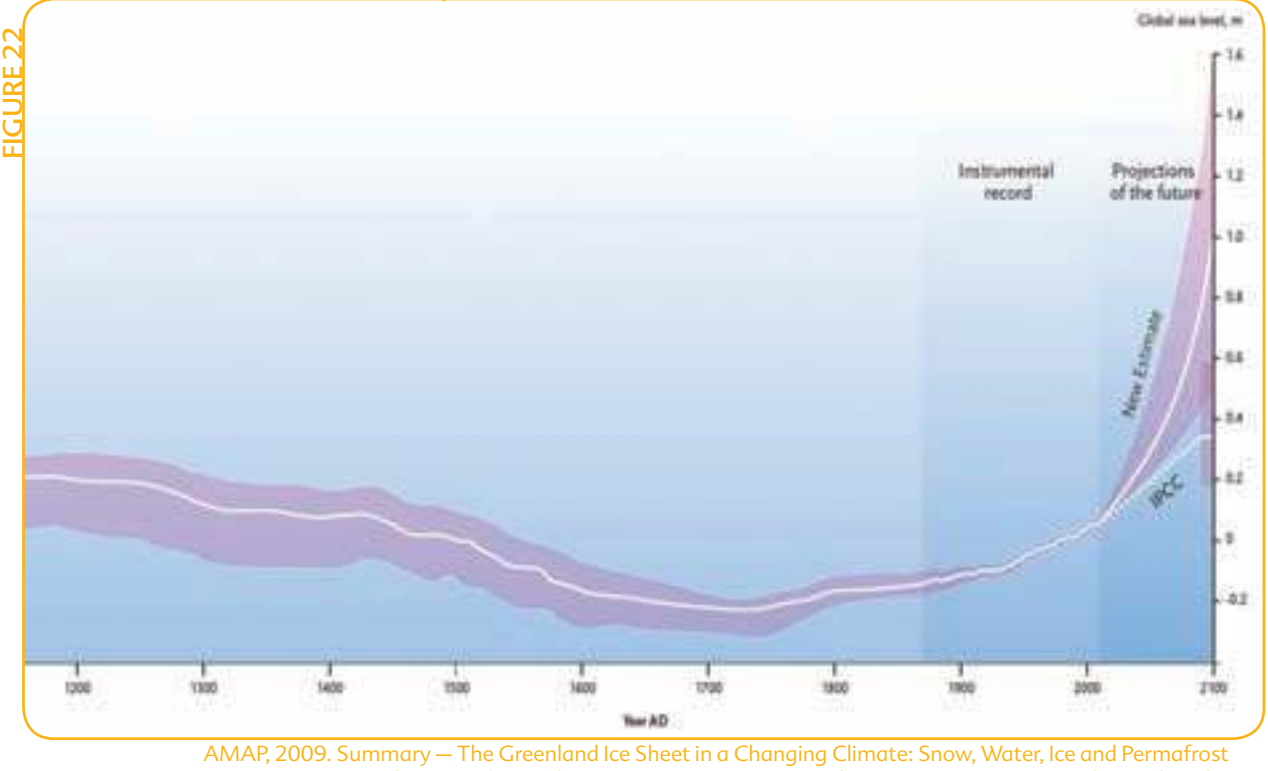
GLOBAL TEMPERATURE TREND



Zoï Environment Network and GRID-Arendal 2009

FIGURE 22

SEA LEVEL RISE - MODEL PROJECTIONS TO 2100



AMAP, 2009. Summary – The Greenland Ice Sheet in a Changing Climate: Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2009. Arctic Monitoring and Assessment Programme (AMAP), Oslo.

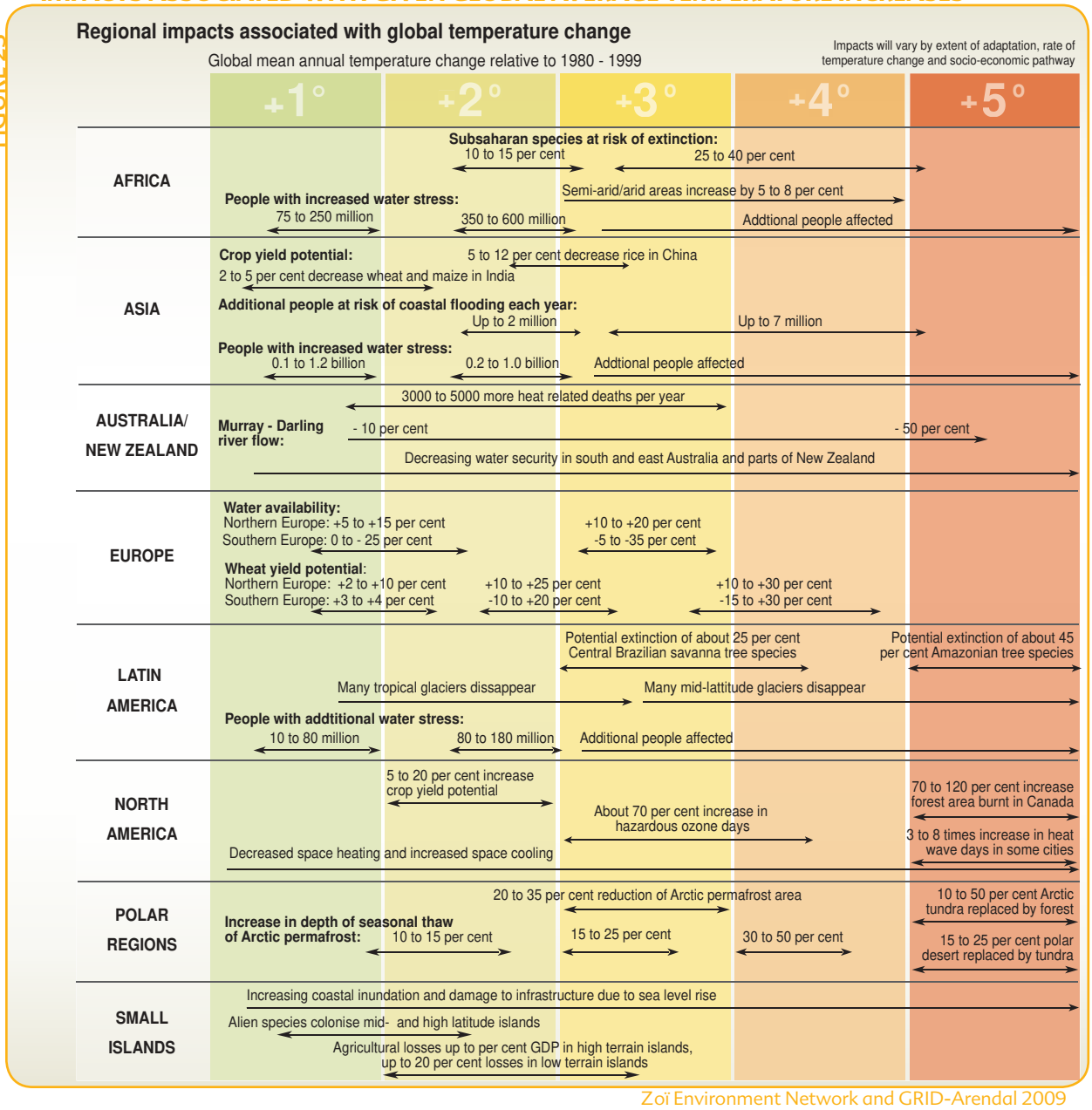
options for each. It also looks at the economics of climate change, examining the contribution of our economies to climate change phenomena, as well as the ways in which economics evaluates climate change impacts and guides the development of policy options. Finally, it explains the international policy framework for dealing with climate change and current negotiated global agreements that seek 'to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (United Nations Framework Convention on Climate Change).

3.1 Mitigation and Adaptation - A two-pronged approach

Proactive efforts to reduce greenhouse gas (GHG) emissions — **mitigation** — and lessen the harm of climate change impact — **adaptation** — are two different but complementary approaches towards dealing with climate change. Mitigation tackles

FIGURE 23

IMPACTS ASSOCIATED WITH GIVEN GLOBAL AVERAGE TEMPERATURE INCREASES



Zoï Environment Network and GRID-Arendal 2009

the causes of climate change while adaptation tackles its effects on society and the environment.

Mitigation is necessary as a means to avoid climate change impacts. The idea that less mitigation now will result in greater climatic change and consequently require more adaptation later is the basis for the urgency surrounding GHG emission reductions. If no action is taken to reduce emissions, the concentration of GHGs in the atmosphere could reach double that of pre-industrial levels by 2035, virtually binding the planet to a global average temperature rise of over 2 °C. In the long term, there would be a greater than 50% chance that the temperature rise would exceed 5 °C. This rise is equivalent to the change in average temperature from the last ice age (10,000 to 12,000 years ago) to today. Such a radical change would lead to major changes to where people live and how they live their lives. It would also mean radical changes that will touch each of the world regions (see Figure 23).

Adaptation to observed and projected future climate change is already taking place, though only on a limited basis. Some examples of adaptation measures that are being implemented include the introduction of drought tolerant crops, building of houses which are more resistant to weather events, introduction of flood and coastal defences, and restoring mangroves to reduce vulnerability to storm surges and sea level rise.

3.2 Mitigation - Ways to reduce GHGs

Greenhouse gas emission reductions can be achieved using a combination of techniques, technologies, and other measures including:

- use of low- or no-carbon energy sources,
- increased energy saving and efficiency of energy use,
- carbon capture and storage and extension of carbon sinks,
- low carbon lifestyles and consumption choices.

Newly developed and currently available **low- or no-carbon energy sources** and techniques include renewables (solar power, wind power, geothermal power, hydro, tidal and ocean energy), biofuels and biomass, fuel switching (i.e. from coal to natural gas), and, more controversially, nuclear power.

Energy efficiency techniques and technologies can be integrated into various major GHG emitting economic sectors so that they can produce the same goods and provide the same services using less energy, or make use of currently untapped energy potential. These include, among others, insulation and energy-saving lighting, heating and cooling design in buildings; improving transport fuel efficiency or changing the power source of vehicles (e.g. hybrid, plug-in hybrid, biofuels); shifts in goods and personal transport from road to rail; waste incineration and landfill methane capture with energy recovery; and heat/power recovery in industry.

Carbon capture and storage seek to trap emissions at their source before they climb in the atmosphere to the elevation where they do harm and keep them permanently locked away. Point sources such as central power plants are ideal for this, as yet, non-commercialised technique. Using biomass such as forests as **carbon sinks** is already in place as a proven and operational carbon sequestration technique. Research is underway to increase the carbon sequestration performance of certain tree species. Maintaining the existing stock of forests is also a key component of effective sequestration, though with increasing dry periods in some areas as a consequence of climate change, forest fires pose a risk to this strategy.

The main driver of greenhouse gas emissions is human consumption — that is, if there was no consumption of goods and services, there would be no anthropogenic GHG emissions. However, the increasing global population and wealth coupled with a trend towards western-style consumption is compounding the already long list of environmental pollution problems affecting land, water and, of course, the atmosphere. **Lifestyle changes** and low-carbon consumption choices like buying local goods, eating less meat, and using public or non-motorized transport are all practical ways for individuals to take action on GHG emission mitigation (see Figure 24, next page).

Mitigation action must combine, coordinate, and balance all the available means for an optimum and cost-effective end result. Indeed, mitigation must not necessarily be seen as a cost, but there are many potential benefits to the above-mentioned actions for economic development, market creation, health, and technology development in addition to the associated GHG reductions.

