

Water and Climate Change:

Stats and Facts on Climate Change Impacts on Water Resources

General Impacts

- The Intergovernmental Panel on Climate Change states that ‘water and its availability and quality, will be the main pressures on, and issues for, societies and the environment under climate change’.¹ People will feel the impact of climate change most strongly through changes in the distribution of water around the world and its seasonal and annual variability.²
- Water is the primary medium through which climate change influences the Earth's ecosystems and therefore people's livelihoods and well-being. Already, water-related climate change impacts are being experienced in the form of more severe and more frequent droughts and floods.³
- Global warming will transform the hydrological patterns that determine the availability of water. Many of the world's most water-stressed areas will get less water, and water flows will become less predictable and more subject to extreme events.⁴
- Climate change will alter patterns of water availability by intensifying the water cycle. Droughts and floods will become more severe in many areas. There will be more rain at high latitudes, less rain in the dry subtropics, and uncertain but probably substantial changes in tropical areas.⁵
- Higher average temperatures and changes in precipitation and temperature extremes are projected to affect the availability of water resources through changes in rainfall distribution, soil moisture, glacier and ice/snow melt, and river and groundwater flows; these factors are expected to lead to further deterioration of water quality as well. The poor, who are the most vulnerable, are also likely to be affected the most.⁶

¹ IPCC Technical Paper on Water and Climate Change, p 7, <http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf>

² Stern, Nicholas, The Economics of Climate Change, Chapter 3 – How climate change will affect people around the world p63

http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/Chapter_3_How_climate_change_will_affect_people_around_the_world_.pdf

³ UN Water Policy Brief for COP15, p 1 http://www.unwater.org/downloads/UNWclimatechange_EN.pdf

⁴ United Nations Development Report 2006, Beyond Scarcity: Power, Poverty and the Global Water Crisis p15

<http://hdr.undp.org/en/media/HDR06-complete.pdf>

⁵ Ibid

⁶ Ibid

The Stern Report on the Economics of climate change outlines the potential impacts of climate change as expressed through water at various degrees of temperature increase⁷:

1°C	2°C	3°C	4°C	5°C
Small glaciers in the Andes disappear completely, threatening water supplies for 50 million people	Potentially 20 - 30% decrease in water availability in some vulnerable regions, e.g. Southern Africa and Mediterranean	In Southern Europe, serious droughts occur once every 10 years 1 - 4 billion more people suffer water shortages, while 1 – 5 billion gain water, which may increase flood risk	Potentially 30 – 50% decrease in water availability in Southern Africa and Mediterranean	Possible disappearance of large glaciers in Himalayas, affecting one-quarter of China’s population and hundreds of millions in India

- Differences in water availability between regions will become increasingly pronounced. Areas that are already relatively dry, such as the Mediterranean basin and parts of Southern Africa and South America, are likely to experience further decreases in water availability, for example several (but not all) climate models predict up to 30% decrease in annual runoff in these regions for a 2°C global temperature rise and 40 – 50% for 4°C. In contrast, South Asia and parts of Northern Europe and Russia are likely to experience increases in water availability (runoff), for example a 10 – 20% increase for a 2°C temperature rise and slightly greater increases for 4°C, according to several climate models.⁸

⁷ Stern, Nicholas, *The Economics of Climate Change, Chapter 3 – How climate change will affect people around the world* p57
http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/Chapter_3_How_climate_change_will_affect_people_around_the_world_.pdf

⁸ Stern, Nicholas, *The Economics of Climate Change, Chapter 3 – How climate change will affect people around the world* p62
http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/Chapter_3_How_climate_change_will_affect_people_around_the_world_.pdf