Additional Resources

1. Intergovernmental Panel on Climate Change. http://www.ipcc.ch/
2. United Nations Environment Programme. http://www.unep.org/climatechange/
3. United Nations Framework Convention on Climate Change. http://unfccc.int/2860.php

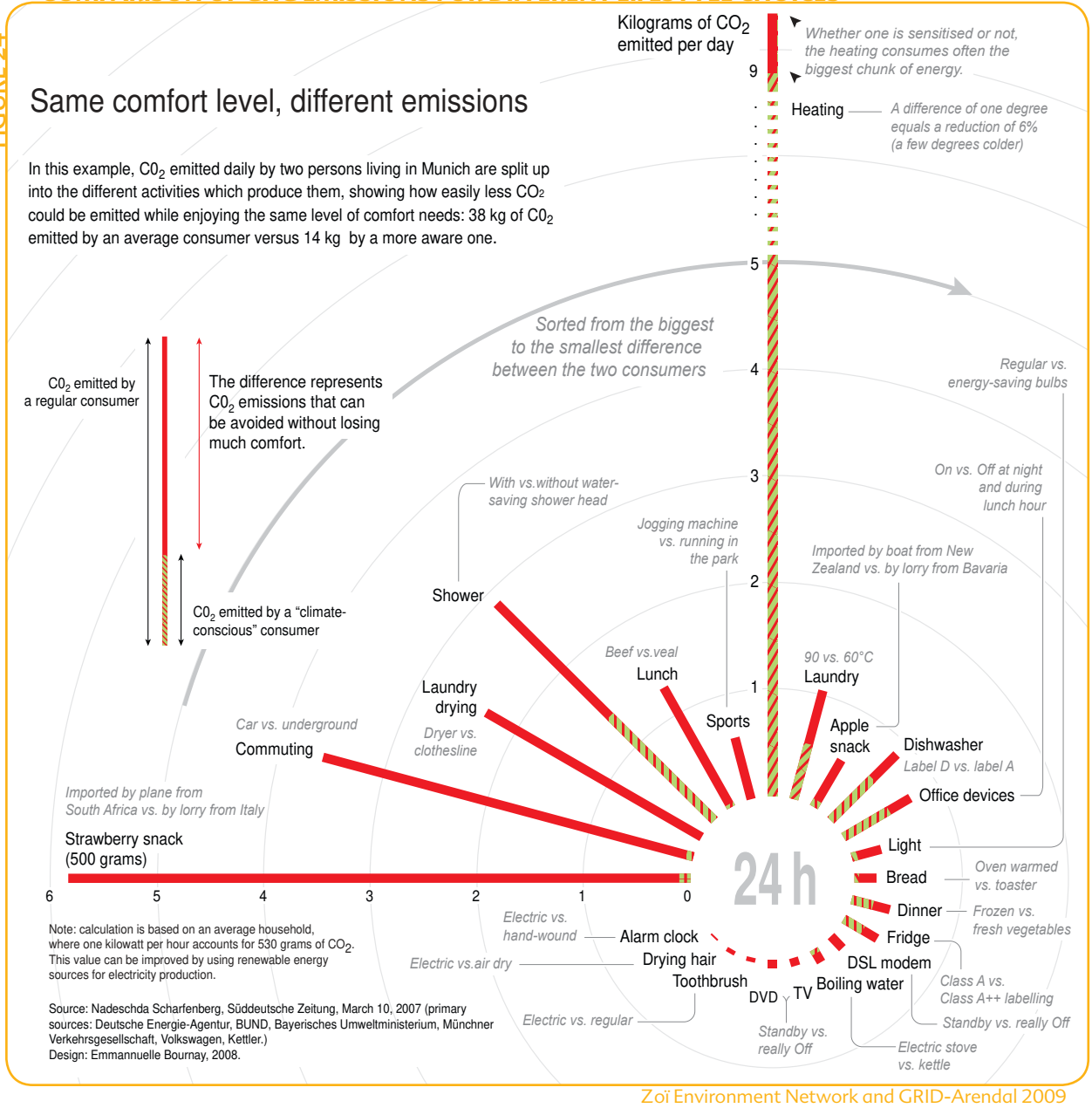
3.3 Mitigation - Policy options to promote reduction

A variety of strategies are available today that, if implemented quickly, could reduce greenhouse gas (GHG) emissions, and consequently help to mitigate the most severe consequences of climate change.

Policy-makers have a crucial role to play in creating the institutional, policy, legal and regulatory frameworks necessary to enable and incentivize

FIGURE 24

COMPARISON OF GHG EMISSIONS FOR DIFFERENT LIFESTYLE CHOICES



Zoï Environment Network and GRID-Arendal 2009

significant emission reductions. The right mix of well-designed policies including regulations and economic instruments can overcome economic, technological, informational and behavioural barriers in the marketplace.

Policy Instruments

Integrated policies include climate change as a factor in broader policy development to facilitate implementation of mitigation mechanisms.

Regulatory standards provide certainty and consistency on emissions levels, and send a clear signal that discourages a 'business as usual' approach. By mandating standards, governments could ban or attempt to alter the use of materials and equipment considered to be damaging to climate. For example, standards can be applied to buildings (energy efficiency), fuel use by motor vehicles, energy efficiency of household durables, and the content of fuels.

Reducing Emission for Deforestation and Degradation (REDD+) refers to policy approaches and positive incentives on issues relating to reducing GHG emissions from deforestation and forest degradation, as well as the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

Voluntary agreements between industry and government are a means to engage industry partners to take action on environmental and other issues and are often a precursor to regulations. Theoretically, industries should be compelled to undertake steps to reduce GHG emissions if they fear more costly regulatory controls.

Voluntary actions (corporations, governments, non-profits and civil groups) can act to stimulate action and innovation. (See Voluntary action... text box, next page)

Economic Instruments

Taxes and fees impose a charge or cost to emitters for each unit of pollutant discharged. For example, a carbon tax is an environmental tax levied on the carbon content of fuels. It can be implemented by taxing the burning of fossil fuels — coal, petroleum products such as gasoline and aviation fuel, and natural gas — in proportion to their carbon content, thus making them more expensive to use. Accordingly, a carbon tax increases the competitiveness of non-carbon technologies (i.e. wind, sunlight, hydropower and nuclear) which helps protect the environment while raising revenues. Important here is that the tax and fee levels are set high enough to provoke a change in consumption behaviour, and not merely raise revenue.

Financial incentives such as rebates and tax breaks can be used to stimulate new markets for

Creating a Financial Incentive for Solar Water Heating Installation

Sometimes the best rate of interest is also in the best interest of the planet: clean technology.

Despite solar powered-water heaters being an obvious energy-saving solution in hot and sunny countries, the cost of buying them is often prohibitive for many people. Banks are often unfamiliar with the costs and benefits of clean energy, so loans are often not widely available. Yet, solar hot-water systems can earn back the investment in as little as four years, offering years of 'free' hot water after that.

An average four-person household with an electric water heater is responsible for about eight tonnes of CO_2 emissions annually, almost double that generated by a typical modern car.

Enter Prosol— a joint initiative between UNEP, the Italian Ministry for Environment, Land and Sea and the National Agency for Energy Conservation — which has helped 105,000 Tunisian families get their hot water from the sun based on loans of over $60 million — a substantial leverage on Prosol's initial $2.5 million initial cost. The solar water-heater market in Tunisia showed a dramatic increase when low-interest loans were made available to householders, with repayments collected through regular utility bills.

This reduced the risk for local banks while simultaneously showing borrowers the impact of solar heating on their electricity bills. Its success has led the Tunisian government to set an ambitious target of 750,000m^2 of solar water heaters for 2010-2014, making the country comparable to Spain or Italy with populations several times higher. Jobs have been created: 42 suppliers and more than 1000 installation companies have sprung up. The tourism and industry sectors are also now involved, with 47 hotels engaged by late 2009, and there are plans to encourage industry to make greater use of the sun's energy.

Reproduced from the 2010 UNEP Annual Report.
http://www.unep.org/annualreport/2010/

Stern Review: The economics of early action on climate change

"This Review has assessed a wide range of evidence on the impacts of climate change and on the economic costs, and has used a number of different techniques to assess costs and risks. From all of these perspectives, the evidence gathered by the Review leads to a simple conclusion: the benefits of strong and early action far outweigh the economic costs of not acting.

Climate change will affect the basic elements of life for people around the world — access to water, food production, health, and the environment. Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms.

Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more.

In contrast, the costs of action — reducing greenhouse gas emissions to avoid the worst impacts of climate change — can be limited to around 1% of global GDP each year.

The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next. Our actions now and over the coming decades could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes.

So prompt and strong action is clearly warranted. Because climate change is a global problem, the response to it must be international. It must be based on a shared vision of long-term goals and agreement on frameworks that will accelerate action over the next decade, and it must build on mutually reinforcing approaches at national, regional and international level."

An exerpt from the Executive Summary of the review published by Sir Nicholas Stern, Head of the Government Economic Service and Adviser to the Government on the economics of climate change and development in 2007.

http://www.hm-treasury.gov.uk/media/9/9/CLOSED_SHORT_executive_summary.pdf

innovative technologies. For example, a sales tax refund on the purchase and installation of solar panels can spur households and businesses to make the investment to install this technology (see 'Creating a Financial...' text box, previous page).

Tradable permits create a market and a market value (price) for pollution, in this case, carbon. An overall limit to the amount of allowable emissions is set and this amount is distributed to the authorized emission sources (industries) in the form of permits. The permit owners can then either use the permits, or buy and sell them in the market, similar to the traditional stock market. Governments or firms that need to increase their emissions must buy permits from those who require fewer permits. In effect, the buyer is paying a charge for polluting, while the seller

Voluntary Action by U.S. Mayors

U.S. Conference of Mayors Climate Protection Agreement

On February 16, 2005 the Kyoto Protocol, the international agreement to address climate disruption, became law for the 141 countries that have ratified it to date. On that day, Seattle Mayor Greg Nickels launched this initiative to advance the goals of the Kyoto Protocol through leadership and action by at least 141 American cities. In May of 2007, Tulsa Mayor Kathy Taylor became the 500th mayor to sign on. Under the Agreement, participating cities commit to take following three actions:

- Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns;
- Urge their state governments, and the federal government, to enact policies and programs to meet or beat the greenhouse gas emission reduction target suggested for the United States in the Kyoto Protocol -- 7% reduction from 1990 levels by 2012; and
- Urge the U.S. Congress to pass the bipartisan greenhouse gas reduction legislation, which would establish a national emission trading system

http://www.usmayors.org/climateprotection/agreement.htm

is being rewarded for having reduced emissions. Thus, those who can reduce emissions at a lower cost than the cost of buying permits will do so, achieving pollution reduction at the lowest cost to society.

Many of these policies place real or implicit prices on carbon, which creates significant incentives for producers and consumers to invest in lower carbon products, technologies and processes. As fossil fuel prices increase, more low- and no-carbon alternatives will become competitive.

The need for early action

Countries can use different strategies to reduce GHG emissions, but early action increases the likelihood of avoiding the most severe consequences of global climate change. Setting effective carbon prices, strengthening regulations such as efficiency standards, and increasing government funding for research, development and demonstration of low- and no-carbon energy sources could encourage climate solutions.

Delaying the implementation of mitigation strategies and continuing on a 'business-as-usual' path will almost certainly lock us into a more emission-intense future, greatly increasing the risk of more severe and irreversible climate change impacts. The longer we wait to act, the more costly it becomes to limit climate change and to adapt to the unavoidable consequences. (See Stern Review text box, previous page).

Additional Resources

1. Intergovernmental Panel on Climate Change. http://www.ipcc.ch/
2. United Nations Framework Convention on Climate Change. http://unfccc.int/2860.php
3. United Nations Environment Programme. http://www.unep.org/climatechange/

3.4 Adaptation - Facing a new reality

Climate variability and climate change result in impacts (as outlined in section 1 and 2 of this guidebook) which necessitate adjustments in both human and natural systems. Adaptation refers to such adjustments which moderate harm or exploit beneficial opportunities. Although individuals and communities have always been adapting to variations in the climate, this experience is often no longer sufficient to respond to the scale of climate changes occurring today and in the future.

Adaptation in theory: Adaptation categories

Adaptation responses can be broken down into several sub-categories describing the adaptation triggers, timing, and systems involved. Table 3 shows examples of adaptation activities for the different adaptation categories.

Autonomous adaptation is triggered by ecological changes in natural systems and by market or welfare changes in human systems, rather than being a conscious response to climate change.

Planned adaptation, on the other hand, is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change.

Anticipatory adaptation takes place before impacts are apparent, whereas reactive adaptation occurs after the initial impacts of climate change have become manifest.

A distinction can also be based on the living system in which the adaptation takes place — the natural system or the human system. Within the human system, private and public adaptation describes whether private or public interests motivate an adaptation decision.

TABLE 3

EXAMPLES OF ADAPTATION OPTIONS

		Anticipatory	Reactive
Natural systems			- Changes in length of growing season - Changes in ecosystem composition - Wetland migration
Human systems	Public	- Purchase of insurance - Construction of houses on stilts - Redesign of oil rigs	- Changes in farm practices - Changes in insurance premiums - Purchase of air-conditioning
	Private	- Early-warning systems - New building codes, design standards - Incentives for relocation	- Compensatory payments, subsidies - Enforcement of building codes - Beach nourishment

Klein et al, 2005

CHAPTER 3

Vulnerability and Risk Assessment

A typical vulnerability and risk assessment has several key steps:

1. a recording or listing of physical and social assets to be assessed;
2. a determination of the consequences of climate change on the assets listed, for example from sea level rise, longer drought periods, higher summer temperatures, etc. and ranging from insignificant to catastrophic;
3. an assessment of the likelihood that the consequences will become reality, based on current knowledge and models;
4. a cross referencing of the severity of the consequences with the likelihood of the consequences becoming reality, using a risk matrix (see Table 5).

In the final analysis, physical and social assets which face an almost certain catastrophic impact form the proirity list for adaptation planning. Assets with a rare likelihood of insignificant consequences are given a lower priority.

The following web sites have further information on vulnerability and risk assessments:

- http://cses.washington.edu/db/pdf/snoveretalgb574ch8.pdf
- http://cses.washington.edu/db/pdf/snoveretalgb574ch9.pdf
- http://www.lgant.asn.au/sustainability-environment/climate-change-risk-assessment-and-adaptation

Adaptation in practice: Key stages in adaptation planning

A first step in adaptation planning is the identification of **current and future vulnerabilities and assessment of climate risks**. Vulnerability can be described as the degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change. The vulnerability of a system is related to its exposure, sensitivity, and adaptive capacity. Vulnerability assessments consider changes in socio-economic and environmental conditions, biophysical and socio-economic impacts of climate stresses, and the adaptive capacity of the system.

In order to understand potential future vulnerability, the underlying drivers of vulnerability need to be identified. In terms of the assessment of future climate risks, it may sometimes be possible to use scenarios and models to develop projections of these.

Having built an understanding of vulnerabilities and climate risks facing a community or an area, the next step is to identify possible **adaptation options**. Adaptation options can be designed to provide benefits under all plausible future scenarios, including the absence of climate change (these are known as 'no regrets' measures) or can consist of measures taken specifically to anticipate climate change (known as 'climate justified' measures).

Table 4 below gives some examples of possible adaptation measures responding to different climate-related stresses.

TABLE 4 ADAPTATION OPTIONS FOR SELECTED CLIMATE-RELATED STRESSES

Climate-related stress	Examples of adaptation options
Drought	Rainwater harvesting; Water conservation and loss reduction; Ecosystem restoration; Altered farming practices e.g. changes to drought-resistant crops and inter-cropping; Grain storage; Economic diversification
Flood	Restoration of vegetation around river beds; Raised houses and other buildings (schools, hospitals); Flood-resistant roads; Changes in crops; Land use planning; Early-warning systems
Sea level rise	Protection and restoration of coastal wetlands, marshes and mangroves; Coastal defences and sea walls; Consideration of climate change impacts in infrastructure planning
Extreme temperatures	Adjustment of grazing times and areas; Planting of shade trees; Changes to heat-resistant crops; Improvements in public health; Disease control and eradication
Strong winds, cyclones	Wind-resistant housing and infrastructure; Reforestation; Planting of wind breaks; Early-warning systems

The identified adaptation options are normally assessed in order to rank and select the final adaptation measures to be implemented. Some **criteria** that can be used in this assessment include the effectiveness, cost, feasibility, socio-economic impacts and sustainability of the adaptation option in question (see 'Vulnerability...' text box, previous page).

Mainstreaming adaptation

The integration of adaptation measures into existing development processes and activities is known as 'mainstreaming'. It involves the systematic consideration of climate change risks in development planning at all levels. Due to the linkages between climate change, development and poverty reduction, adaptation needs to be supported by such a cross-cutting and integrated policy approach. While in certain situations stand-alone adaptation measures will be needed, in most other cases adaptation activities will need to be implemented as part of a broader suite of measures within existing development processes and decision cycles.[36]

Integrating adaptation to climate change within development activities is essential if governments wish to achieve the targets set in the Millennium Development Goals, as well as related national poverty eradication targets and sustainable development.

Complementary nature of mitigation and adaptation

Climate mitigation and adaptation are not separate alternatives, but function as a complementary set of actions that combine to form an overall strategy to reduce GHG emissions and climate change impacts. There are also ways to combine the mitigation and adaptation agendas, for example, planting mangroves along a coast sequesters carbon while at the same time providing a buffer against increased storm surges.

Mitigation efforts can also increase the resilience and capacity of communities to adapt to changes in local climate conditions. Reducing both loss of natural habitat and deforestation can have significant biodiversity, soil and water conservation benefits, and can be implemented in a socially and economically sustainable manner. For example, forestation and sustainable bioenergy plantations can restore degraded land, manage water runoff, retain soil carbon and benefit rural economies[37] thus improving their ability to adapt to adverse impacts of climate change.

Additional resources:

1. OECD (2009) Policy Guidance on Integrating Climate Change Adaptation into Development Co-operation. http://www.oecd.org/dataoecd/0/9/43652123.pdf
2. USAID (2007) Adapting to Climate Variability and Change: A Guidance Manual for Development Planning. http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf
3. UNDP (2010) Designing Climate Change Adaptation Initiatives: UNDP Toolkit for Practitioners. http://www.adaptationlearning.net/sites/default/files/ Toolkit_for_Designing_Climate_Change_Adaptation_Initiatives____November_2010.pdf
4. Schipper and Burton (2008) The Earthscan Reader on Adaptation to Climate Change
5. UNFCCC Nairobi work programme on impacts, vulnerability and adaptation to climate change: http://unfccc.int/adaptation/nairobi_work_programme/items/3633.php
6. Eldis Climate Change Adaptation. http://www.eldis.org/go/topics/dossiers/climate-change-adaptation
7. WeAdapt. http://www.weadapt.org

36 Policy Guidance on Integrating Climate Change Adaptation into Development Co-operation, 2009. http://www.oecd.org/dataoecd/0/9/43652123.pdf)

37 Intergovernmental Panel on Climate Change (2007). Climate Change 2007: Synthesis Report. Geneva, Switzerland.

TABLE 5 **RISK MATRIX**

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	medium	high	high	extreme	extreme
Likely	medium	medium	high	high	extreme
Possible	low	medium	high	high	high
Unlikely	low	low	medium	medium	high
Rare	low	low	medium	medium	high

Swan River Trust. Climate Change Risk Assessment Project.. 2010

8. Adaptation Learning Mechanism. http://www.adaptationlearning.net

9. UNEP Climate Change Adaptation. http://www.unep.org/climatechange/adaptation

10. IPCC (2007) Climate Change 2007 — Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC

3.5 The Economy and Economics - Part of the problem and solution

How do our economies contribute to climate change?

The choices that governments, companies, and individuals make when producing, marketing and consuming goods and services are the main drivers of anthropogenic or man-made climate change. A good example is the reliance, particularly in developed countries, on carbon-intensive transport, heating and electricity services based upon the combustion of fossil fuels. The economic decisions that give rise to such a scenario are determined not only by markets and prices, but are also influenced by environmental, social, cultural and political factors. At the national economy level, societies can contribute to climate change in three ways: **delinking economic growth from environmental deterioration, changes in technology, and population size.**

Delinking economic growth from environmental deterioration

Economic growth helps to generate employment and lift people out of poverty. Green growth can also lead to more environmentally-friendly production and consumption practices being implemented, with a benefit of more efficient resource managment and reduced GHG emissions.

National consumption levels determine how many natural resources are needed to satisfy the total demand for goods and services of the society, and indirectly, how much waste is generated. This is particularly relevant in the developed world, which has historically shown strong economic growth rates and high consumption levels, but is starting also to have relevance in some large emerging developing economies.

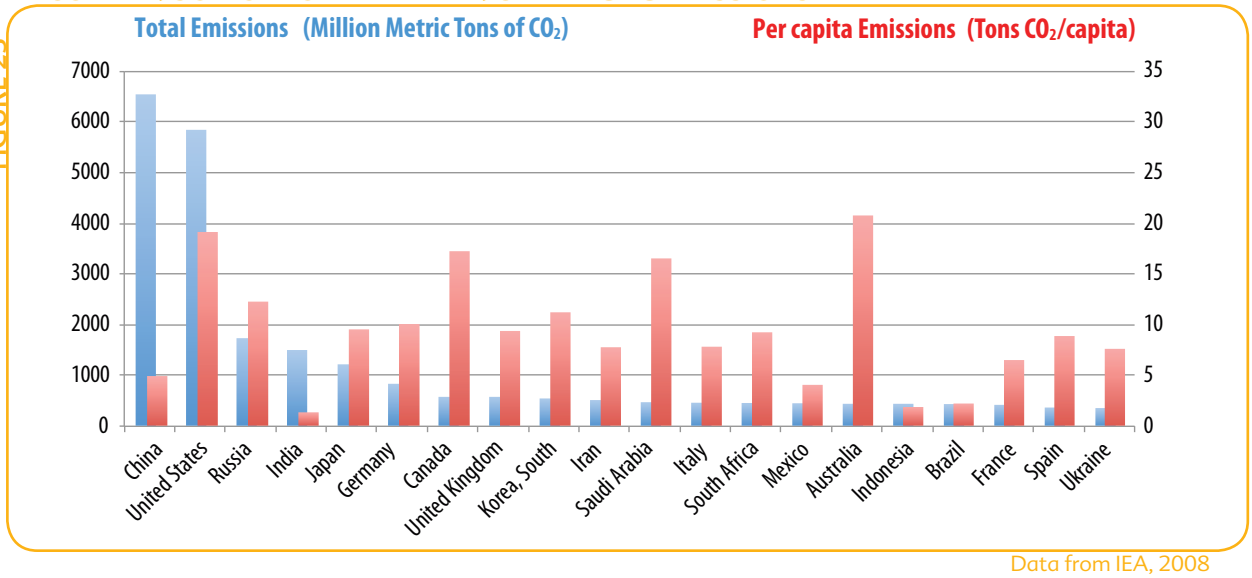
The production and provision of goods and services has traditionally caused environmental deterioration. However, advances in policy, technology, resource management, and business thinking have created the possibility for a 'green economy', which delinks economic growth from environmental damage (see 'Moving Towards...' text box).

Changes in technology

Changes in technology relates to the type of technologies being deployed, particularly in energy-intensive sectors (e.g. electricity generation, transport, buildings, and industries such as mining, cement, chemicals, iron and steel). The majority of

FIGURE 25

COMPARISON OF TOTAL AND PER CAPITA GHG EMISSIONS



Data from IEA, 2008

established technologies now in use help to sustain the economic growth of a country, but do so at the expense of nature and our climate. This is because most of these technologies rely upon fossil fuel-based energy (coal, oil, gas).

It is important to understand that it is not economic growth per se that has shaped the climate change problem, but the composition of that growth and the type of development model being pursued —in other words, the fossil fuel-based economy that dominates our world. Economic growth and consumption levels could be sustained, in principle, whilst also respecting nature and the climate, by using energy more efficiently and by switching to low- and no-carbon energy technologies.

Population size

Most environmental problems, including those arising from climate change, are impacted by population growth. Distinct population groups contribute in different ways. Age structure, household size and spatial distribution—and most important, level of development—all affect per capita emissions. For the most part, countries with high rates of poverty and population growth contribute relatively little to greenhouse gases. Unless low-income countries follow new, low carbon paths of development, higher standards of living will lead to higher per capita greenhouse gas emissions.

When looking at GHG emissions across countries, rankings vary depending on whether one considers the total amount, or per capita amount of GHG emissions. Figure 25 shows that China and the United States are by far the largest emitters of total carbon dioxide emissions. But when emissions per capita are considered, Australia, the United States, Canada, and Saudi Arabia are the largest emitters. **Per capita emissions** are a good indicator of which countries could motivate lifestyle changes in order to reduce GHG emissions.

Moving Towards a Green Economy

The last two years have seen the idea of a 'green economy' float out of its specialist moorings in environmental economics and into the mainstream of policy discourse.

UNEP defines a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services.

Towards a Green Economy — the main output of the Green Economy Initiative — demonstrates that the greening of economies is not generally a drag on growth but rather a new engine of growth; that it is a net generator of decent jobs, and that it is also a vital strategy for the elimination of persistent poverty.

From http://www.unep.org/greeneconomy

How is economics used to assess climate change impacts and contribute to policy responses?

Assessing climate change impacts

Accurate assessment of climate change impacts is crucial for good climate mitigation and adaptation policy-making: it enables governments to calculate the value of avoidable damages as well as the cost attributed to any given climate control action. It is possible to monetize certain climate change damages because they are associated with market prices or 'market impacts' (e.g. climate-related destruction of the physical assets of a business). Other aspects are difficult to monetize because they are not subject to market transactions; these are 'non-market impacts' (e.g. the **ecological** value of destroyed forest stocks, loss of human life, or a decrease in the number of people with access to clean drinking water). In other words, climate change may not only result in serious direct economic damage, but also indirectly limit economic development due to the damage inflicted on people and natural systems. Valuation of ecosystem services can also help decision making for both adaptation and mitigation.

The consequences for climate mitigation policies and action are very much dependent on the economic approach adopted for evaluating climate damages. This is why it is important to distinguish between two types of approach: **traditional/conventional models** and **new alternative ways of looking at the problem**.

CHAPTER 3

Traditional/conventional models

Traditional economic models adopt one of two approaches: (1) focus only on market impacts; or (2) assign monetary values to as many impacts as possible and aggregate these under a single value.

If only market impacts are considered, overall climate damages would be grossly underestimated. For example, Stern[38] finds that the global economic cost of climate change rises steeply from 5% of GDP when only market impacts are evaluated, to around 20% of GDP when other non-market impacts are included. If non-market impacts are considered, these tend to be assigned arbitrary and controversial values, through the overuse of Cost-Benefit Analysis (CBA) in public policy-making. CBA compares the costs of controlling GHG emissions with the benefits of avoiding climate-induced damages. The CBA approach has been questioned both on theoretical economic grounds and from ethical and social justice standpoints, because it distorts the meaning of values assigned to societal well-being.[39, 40] Evidence has also shown that the use of the traditional economic approach leads to inaction on the climate policy front, leading people to do little later, rather than take strong action now. This occurs despite unequivocal scientific evidence of human-induced climate change that may have catastrophic consequences in the longer term, warranting immediate action.[41]

Alternative ways of looking at the problem

Alternative new thinking in the area of climate economics is emerging. One example is the **precautionary approach to climate control**, which does not require perfect information about potential damages and benefits (as required by traditional economics).[42] Under this approach, climate policy can be based on insurance or risk principles, whereby investments are made to protect against events that do not usually happen, but could cause tremendous damage if they were to occur.

Another alternative being advocated is climate policy assessment based on multidimensional economic, social, environmental and institutional criteria.[43] In this case, avoided climate damages are assessed in their natural units depending on

38 The Economics of Climate Change. The Stern Review, N. Stern, Cambridge University Press, 2007.

39 Cost-benefit analysis, for example, leads to the conclusion that toxic waste should preferably be dumped on to the developing world. After all, life is already short in the developing world, and the presence of low wages and poor productivity means that the dumping will be inexpensive in both action and consequence. http://www.bmj.com/content/330/7499/1091.1.extract

40 Priceless: On Knowing the Price of Everything and the Value of Nothing, F. Ackerman and L. Heinzerling, New Press, 2004.

41 'Summary for Policymakers', S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds)] Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, 2007.

42 'Reducing abrupt climate change risk using the Montreal Protocol and other regulatory actions to complement cuts in CO_2 emissions', M. Molina, D. Zaelke, K.M. Sarma, S.O. Andersen, V. Ramanathan and D. Kaniaru, Proc. Natl. Acad. Sci. USA, 106(49) 20616–21, 2009.

43 'Multi-criteria analysis for climate change: developing guidance for sound climate policy planning (MCA4climate)', undergoing project of UNEP's Energy Branch in the Division of Technology, Industry, and Economics, 2011. http://www.mca4climate.info/

Developing Multi-criteria Analysis

Climate change is a pervasive and complex problem, with uncertainty surrounding its multi-faceted impacts. Setting priorities is hampered by the lack of a systematic and comprehensive description of the issues concerned, the links amongst them, and the trade-offs involved. Structured guidance is needed to underpin long-term policy planning in the area of climate change, which would systematically consider the direct and indirect economic, social, environmental, and institutional costs and impacts.

The goal of the MCA4climate project and approach is to help fill this gap by putting forward methodological guidance enabling national goverments (particularly from developing countries) to identify low-cost, environmentally effective and pro-poor climate mitigation and adaptation policy choices. It seeks to diffuse the perceived fear of high mitigation and adaptation costs associated with climate action. The methodology developed is based on a multi-criteria approach (MCA) and offers a useful planning tool for prioritizing and populating with concrete measures and economy-wide climate strategies.

From http://www.mca4climate.info

MCA4climate

the type of impact being investigated. To provide an example, health impacts are expressed in the number of people at risk from a disease due to climate change, instead of estimating controversial dollar values for life and death (e.g. $4 million for the life of a person). Such alternative approaches typically argue for immediate and fast climate action, whilst providing a more comprehensive picture of the costs, risks and opportunities involved (see 'Developing Multi-criteria...' text box).

Policy criteria

Well-designed climate policies can contribute to effective climate mitigation and adaptation, and may also improve employment prospects, maintain economic growth, reduce poverty and achieve other social and environmental benefits. Policy action on the climate front could provide much sought-after opportunities to steer countries towards a 'green economy'. The latter would translate into improved human well-being and reduced inequalities over the long term, while reducing exposure of future generations to significant environmental risks and ecological scarcities.[44] Factors that sustain our economies like employment, environmental quality, equity and social justice (i.e. overall quality of life) provide better criteria against which to measure policy performance, and should take precedence over economic growth targets.

Additional Resources

1. Green Economy Report: A Preview. UNEP, 2007. http://www.unep.org/GreenEconomy/
2. 'Multi-criteria analysis for climate change: developing guidance for sound climate policy planning (MCA4climate)'. On-going project of UNEP / DTIE - Energy Branch, 2011. http://www.mca4climate.info/
3. The Economics of Climate Change. The Stern Review, N. Stern, Cambridge University Press, 2007. http://siteresources.worldbank.org/

3.6 International Responses - Policies at the global level

Over the recent decade, climate change has become one of the most prominent issues in science, politics and the media.

44 Green Economy Report: A Preview, United Nations Environment Programme (UNEP), 2007: http://www.unep.org/GreenEconomy/.

Global awareness and concern regarding climate change have been increasing since the mid-eighties and especially since the International Panel on Climate Change (IPCC) produced its First Assessment Report on Climate Change (1990). There was mounting evidence of changes to the global climate and strong suspicion that humanity was their main driver. Following that trend, international negotiations on climate change were launched, culminating at the first Earth Summit in 1992 in Rio de Janeiro, Brazil. Not only were country leaders participating in the debates, but international organisations such as Environmental Non-Governmental Organisations (ENGOs) and industry leaders actively took part. This approach was innovative and consistent with the stakeholder participation policy promoted within the concept of sustainable development. At the Earth Summit, climate change became an issue to be addressed by the international community.

UNFCCC — A global treaty to combat climate change

The Earth Summit saw the establishment of the United Nations Framework Convention on Climate Change (UNFCCC). This convention is an international treaty that supports an intergovernmental negotiating process among countries (called 'Parties') with a view to limit dangerous anthropogenic interference with the Earth's climate. The Convention is based on several fundamental principles, including the precautionary principle, the historical responsibility of developed countries (i.e. Annex I countries) and the right to development for developing countries (i.e. non-Annex I countries).

UNFCCC discussions are maintained in two major streams called the Subsidiary Body for Implementation (SBI), that develops recommendations to assist the Parties in assessing and reviewing the implementation of the Convention, and the Subsidiary Body for Scientific and Technological Advice (SBSTA), which serves as the link between the policy-oriented needs of the Convention and the scientific, technical and technological assessments and information provided by various external groups (see Figure 26, next page).

In 2009, the Ad Hoc Working Group on Long term Cooperative Action under the Convention (AWG-LCA) and the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) were created. The AWG-LCA is the framework for discussions among all the Parties to the Convention aimed

Global CO_2 Emissions Reach a Record High in 2010

Energy-related carbon-dioxide (CO_2) emissions in 2010 were the highest in history, according to the latest estimates by the International Energy Agency (IEA). After a dip in 2009 caused by the global financial crisis, emissions are estimated to have climbed to a record 30.6 Gigatonnes (Gt), a 5% jump from the previous record year in 2008, when levels reached 29.3 Gt. In terms of fuels, 44% of the estimated CO_2 emissions in 2010 came from coal, 36% from oil, and 20% from natural gas.

In addition, the IEA has estimated that 80% of projected emissions from the power sector in 2020 are already locked in, as they will come from power plants that are currently in place or under construction today.

The challenge of improving and maintaining quality of life for people in all countries while limiting CO_2 emissions has never been greater. While the IEA estimates that 40% of global emissions came from OECD countries in 2010, these countries only accounted for 25% of emissions growth compared to 2009. Non-OECD countries — led by China and India — saw much stronger increases in emissions as their economic growth accelerated. However, on a per capita basis, OECD countries collectively emitted 10 tonnes, compared with 5.8 tonnes for China, and 1.5 tonnes in India.

http://www.iea.org/index_info.asp?id=1959

at promoting a comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action. The AWG-KP leads the process for considering further commitments of the Kyoto Protocol signatory countries (Annex I Parties) for the period beyond 2012.

FIGURE 26

UNFCCC ORGANIZATION CHART

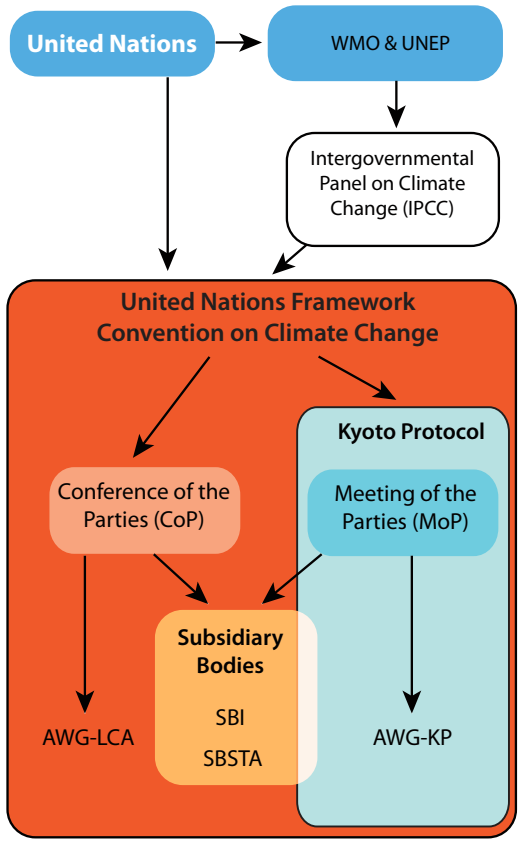
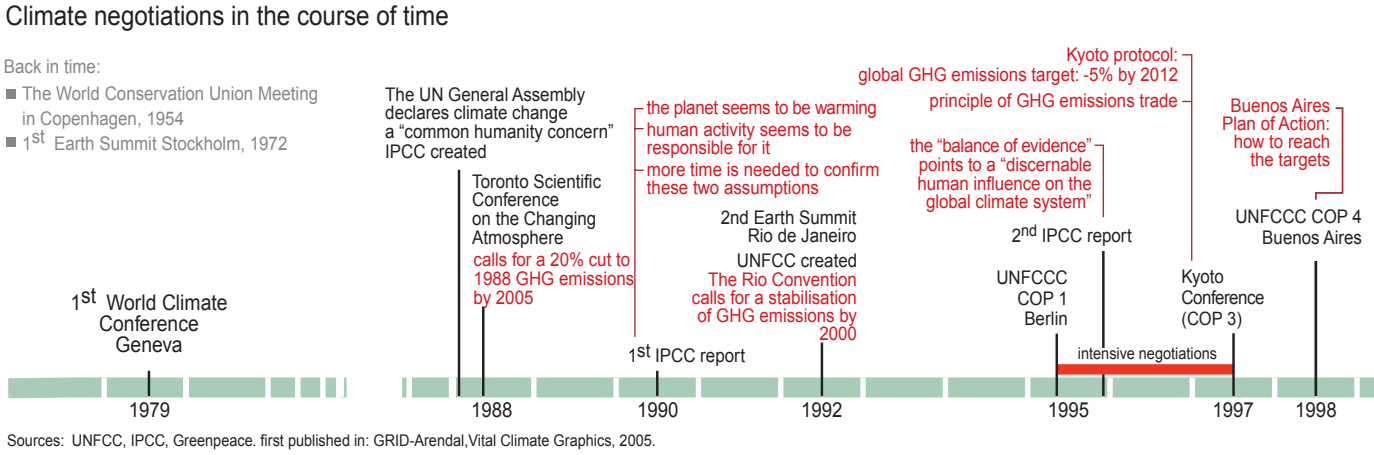


FIGURE 27

HISTORICAL DEVELOPMENT OF INTERNATIONAL AGREEMENTS ON CLIMATE CHANGE



Sources: UNFCC, IPCC, Greenpeace. first published in: GRID-Arendal,Vital Climate Graphics, 2005.

The Kyoto Protocol sets overall GHG emission reductions of 5.2% compared to 1990 emission levels for Annex I countries, to be achieved by 2012. The Kyoto Protocol represents a considerable breakthrough in terms of international negotiations for it allowed the creation of a flexible system for emissions mitigation via three main mechanisms: emissions trading, the clean development mechanism (CDM) and joint implementation (JI). With the first commitment period of the Kyoto Protocol ending on December 2012, the AWG-KP is undertaking negotiations on the extension of the Protocol.

The Conference of the Parties (COP) is the supreme body of the UNFCCC, comprised of countries that have ratified or acceded to the UNFCCC, and the COP is the executive body, i.e. the organ that takes and adopts decisions. The COP's meetings are held on an annual basis in various locations of the world while intercessional meetings of the UNFCCC Subsidiary Bodies (SBI and SBSTA) are held in Bonn (see Figure 27). The decision-making process is built on the United Nations principle of consensus.

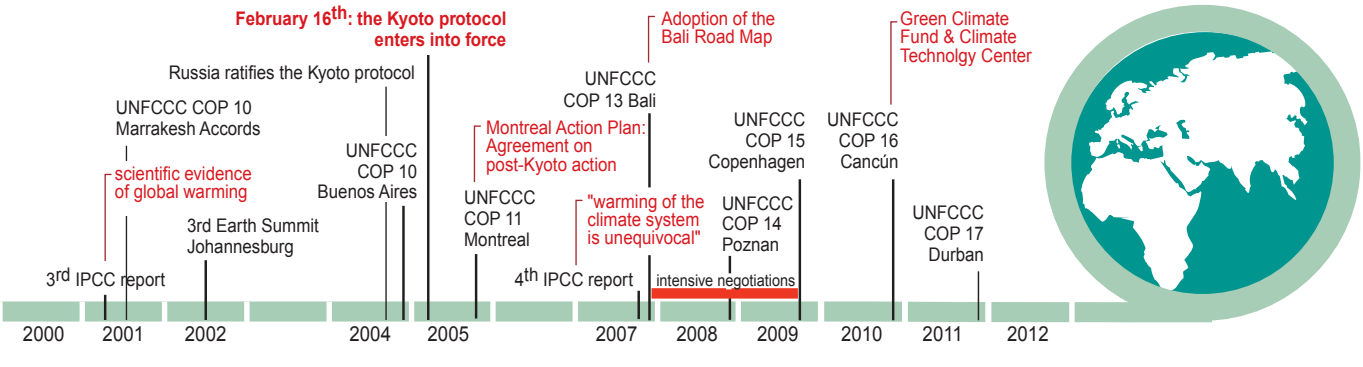
The last COP 16 in December 2010 in Cancun, Mexico, led to reinforcement of the international acknowledgement of the necessity to limit global warming in 2050 at 2 degrees Celsius, to take practical and tangible actions to reduce GHG emissions and to avail adequate funds for those actions. Moreover, the parties committed themselves to consider the more rigorous objective of 1.5 degrees Celsius within the coming years. The parties also established a new framework for adaptation at Cancun, outlining the key activities and structures required for enhanced action and progress on adaptation. A new Technology Mechanism will enhance action on technology development and transfer and support action on mitigation and adaptation in order to achieve the full implementation of the Convention. However, the issue of extending the Kyoto Protocol with its binding reduction targets for the second commitment period is not yet resolved.

Meeting the common challenge

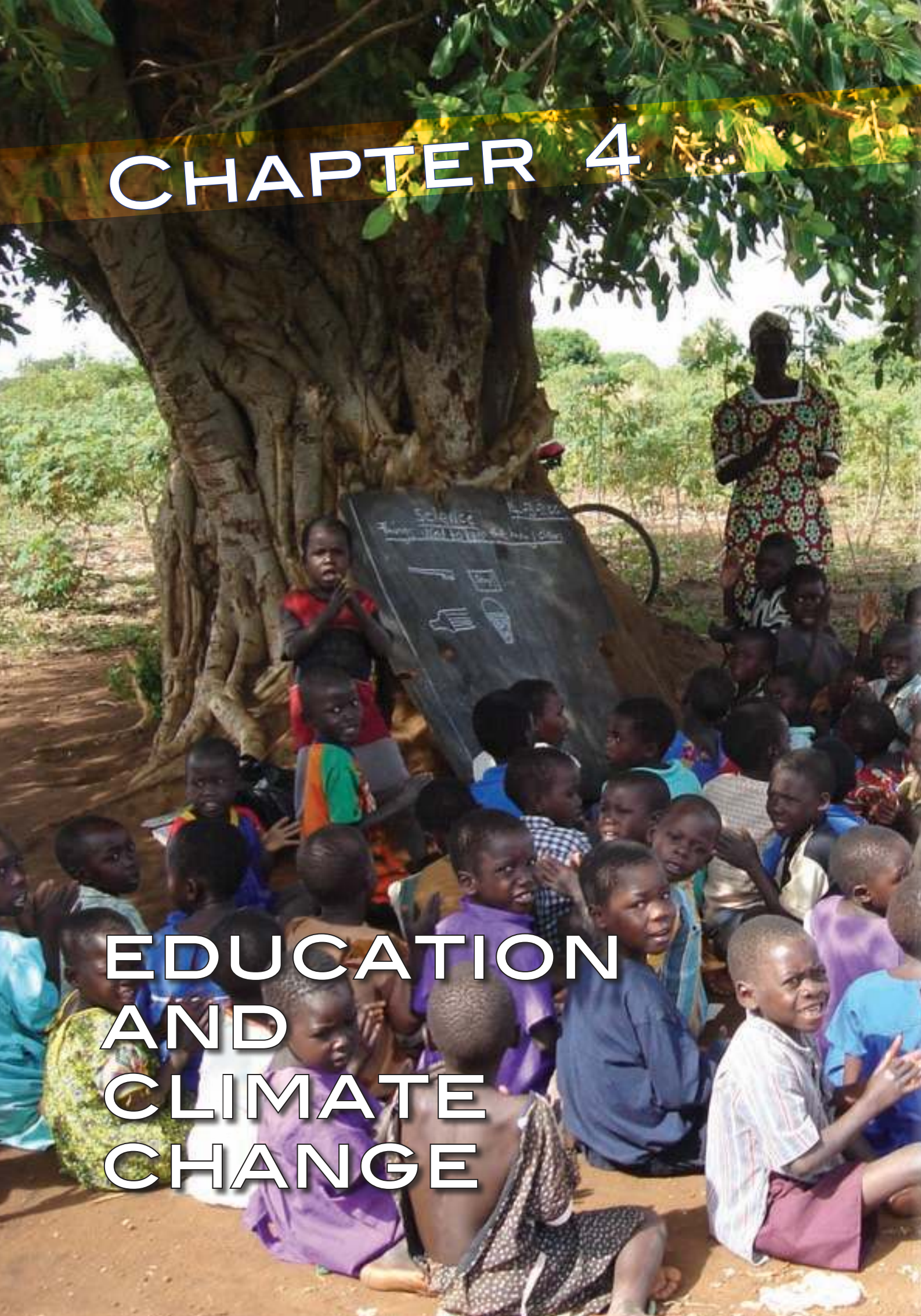
Climate change challenges national governments to think beyond their own borders and to act in the interest of the entire international community in a coordinated and unified manner as never before. Understanding the complexities of climate change has also challenged the international scientific community to work together in order to provide the necessary models and information needed to enable realistic and effective decision-making. However, there still remains much to be done to meet the common challenge of climate change.

Additional Resources

1. UNFCCC. http://www.unfccc.int
2. Local Government Climate Roadmap. http://www.iclei.org/index.php?id=7694
3. World Resources Institute - Climate, Energy and Transport. http://www.wri.org/climate
4. Green Economy Report: A Preview, UNEP, 2007. http://www.unep.org/GreenEconomy/
5. IPCC (2007). Climate Change 2007: Synthesis Report. Geneva, Switzerland. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm



Zoï Environment Network and GRID-Arendal 2009



CHAPTER 4

EDUCATION AND CLIMATE CHANGE

Education represents an important strategic resource in the fight against climate change and preparation for its current and future impacts. Education policies and curricula need to promote strategies to address climate change, in terms of **mitigation** and **adaptation** by increasing knowledge and understanding of the causes and impacts. Additionally, it should enhance knowledge, skills, values and attitudes for effective mitigation using appropriate action-oriented pedagogies.

Education for sustainable development (ESD) provides a framework for climate change education. It includes a wide spectrum of educational responses to climate change, and promotes a systemic and multi-disciplinary understanding of the causes and consequences. It proposes learning approaches that deliver critical thinking and problem-solving skills, as well as the attitudes and knowledge that empower individuals and communities to make informed and responsible decisions.

Climate change education for **mitigation** should make people aware of the impacts caused to the climate by greenhouse gas (GHG) emissions, as a result of consumption patterns and lifestyles, and should teach alternative, more sustainable solutions.

Climate change education for **adaptation** prepares learners for uncertain futures that hold both risks and opportunities. Climate change has a particularly severe impact on the life of rural populations, coastal communities and girls and women, so these populations must be targeted with education programmes to increase their adaptive capacities, in addition to overall community resilience to climate-related hazards.

Preparing and protecting learners, education systems, and educational infrastructure against the impacts of climate change are also of paramount importance. Climate change-induced disasters can damage or destroy school buildings and render education systems non-functional, threatening the physical safety and psychological well-being of communities and interrupting educational continuity. Disaster preparedness programmes are essential to saving lives, teaching learners how to react in disaster situations.

Climate change, population growth, poverty, environmental degradation, water shortages, conflict, global health crises...the list of current global problems and looming climate change impacts is long and daunting, yet each individual and community plays an essential role in contributing to or mitigating the extent of each one of these problems. This chapter describes educators' and education's role in showing the way forward.

4.1 Education for Sustainable Development - Taking climate change education beyond science

The traditional thinking on climate change education (CCE) in formal educational settings is limited to teaching atmospheric composition and processes from a natural science perspective. Climate science has traditionally been taught in geography (e.g. climatology) and earth science (e.g. meteorology). This part of CCE can be easily updated in primary and secondary education through cyclical revisions of the science curriculum, which take place in many countries about once every decade.[45] Climate change education, however, is greater than climate science. It is cross-curricular and cuts across various disciplines.

Mitigating as well as adapting to climate change is going to take far more than knowledge of the natural sciences. For places where the impacts of climate change are not immediate or extreme, an appropriate educational goal is mitigation and solidarity — working together to lessen climate change for ourselves and others around the world. Climate change mitigation requires a change in consumption patterns and fuel use for everyone. This will require large-scale public awareness (i.e. non-formal education) campaigns inclusive of all people of all ages to change behaviours. However, CCE will also need to include training for the workforce as well as schooling (i.e. formal education) and informal (e.g. media) education.

In places in the world where the sea level is rising, droughts parch the land, or floods inundate homes and fields, educating for adaptation is essential. The skills needed for people to adapt to climate change will include decision-making to promote positive change against a background of uncertainty and instability. However, the discussion concerning which other skills should comprise CCE is complex: information and knowledge are important; so too are skills, values and principles.

45 'Rethinking Climate-Change Education: Everyone wants it, but what is it?' The Green Teacher, 89, R. McKeown and C. Hopkins, Summer, 2010.

CHAPTER 4

Fortunately, 'Education for Sustainable Development (ESD)' is an existing framework that can help clarify the complexity of CCE and quicken its implementation.

Education for sustainable development: A valuable framework for CCE

Major UN partners working on CCE (i.e. UNEP, UNESCO and UNICEF) agree that ESD constitutes the best available framework for addressing climate change through education. Generally ESD is the collective contribution of the world's education, public awareness and training systems to sustainable development.

The ESD framework and pedagogies provide an educational framework for many environmental, social, economic, ethical and political issues and are thus ideal for addressing the wide variety of impacts related to climate change.

ESD can be implemented in myriad ways such that the resulting ESD programme is locally relevant and culturally appropriate, reflecting the unique environmental, social and economic conditions of each locality. Furthermore, ESD increases civil capacity by enhancing and improving the workforce, social tolerance, environmental stewardship, participation in community-based decision-making, and quality of life. These features enable climate change education to acquire a wider and deeper meaning and applicability through close association with ESD (see 'Education for...' text box).

Education for sustainable development has four thrusts:

1. Improving access to and retention in quality basic education,
2. Re-orienting existing education programmes to address sustainability,
3. Increasing public awareness, and
4. Providing training.[46]

Climate change education fits within all four thrusts. Like ESD, it requires teaching across all age groups and engages with formal, non-formal and informal education. The following section describes how CCE dovetails with each of the four thrusts of ESD.

Education for Sustainable Development:

- is based on the principles and values that underlie sustainable development;
- deals with the balanced well-being in all three realms of sustainability — environment, society and economy;
- promotes life-long learning;
- is locally relevant and culturally appropriate;
- is based on local needs, perceptions and conditions, but acknowledges that fulfilling local needs often has international effects and consequences;
- engages formal, non-formal and informal education;
- accommodates the evolving nature of the concept of sustainability;
- addresses content, taking into account context, global issues and local priorities;
- builds civil capacity for community-based decision-making, social tolerance, environmental stewardship, adaptable workforce and quality of life;
- is interdisciplinary. No one discipline can claim ESD for its own, but all disciplines can contribute to ESD;
- uses a variety of pedagogical techniques that promote participatory learning and higher-order thinking skills.

Improving access to and retention in quality basic education

Climate change impacts, as described in earlier sections of this guide, will cause substantial environmental, social, and economic changes. All of these will present significant challenges to educational systems.

The effect of poverty on families and communities also impacts school enrolment. Policies and programmes are necessary to ensure that children enroll in school and stay enrolled despite poverty induced by climate change.

Climate change is likely to cause people to migrate in large numbers. Migration destination countries and regions need to ensure that children in displaced families can still access learning opportunities or education (see 'School System...' text box).

46 United Nations Decade of Education for Sustainable Development (2005—2014): International Implementation Scheme.

School System Disaster Response

The response of school systems in providing educational services to displaced families from New Orleans and other coastal cities when hurricanes Katrina and Rita hit the Gulf Coast of the United States in 2005 provides an example of accommodating children affected by an extreme weather event. Schools and school districts expedited enrolments to assure children did not remain out of school for an extended period of time. The US Congress approved funding for schools, which were educating displaced students. In some cases families returned to their hometowns when schools reopened; in other cases the families stayed permanently in their new communities and schools were able to deal with the fluctuation of enrolments.

Reorienting existing education programmes to address sustainability

Curricular revisions, not only in science and mathematics education, but also in the social sciences and humanities are needed to educate the younger generation about climate change, and to stimulate the problem-solving and critical thinking skills needed to generate solutions at the local and global levels. For some geographic regions, re-orienting education will go deeper. In the case of climate-induced migration, new skills may be necessary to live with members of other ethnic groups and/or cope with a changing physical environment. These need to be incorporated into the curriculum.

Reorienting curricula to address sustainability and climate change requires the inclusion of relevant knowledge, skills, perspectives, and values as well as methods for how these should be applied to the further study of related issues. It also requires changing pedagogical techniques to foster higher-order thinking skills, support decision-making, involve participatory learning and stimulate the formulation of questions. Pedagogical methods should also acknowledge the learners' knowledge and experience and make content relevant to daily life. Methods of instruction and the learning process should be adjusted to engage students that respond to different learning styles.[47]

47 Contributing to a More Sustainable Future: Quality Education, Life Skills and Education for Sustainable Development. UNESCO, 2005b.

Increasing public awareness

Eliciting a response to climate change from the general public requires significant behavioural shifts. For mitigation, the response will require thoughtful changes related to energy use and consumer habits. Major public awareness campaigns, characterized by unbiased and reliable information, are needed to initiate appropriate changes in lifestyle. Both individual and collective actions (e.g. public participation in support of implementation of climate change legislation) play an important part in any widespread response to climate change.

Providing training

Many of today's adults received their schooling before climate change was a issue. As a result, professional development and training related to climate changes are needed for all sectors of the workforce to reduce atmospheric emissions of greenhouse gases and to move towards a green economy. Today, more than 95% of businesses are small and medium-sized. Generally, smaller businesses cannot provide their own training related to climate change and will depend on external sources of professional development.

Effective integration of CCE

For CCE to be effective it should be incorporated into educational plans and policies. Changes in educational systems need to occur in programmes, practices and policies. For example, changes in primary and secondary curriculum need to be accompanied by changes in assessment, as well as teacher education. Mandates for public information to help achieve conservation goals must be accompanied by funding.

Climate change brings with it a sense of urgency to which the education community is responding, but it cannot do so alone. Coordination and policy support of such efforts are also needed to bring about more effective change.

Additional Resources

1. Climate Change Education for Sustainable Development, UNESCO, 2010. http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/climate-change-education/
2. Contributing to a More Sustainable Future: Quality Education, Life Skills and Education for Sustainable Development. UNESCO, 2005b.

http://unesdoc.unesco.org/images/0014/001410/141019e.pdf

3. Food Security and Climate Change Challenge Badge. World Association of Girl Guides and Girl Scouts. 2009. http://www.wagggsworld.org/en/resources/document/view/3833
4. Hurricane Katrina and Rita: The School Impact. Education Week. http://www.edweek.org/ew/collections/hurricane-katrina/index.html
5. 'Rethinking Climate-Change Education: Everyone wants it, but what is it?' The Green Teacher, 89, R. McKeown and C. Hopkins, Summer, 2010
6. 'United Nations Decade of Education for Sustainable Development (2005—2014): International Implementation Scheme', UNESCO, 2005. http://unesdoc.unesco.org/images/0014/001486/148650E.pdf

Satisfying Global Consumption Requires Resources of 1.5 Earths

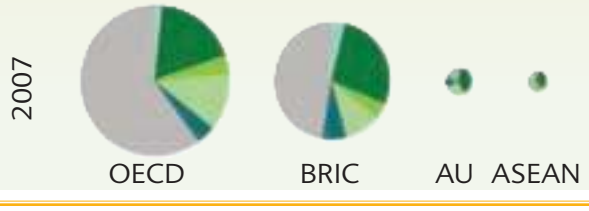
Humanity's Ecological Footprint has more than doubled since 1966. In 2007, humanity used the equivalent of 1.5 planets to support its activities.

Even with modest UN projections for population growth, consumption and climate change, by 2030 humanity will need the capacity of two Earths to absorb carbon dioxide waste and keep up with natural resource consumption.

The scope of the challenges humanity faces not only for preserving biodiversity, but also for halting climate change and meeting human development aspirations, such as reducing worldwide hunger and poverty are imense. Yet change is possible.

From: **The Global Footprint Network 2010 Living Planet Report**. http://www.footprintnetwork.org/en/index.php/GFN/page/2010_living_planet_report/

Relative ecological footprint of four country groupings



4.2 Education for Mitigation - Changing behaviour for the common good

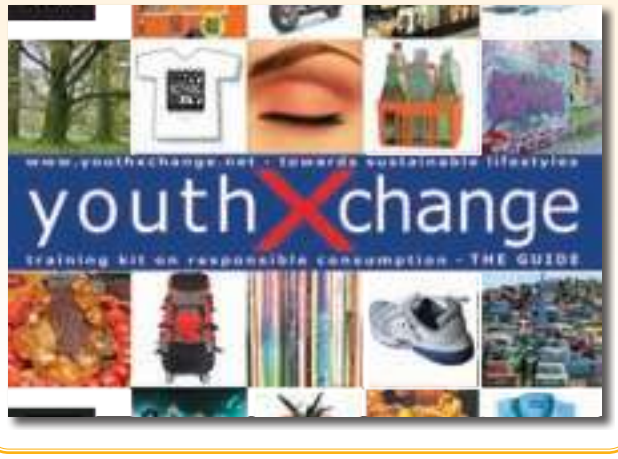
Climate change **mitigation** is defined by the United Nations as a human intervention to reduce the sources of greenhouse gas (GHG) emissions primarily linked to human actions of production and consumption.

Every day, people engage in consumption to varying degrees — we eat, move about, clothe and shelter ourselves as we go about our daily routines. The global economy exists to allow this consumption to occur, producing and delivering the goods and services we require, desire and can afford. Our lifestyle choices define, connect and differentiate us. They are representative of the ways in which we lead our lives and interact with one another in our global society of nearly 7 billion people.

On a global scale, our day-to-day life and choices may seem like a drop in the ocean, especially when

Climate Change Mitigation Information Targeted to Youth

The UNEP/UNESCO YouthXChange Guidebook on Climate Change and Lifestyles can be used in classroom teaching to explore the links between lifestyles and climate change and help young people consider the actions they might take towards more sustainable lifestyles it provides examples and case studies on actions that promote greater understanding of climate change and lifestyles among youth. The guidebook is downloadable from www.youthxchange.net.



it comes to confronting challenges that have far-reaching environmental, social and economic implications. But scientists have shown that small variations can affect giant systems — the way in which we live impacts not only ourselves but also our natural environments and societies worldwide (see 'Satisfying Global...' text box). Many opportunities exist through our individual and collective choices to initiate change and create solutions for sustainable lifestyles. Practically, this involves adopting attitudes and learning skills to reduce energy consumption, use renewable forms of energy, design greener technologies, make changes in consumption patterns, mitigate biodiversity loss, etc., while ensuring quality of life for all. Everyone — from politicians to educators, school administrators and students — has a role to play in facilitating the shift towards more sustainable lifestyles.

Education for mitigation must not simply introduce new content about climate change, causes and consequences. 'Climate change education is about helping learners understand and address the impacts of global warming today, while at the same time encouraging the change in attitudes and behaviour needed to put our world on a more sustainable path.'[48] It must equip individuals with the values, knowledge and skills to make choices and decisions that minimize the use of natural resources, emissions, waste and pollution while supporting equitable socio-economic development and progress for all and contributing to the growth of new solutions. It enables each and every person to rethink the way they live, buy and consume. It also entails rethinking how our daily lives are organized, altering the ways in which people socialize, exchange, share, educate and build identities.

Education for mitigation must therefore not only teach the global problems linked to climate change, but also local solutions currently emerging everywhere. This calls for contextualised approaches to curriculum development and implementation with respect to climate change mitigation. Local solutions to reducing CO_2 emissions such as public transportation or collaborative consumption examples such as community gardens are but two examples that can empower practitioners and educators and their audiences. Schools can lead by example by strengthening mitigation programmes (e.g. reuse, reduce, recycle) or by integrating new programmes (e.g. school gardens).

Young people and young adults entering life as citizens and professionals can be catalysts for social, cultural and technological innovation. They are also key actors in shaping lifestyles and consumption trends. In a globalized and virtually connected world, young people are often the drivers of innovation — actors of change essential to build a sustainable planet (see 'Children and...' text box).

Children and Youth as Agents of Change

The World Association of Girl Guides and Girl Scouts (WAGGGS), with 10 million members globally, has a Food Security and Climate Change challenge badge for ages 5- 10, 11-15, and 16 — 20. A youth guide and a resource activity pack support the challenge badge. It motivates young people to take actions to improve their lives and encourage their local communities to become more environmentally friendly. The Guide raises awareness about the contribution of everyday activities to climate change.

©WAGGGS (Cancun COP 16)

Additional Resources

1. UNEP UNESCO YouthXChange Guidebook Towards Sustainable Lifestyles: This programme and guidebook (translated into eighteen languages) aims to engage young people worldwide on issues of sustainable consumption. http://www.YouthXchange.net/ http://www.unep.fr/scp/youth/publications/
2. The Story of Stuff: This resourceful website and twenty-minute video animation exposes the connections between a number of environmental and social issues, and provides solutions to create a more sustainable world. http://www.storyofstuff.com/blog/

48 Koïchiro Matsuura, former Director-General of UNESCO, 2009.

3. 350.org: This international campaign works to build a movement to unite the world around solutions to climate change. http://www.350.org
4. Looking for Likely Alternatives/Sustainable Everyday Project: This website includes case studies, videos and pedagogical tools to teach sustainability in a creative way. http://www.sustainable-everyday.net
5. Eco-Schools — Foundation for Environmental Education: This programme promotes sustainable development through environmental education (formal school education, training of staff and general awareness raising). http://www.eco-schools.org/
6. Create your Future: developed for children by the organization Japan for Sustainability, this interactive website contains many new ideas and ways to rethink current consumption patterns. http://www.kidsforfuture.net
7. Facing the Future provides curriculum resources, teacher workshops, and service learning opportunities used by teachers, schools, and districts in all 50 U.S. states and over 120 countries. http://www.facingthefuture.org

Videos, lessons plans and curricula inspirations

1. The Green Education Foundation. http://www.greeneducationfoundation.org/
2. The Center for Environmental Education. http://www.ceeonline.org/
3. Do the Green Thing. http://www.dothegreenthing.com
4. The Green School. http://www.thegreenschool.org

4.3 Education for Adaptation - Learning to deal with local changes

Climate change is impacting on the lives of people and communities around the globe. The effects of climate change are forcing people to change their livelihoods, prepare for and recover from disasters and, in some cases, move to new places or countries.

Education can play an important role in facilitating adaptation to the challenges posed by climate change. It can help reduce the vulnerability of communities and improve their capacity to adapt to changes in their social, economic and ecological environment, and an uncertain future. Most importantly, it helps individuals to make informed decisions on how to adapt their lives and livelihoods to the effects of climate change and reduce risk and vulnerability.

Community-based Monitoring

Community-based monitoring (CBM) is a complex research field that is becoming an essential and often required component in academic research and natural resource management (Fleener et al., 2004; Huntington, 2008). It is often used as a validation of results produced by conventional research methods. CBM enables researchers to reach beyond traditional data collection strategies by using the best available knowledge, be it academic, indigenous or local.

The Circumpolar Biodiversity Monitoring Program commissioned the development of a Community-Based Monitoring Handbook (Gofman and Grant Friedman, 2010). The handbook enhances the role of community-based observations in the current and emerging Arctic research projects and recommendations can also be applied to broader monitoring efforts and in non-Arctic regions. The Handbook reviews several ongoing community monitoring programmes, and is written for a diverse audience that includes scientists, students, Arctic community residents and government officials.

Projects reviewed include:

- Arctic Borderlands Ecological Knowledge Co-op (http://taiga.net/coop/)
- Community Moose Monitoring Project and Community Ecological Monitoring Project, ECORA (Integrated Ecosystem Approach to Conserve Biodiversity and Minimize Habitat Fragmentation in the Russian Arctic, http://www.grida.no/ecora/)
- Marine Rangers Project in Australia (www.atns.net.au/agreement.asp?EntityID=4923)
- Siku-Inuit-Hila Project (Chapter 3.10) and Snowchange Network in Finland (http://www.snowchange.org)

Education for adaptation is not an easy task. The future of vulnerable communities in coastal areas, deserts or mountains is already uncertain in the short term. Education for adaptation therefore has to prepare for futures characterized by uncertainty. Adaptation to climate change requires individuals to be aware of potential changes in the climate and to understand the implications on their lives. It requires them to assess the risks such changes hold for their future, and to take informed decisions on how to adapt their livelihoods and homes.

Quality education that equips individuals with critical thinking and problem-solving skills improves the adaptation capacities of affected communities. Education programmes that explicitly prepare for disaster, and promote indigenous knowledge, sustainable lifestyles and sustainable development will further enhance these capacities.

Education for adaptation plays a key role in enhancing the resilience of communities, in particular, in **rural areas** where livelihoods are dependent on the weather. Education programmes can help to raise awareness of changing farming requirements and incorporate climate information into the decision-making of rural communities. In agriculture, for instance, adaptation options for education may explore opportunities of reducing dependency on rain-fed agriculture, adopting drought resistant and early maturing varieties, as well as better use and management of rain water through rainwater harvesting. These may require the use of action enquiry strategies in teaching and learning.

The education **of girls and women**, in particular, has a remarkable impact on the capacity of communities to adapt to climate change. The responsibility for securing food, water and energy for cooking frequently lies with women and girls, who also become leading actors in the event of disasters. Women often form part of strong social networks within their communities and can play a vital role in the collective management of risk and change as well as educating peers on the same.

Indigenous and local knowledge is a key resource for communities in understanding the environment, and assessing and adapting to climate change impacts. It should be strengthened and integrated into education programmes. Building on students' knowledge of local communities and their culture and value systems is essential. This makes climate change education more authentic and relevant to specific situations, and helps to find local, realistic and affordable solutions for adaptation.

In places facing immediate and extreme impacts, such as low-lying small island states, schools may also play a role in **preparing the population for migration**. They can ensure that students acquire the necessary language skills and qualifications to assist them in adapting to new homelands and establishing new livelihoods. Adaptation strategies therefore need to strengthen the capacity of education systems in countries receiving migrants to enable them to respond to new migration streams and provide the requisite skills to assist adaptation.

Education systems and related infrastructure need to be equipped to adapt to climate change. Entire school communities including authorities, administrative staff, teachers and parents must be prepared to ensure a **climate-safe school environment** — for example, through the development of school and community action plans and 'climate-safety codes'.[49]

Educators can Raise Awareness on Climate Change-related Health Problems

Find out what health issues are most likely to be worsened by climate change in your geographical location. WHO websites, including those of regional and country offices, feature scientific and advocacy information on climate change and health. The Intergovernmental Panel on Climate Change (IPCC) periodically publishes Assessment Reports which include a section on human health. Many national governments, scientific and health organizations and some sub-national authorities also publish information on the health impacts of climate change in their territories.

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49 Climate-safety Codes are short statements in the form of do's and don'ts with inherent adaptation and mitigation messages and values. These can be publicly displayed in strategic points in the schools where learners can repeatedly read, internalize and adopt them as part of their value systems.

Adaptation also needs to be taken into account when constructing schools to ensure safe school sites and **climate-proof design**. Thorough risk assessments should be undertaken when choosing school locations and improving buildings to withstand severe weather conditions caused by climate change.

Negative effects of climate change on **health** will likely be defining factors throughout most of the adult life of today's students.[50] Children — in particular, those living in poor countries or living with pre-existing health conditions like asthma — are among the most vulnerable and will be exposed to the resulting health risks and related consequences for a longer period of time. It is therefore vital that students be made aware of the current and predicted impacts of climate change so that they can act to better protect themselves and the health of their families. Health education can help prepare learners to confront such challenges (see 'Educators can...' text box, previous page).

Additional Resources

1. Climate Frontlines: a platform for indigenous peoples, small islands and vulnerable communities' knowledge on climate change, UNESCO. http://www.climatefrontlines.org/
2. Guide on climate change and indigenous peoples, TEBTEBBA, 2009. http://www.tebtebba.org/index.php?option=com_docman&task=doc_download&gid=468&Itemid=27
3. Participatory Learning in Practice: Community Based Adaptation to Climate Change, International Institute for Environment and Development (IIED), 2009. http://www.childreninachangingclimate.org/database/other/Publications/NP_PLA_CBA_14573IIED.pdf
4. Sandwatch manual: Adapting to Climate Change and Educating for Sustainable Development, UNESCO, 2009. http://www.sandwatch.ca/New%20Sandwatch%20Manual/Manual.pdf
5. Climate and health factsheet. WHO, 2005. http://www.who.int/globalchange/publications/factsheets/fsclimandhealth/en/index.html
6. Fourth Assessment Report, Intergovernmental Panel on Climate Change, Working Group II, Section 8 (human health). http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch8.html
7. Global health risks: Mortality and burden of disease attributable to selected major risks. World Health Organization, 2009. http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf
8. Protecting health from climate change. Messages to different groups and sectors (Young people, 16—24 years old). World Health Organization, 2008. http://www.who.int/globalchange/publications/factsheets/WHD2008_young_people_2.pdf
9. WHO Manual for Students (South Asia Regional Office). http://www.searo.who.int/LinkFiles/World_Health_Day_2008_Toolkit-Student-Manual.pdf
10. WHO Manual for Teachers (South Asia Regional Office). http://www.searo.who.int/LinkFiles/World_Health_Day_2008_TeacherManual.pdf
11. WHO portal on climate change and health. http://www.who.int/globalchange/en/

4.4 Education for Disaster Risk Reduction - Preparing for the worst

What is the link between climate change and natural hazards and disasters?

Climate change is expected to increase the frequency and intensity of climate-related hazards such as floods, droughts and heat waves.

The capacity of communities, particularly in low-income countries, to cope may be diminished as a consequence of continual climate change-related degradation of ecosystems, reduced availability of water and food, and loss of biodiversity and natural assets, thus increasing their vulnerability.

When vulnerable communities lack the resilience and resources to cope with a hazard, such hazards become disasters. Other variables such as population growth may also compound and exacerbate the impacts of climate change in increasing the likelihood of disasters.

50 Climate and health factsheet. World Health Organization, 2005.

Disaster risks multiply with the intensity of the hazard and with social and environmental vulnerabilities of the society and the environment. In turn, they may be reduced by society's ability to cope with the hazard, as shown in the following equation:[51]

$$\text{Disaster risk} = \frac{\text{Natural hazard} \times \text{Vulnerability}}{\text{Capacity of societal system}}$$

What are the impacts of disasters on education?

Natural disasters can destroy schools and can render education systems non-functional, thus affecting the physical safety and the psychological well-being of individuals and communities. School enrolment may decline among the most vulnerable, often girls, those living in poverty and in child-headed households, or learners enrolled in school but who rarely attend. Moreover, the quality of education may also be impaired as a result of disasters. According to UNICEF, approximately 175 million children are likely to be affected by an expected increase in climate change-related natural disasters in the next 10 years[52]. UNISDR estimates that more than half a million children are displaced from school every year due to flooding alone,[53] with floods amongst the most frequent and recurrent natural disasters worldwide.

Why is education important for Disaster Risk Reduction?

While the negative effects of disasters on education have to be taken into account and acted upon to ensure that the protective dimensions of the school system are not lost, education is also an instrument for preventing disasters from happening. Many hazards only become disasters due to human behaviour or as a result of a lack of preparedness. What people **know** has therefore often been demonstrated to be more important than what people **have** when it comes to avoiding or limiting the harmful consequences of hazards.

Ensuring quality education before, during, and after disasters can help build individual and community resilience to future climate change-induced disasters. It can reduce vulnerabilities to hazards by equipping learners and their communities with life-saving knowledge and helping them to develop positive coping mechanisms. Education can be instrumental in building local capacity to cope after disasters and in helping learners and the community to return to a normal life.

Education facilities may in a similar way represent a safe place for children in an insecure environment. Education thus represents a critical component of Disaster Risk Reduction (DRR) responses, which help communities and individuals prepare for disasters and prevent and mitigate their vulnerability to risk.

Disaster Risk Reduction and educational activities

There are a variety of concrete DRR activities that education planners and practitioners can design and implement at national, district or classroom level to help ensure educational continuity, and to strengthen education systems and learning on DRR. Successful DRR and education programmes often have three key components: (1) safe school construction; (2) disaster prevention education, including curriculum development, the integration of DRR awareness and knowledge into the provision of education; and (3) integration of DRR into policy and planning.

1) Safe school construction

Safe education facilities are essential to preparedness planning and, ultimately, in reducing risk. Policy-makers should advocate for legislation on safe school facilities that is linked to funding, to ensure that all new school buildings are built to satisfactory standards and resistant to potential local climate-related hazards and risks, and that existing schools are assessed and retrofitted when necessary. Such legislation should also specify that schools should not be built in hazard or disaster-prone areas, such as flood plains. Focus should also be placed on training and providing incentives to local builders to abide by hazard-resistant standards. Moreover, the media (radio, television, newspapers, internet, etc) can be used to highlight the dangers of unsafe schools for children, and to encourage a culture of safety. In this context, the INEE guiding principles[54] constitute an important instrument to address critical gaps relating to disaster resilient construction and retrofitting of school buildings.

51 'The role of local institutions in reducing vulnerability to recurrent natural disasters and in sustainable livelihoods development in high-risk areas', Asian Disaster Preparedness Centre, FAO Case Study, 2003.
52 UNICEF Humanitarian Action Report, 2010.
53 UNESCO Framing Paper for DRR and Education, 2010, Internal document.
54 INEE Guidance Notes on Safer School Construction, http://gfdrr.org/docs/Guidance_Notes_Safe_Schools.pdf

Disaster Kit Components

The UNISDR Guidance on School Emergency and Disaster Preparedness also provides a suggestion for a 'first aid kit'. It cites an example from the American Red Cross for first aid kits for a family of four that includes:

- 2 absorbent compress dressings (5 x 9 inches)
- 25 adhesive bandages (assorted sizes)
- 1 adhesive cloth tape (10 yards x 1 inch)
- 5 antibiotic ointment packets (approximately 1 gram)
- 5 antiseptic wipe packets
- 2 packets of aspirin (81 mg each)
- 1 blanket (space blanket)
- 1 breathing barrier (with one-way valve)
- 1 instant cold compress
- 2 pair of nonlatex gloves (size: large)
- 2 hydrocortisone ointment packets (approximately 1 gram each)
- Scissors
- 1 roller bandage (3 inches wide)
- 1 roller bandage (4 inches wide)
- 5 sterile gauze pads (3 x 3 inches)
- 5 sterile gauze pads (4 x 4 inches)
- Oral thermometer (non-mercury/nonglass)
- 2 triangular bandages
- Tweezers
- First aid instruction booklet

http://readyclassroom.discoveryeducation.com/media/pdfs/SCHOOL-EMERGENCY-SUPPLIES-GO-KIT.pdf

2) Disaster prevention education

Governments must commit to teacher training and curricula development to support large-scale teaching on DRR. Disaster prevention and preparedness need to be incorporated throughout formal curricula and through co-curricular and informal means. Students can be taught about disasters and their impacts on people's lives as part of the science and life-skills curricula. While classes should familiarize students with local hazards and what to do in an emergency, a multi-hazard approach should be adopted to instruct learners about the variety of hazards that exist. Policy-makers can engage teachers and students in adapting, developing and testing high-quality interactive materials and strategies to teach DRR, while teachers should be trained in how to create safe learning environments that promote the protection and well-being of learners. Disaster risk reduction education should be integrated into all levels and types of education. A number

Preparing a School Emergency Preparedness Plan

The components of a school DRR emergency and preparedness plan are available in UNISDR's Guidance Notes on School Emergency and Disaster Preparedness.

http://www.unisdr.org/preventionweb/files/15655_1msshguidenotesprefinal0313101.pdf

publications and resources have been developed by key actors, including INEE, ISDR, COGS and TPKE.[55]

3) Policy and planning

Disaster risk reduction and education initiatives must involve education policy-makers, planners and officials at all levels. This is key to ensuring their success and sustainability. Officials need to make sure that a clear DRR policy for education exists and that contingency plans are in place for when a hazard or disaster does strike. Management and accountability systems are also essential as safeguards to ensure that policies and plans are carried out. Similarly, education should be included as part of national DRR and response plans, to ensure its distribution and implementation.

Measures at the school level could involve establishing school safety committees and developing school emergency and disaster preparedness plans. These can include policies and procedures that promote the safety and welfare of students, and the protection of school buildings, education materials and furniture (see 'Preparing a...' text box). Emergency drills should be held regularly to develop students' capacity to respond to disasters and to identify training needs. First aid kits or disaster kits modelled after earthquake survival kits should be introduced into schools where necessary, along with training on their use (see 'Disaster Kit...' text box).

55 INEE: International Network for Education in Emergency; ISDR: International Strategy for Disaster Reduction; COGS: Coalition for Global School Safety and Disaster Prevention Reduction; TPKE: Thematic Platform on Knowledge and Education.

DRR and Education Intervention — Two Examples

Following cyclone Nargis, which struck Myanmar in 2008, UNESCO's Myanmar Education Recovery Programme (MERP) provided technical assistance to complement the humanitarian efforts of the government and the UN system. The objective was to enhance the resilience of the education sector by ensuring that disaster risk reduction and emergency preparedness became integral parts of the planning and management of the education system. UNESCO concentrated on the promotion of a culture of safety through a participatory approach involving education officials at all levels, as well as representatives from local communities, so that they could all do their part to effectively implement and monitor the response, rehabilitation and recovery programme. The organization was also involved in the delivery of DRR resource packs for township education officers, school principals, teachers, and an estimated 400,000 students from affected townships.

Following the floods in Namibia in early 2009, UNESCO developed lessons learnt on flood response in the education sector and shared good practices with national authorities and partner organizations. As in Myanmar, the agency adopted a multi-level approach by targeting both government and the community. Workshops were held with the aim of strengthening the national capacity for education in emergency preparedness. Concurrently, DRR school manuals drawing on indigenous knowledge were developed, local journalists were trained in DRR, and radio programmes on disaster risk reduction were supported.

Students Influence the Move to a Safer School Location

In the Phillippines, after learning that their school was at high risk of landslides following a risk assessment, children's organisations conducted a campaign to educate their peers on the physical processes of landslides and many students also wrote to the School Division Superintendent to express their desire to locate. The School Headmaster had decided to hold a community referendum on whether to relocate the school, and although the parents were initially against it and students for it, the students' efforts were able to influence the vote so that the school was moved to a safer location.

Full story at: http://www.plan-uk.org/what-we-do/disasters/increasing-resilience/25540/

CHAPTER 4

Guiding principles

1) Learners as agents of change

Children, youth and other learners should be encouraged and supported to spread DRR knowledge. Although students are often the most vulnerable in the face of disasters, they can play a key part in building community resilience, acting as bridges between families and communities. Transferring DRR skills to children and youth increases the likelihood that vital knowledge on how to reduce risk will be passed on to future generations. Schools and child and youth clubs can also play an important role in disaster prevention through involving children in awareness-raising activities (street dramas, theatre, music performances and games, etc). Street posters can also be a useful tool for raising awareness on DRR issues. Children and youth can also get directly involved in other DRR initiatives such as tree planting, water harvesting and drip irrigation (see 'Students Influence...' text box, previous page). The inclusion of DRR messages in radio programmes for and by children and youth is also a means to reach a wider community, especially those in distant rural areas.

2) Targeting the most vulnerable

It is important to reach out to the most vulnerable who are often the worst affected by disasters, but tend to be ignored in preparedness work and even in some emergency responses. These include the elderly, the disabled, children and youth living or working on the street, those in child-headed households, or learners enrolled in school but who rarely attend. These groups need to be specifically targeted in DRR education, and the programmes should be conscious of local gender dynamics.

Additional Resources

1. UNISDR. Guidance Notes on School Emergency and Disaster Preparedness. http://www.unisdr.org/preventionweb/files/15655_1msshguidenotesprefinal0313101.pdf
2. UNISDR. Let our children teach us. http://www.unisdr.org/eng/partner-netw/knowledge-education/docs/Let-our-Children-Teach-Us.pdf
3. UNISDR. Disaster Prevention for Schools Guidance for Education Sector Decision-Makers. http://www.preventionweb.net/files/7344_DPforSchoolssm.pdf
4. UNCRD. Reducing Vulnerability of School Children to Earthquakes. http://www.preventionweb.net/files /4001_UNCRDSESIpublication2008.pdf
5. IFRC. Better be Prepared: Protected School. http://www.proventionconsortium.org/themes/default/pdfs/CRA/VCA4_en.pdf
6. INEE Guidance Notes on Safer School Construction. http://gfdrr.org/docs/Guidance_Notes_Safe_Schools.pdf
7. American Red Cross. Anatomy of a First Aid Kit. http://www.redcross.org/ services/hss/lifeline/fakit.html
8. UNISDR. Towards a Culture of Prevention: Disaster Risk Reduction Begins at School — Good Practices and Lessons Learned. http://www.unisdr.org/eng/about_isdr/isdr-publications/11-education-good-practices/education-good-practices.pdf
9. Save the Children. Child-led Disaster Risk Reduction: A Practical Guide

   Part 1. http://sca.savethechildren.se/upload/scs/SEAP/publication/publication%20pdf/Disaster/Child-led%20Disaster%20Risk%20Reduction-A%20practical%20guide-part%201.pdf
   Part 2. http://sca.savethechildren.se/upload/scs/SEAP/publication/publication%20pdf/Disaster/Child-led%20Disaster%20Risk%20Reduction-A%20practical%20Guide-Part%202.pdf
10. UNICEF and UNISDR. Let's Learn to Prevent Disasters: educational kit and Riskland game. http://www.preventionweb.net/files/2114_VL108012.pdf

GLOSSARY OF TERMS USED

Adaptation: Adjustment in natural or human systems over time to a new or changing environment, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

Adaptive capacity: The concept of adaptive capacity is often used when describing a system's ability to adjust in response to climate change (i.e. to adapt). Enhancing a system's adaptive capacity is crucial for reducing its vulnerability to climate change risks. In ecological systems, adaptive capacity is related to diversity, whereas in social systems, institutions and networks play an important role.

Biodiversity: The variability among living organisms from all sources such as terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. It encompasses diversity within species, between species and of ecosystems.

Carbon footprint: A carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. and has units of tonnes (or kg) of carbon dioxide equivalent.

Carbon market mechanisms: To help countries meet their greenhouse gas emission targets under the Kyoto protocol, and to encourage the private sector and developing countries to contribute to emission reduction efforts, three market-based mechanisms were included in the Protocol — emissions trading, the clean development mechanism and joint implementation.

Climate: 'Average weather' described in terms of the mean and variability of relevant quantities such as temperature, precipitation and wind over a period of time ranging from months to thousands or millions of years. Climate can also be used to describe the state, including a statistical description, of the climate system. The period of time normally used is 30 years (WMO).

Climate change: Alternations in the state of the climate system over time due to natural variability or as a result of human activity. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural variability observed over comparable time periods."

Desertification: The degradation of land in arid, semi-arid, and dry sub-humid areas due to various factors including climatic variations and human activities. A major impact of desertification is reduced biodiversity and diminished productive capacity.

Disaster: a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster risk reduction (DRR): The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness and response for adverse event.

Ecosystem: A dynamic and complex system of living organisms and their physical environment interacting with each other as a functional unit. The extent of an ecosystem may range from very small spatial scales to the entire Earth.

El Niño: Systematic and reoccurring weather patterns of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe.

Geo-engineering: Technological options to achieve a deliberate manipulation of the Earth's climate to produce a planetary cooling effect in order to mitigate the impact of global warming from greenhouse gas emissions.

Global warming: Gradual increase, observed or projected, in global surface temperature, referred to as the global temperature, as one of the consequences of the enhanced greenhouse effect, which is induced by anthropogenic emissions of greenhouse gases into the atmosphere.

Greenhouse effect: A term describing the role the earth's atmosphere plays in insulating and warming the earth's surface. Without this effect the earth would be a frozen planet with an average temperature on the surface of about -18°C (about 0°F).

Greenhouse gas (GHG): Gaseous constituents such as water vapour (H_2O), carbon dioxide (CO_2),

GLOSSARY OF TERMS USED

nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) in the atmosphere. These gases, both natural and anthropogenic, can absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere, and by clouds causing the warming greenhouse effect.

Human displacement: The forced migration of a group of people due to a change in local circumstances (e.g. flooding, conflict, drought, etc.).

Hydrologic cycle: The movement of water as it evaporates from rivers, lakes or oceans, returns to the earth as precipitation, flows into rivers and evaporates again.

Intergovernmental Panel on Climate Change (IPCC): The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC. The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters.

Migration: Human migration is physical movement by humans from one area to another, sometimes over long distances or in large groups. The movement of populations in modern times has continued under the form of both voluntary migration within one's region, country, or beyond and involuntary migration.

Millennium Development Goals (MDG): A series of eight international development goals that all 192 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015. They include eradicating extreme poverty, reducing child mortality rates, fighting disease epidemics such as AIDS, and developing a global partnership for development.

Mitigation: A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

North Atlantic Oscillation: A permanent low-pressure system over Iceland (the Icelandic Low) and a permanent high-pressure system over the Azores (the Azores High) control the direction and strength of westerly winds into Europe. The relative strengths and positions of these systems vary from year to year and this variation is known as the North Atlantic Oscillation.

Ocean acidification: A decrease in the pH of seawater due to the uptake of anthropogenic carbon dioxide.

Reducing Emission for Deforestation and Degradation (REDD+): A set of steps designed to use market/financial incentives in order to reduce the emissions of greenhouse gases from deforestation and forest degradation. Its original objective is to reduce green house gases but it can deliver "co-benefits" such as biodiversity conservation and poverty alleviation.

Sustainable development: is a development that seeks to meet the needs of the present without compromising those of future generations. Sustainable development is a vision of development that encompasses populations, animal and plant species, ecosystems, natural resources and that integrates concerns such as the fight against poverty, gender equality, human rights, education for all, health, human security, and intercultural dialogue.

United Nations Framework Convention on Climate Change (UNFCCC): The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership. Under the Convention, governments: i) gather and share information on greenhouse gas emissions, national policies and best practices ii) launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries iii) cooperate in preparing for adaptation to the impacts of climate change.

THE UNESCO CLIMATE CHANGE INITIATIVE
FOUR CORE PROGRAMMES

1. Climate Science and Knowledge

Development of a Science-based UNESCO Climate Change Adaptation Forum.

The objective of the Forum will be to inform public and private sector stakeholders (national policy-makers, vulnerable communities and women, the local media, social, cultural and scientific networks and local, regional and international scientific organizations) in agriculture, fisheries (including aquaculture), forestry, alternative energy, fresh water, oceanography, environmental sciences, and coastal services of the longer-term climate projections and their potential impacts, as well as strengthen capacity for appropriate response strategies.

3. Climate Change, Cultural and Biological Diversity, and Cultural Heritage

Development of a Global Climate Change Field Observatory of UNESCO Sites.

The objective of this Observatory is to use UNESCO World Heritage Sites and biosphere reserves as priority reference sites for understanding the impacts of climate change on human societies and cultural diversity, biodiversity and ecosystems services, the world's natural and cultural heritage, and the possible adaptation and mitigation strategies, such as in relation to REDD+.

2. Climate Change Education (CCE) in the Overall Context of Education for Sustainable Development (ESD)

Development of a Climate Change Education for Sustainable Development Programme.

This programme uses innovative educational approaches to help a broad audience (with particular focus on youth) understand, address, mitigate, and adapt to the impacts of climate change, encourage the changes in attitudes and behaviours needed to put our world on a more sustainable development path, and build a new generation of climate change-aware citizens.

4. Climate Change, Ethics, Social and Human Sciences Dimensions

Development of a new policy-relevant, action-oriented Research Programme on the Social, Human, Ethical and Gender Dimensions of Climate Change.

This programme will focus in particular on the design and implementation of appropriate climate change adaptation actions, based on the MOST and environmental ethics programmes, benefitting the most vulnerable related to the cross-cutting issues of energy, water and biosphere management, as well as improve understanding of gender equality issues related to climate change.

For more information, please visit: www.unesco.org/en/climatechange

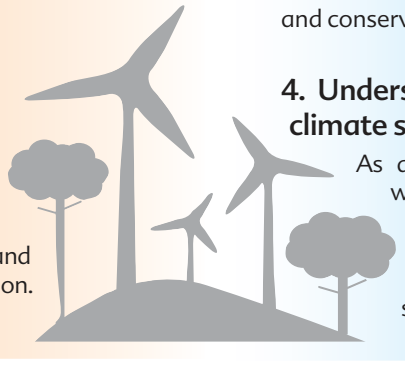
UNEP'S WORK ON CLIMATE CHANGE
FOUR CORE PROGRAMMES

1. Resilience to a changing climate

UNEP helps countries to reduce their vulnerability and use ecosystem services to build resilience against the impact of climate change.

2. Reducing Emissions from Deforestation and Forest Degradation (REDD)

UNEP supports countries to develop REDD strategies and to test innovative REDD pilot projects, including consideration of co-benefits such as biodiversity and livelihoods in REDD strategy and action.



3. Low carbon growth

UNEP support countries to make the transition to low carbon growth and green economies by promoting access to finance and scaling up clean and renewable energy sources, energy efficiency and conservation.

4. Understanding and awareness of climate science

As a science based organization, UNEP works to provide relevant climate change science and information for decision making to national policymakers and negotiators, major groups, civil society and the private sector.

For more information, please visit: www.unep.org/climatechange

United Nations
Educational, Scientific and
Cultural Organization

UNEP

CLIMATE CHANGE STARTER'S GUIDEBOOK

AN ISSUES GUIDE FOR EDUCATION PLANNERS AND PRACTITIONERS

More information

For more information on UNESCO's work on climate change, please visit our website:
http://www.unesco.org/en/climatechange

For more information on UNEP's work on Climate Change, please visit our website:
http://www.unep.org/climatechange

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