Agriculture and Food Systems

- Climate change-induced disruption of food production systems may expose an additional 75–125 million people to the threat of hunger.⁹
- Climate change is likely to cause marked reductions in water availability in East Africa, the Sahel and Southern Africa as rainfall declines and temperature rises, with large productivity losses in basic food staples. IPCC scenarios predict that potential yields in rain-fed systems in Africa may reduce by up to 50% by 2020. Projections for rainfed areas in East Africa point to potential productivity losses of up to 33% in maize and more than 20% for sorghum and 18% for millet.¹⁰
- Climate change will affect rainfall, temperature and water availability for agriculture in vulnerable areas. For example, drought-affected areas in sub-Saharan Africa could expand by 60–90 million hectares, with dryland zones suffering losses of US\$26 billion by 2060 (2003 prices), a figure in excess of bilateral aid to the region in 2005.¹¹
- Some of the world’s poorest agricultural producers will face some of the toughest climate change adaptation challenges. With their livelihoods dependent on the timing and duration of rainfall, temperature and water runoff patterns, the rural poor face immediate risks with very limited resources. This is especially true for producers dependent on rainfed rather than irrigated agriculture. Over 90 percent of sub-Saharan African agriculture is in this category.¹²

Drought and Desertification

- Drought, desertification and other forms of water scarcity are already estimated to affect as many as one-third of the world’s people and are predicted to worsen as a result of climate change¹³
- Most climate-induced land degradation will occur as a result of changes in the hydrological cycle due to a recurrence of droughts, floods and other extreme climatic events, and changes in precipitation and water resource availability.
- Land devoid of water cannot retain nutrients, cannot effectively support ecosystems, cannot maintain biodiversity, and as such cannot support humans.¹⁴

⁹ United Nations Development Programme Human Development Report 2006, *Beyond Scarcity: Power, Poverty and the Global Water Crisis* p15 <http://hdr.undp.org/en/media/HDR06-complete.pdf>

¹⁰ United Nations Development Programme Human Development Report 2006, *Beyond Scarcity: Power, Poverty and the Global Water Crisis* p15 <http://hdr.undp.org/en/media/HDR06-complete.pdf>

¹¹ United Nations Development Programme Human Development Report 2007-8, *Fighting Climate Change: Human Solidarity in a Divided World* p9 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

¹² United Nations Development Programme Human Development Report 2007/8, *Fighting Climate Change: Human Solidarity in a Divided World* p176 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

¹³ UN World Water Development Report 3: *Water in a Changing World, Climate Change and Possible Futures* p 70 http://www.unesco.org/water/wwap/wwdr/wwdr3/pdf/15_WWDR3_ch_5.pdf

¹⁴ Water and Climate Coalition/Global Public Policy Network on Water Management, *Water World: Why the Global Climate Challenge is a Global Water Challenge* p 7 http://www.stakeholderforum.org/fileadmin/files/GPPN_2008-9/Papers/Water_World_Why_the_global_climate_challenge_is_a_global_water_challenge.pdf

Rising Sea Levels

- Rising sea levels will result in freshwater losses in river delta systems in countries such as Bangladesh, Egypt and Thailand.¹⁵
- The Intergovernmental Panel on Climate Change (IPCC) predicts that millions of people in densely populated low-lying coastal areas risk increasing exposure to flooding by storm surges over the 21st century.¹⁶

Water Stress

- Today, about 700 million people in 43 countries live below the water-stress threshold of 1,700 cubic metres per person. By 2025 that figure will reach 3 billion, as water stress intensifies in China, India and Sub-Saharan Africa.¹⁷
- By 2020, between 75 million and 250 million more people in sub-Saharan Africa could have their livelihoods and human development prospects compromised by a combination of drought, rising temperatures and increased water stress.¹⁸
- It is estimated that by 2025, almost two thirds of the world’s population are likely to experience some kind of water stress, and for one billion of them the shortage will be severe and socially disruptive.¹⁹

Gender Impacts

- In northern Kenya the increased frequency of droughts means that women are walking greater distances to collect water, often ranging from 10 to 15 km a day. This confronts women with personal security risks, keeps young girls out of school and imposes an immense physical burden—a plastic container filled with 20 litres of water weighs around 20 kg.²⁰

¹⁵ United Nations Development Programme Human Development Report 2006, *Beyond Scarcity: Power, Poverty and the Global Water Crisis* p15 <http://hdr.undp.org/en/media/HDR06-complete.pdf>

¹⁶ UN World Water Development Report 3: *Water in a Changing World, Climate Change and Possible Futures* p 70 http://www.unesco.org/water/wwap/wwdr/wwdr3/pdf/15_WWDR3_ch_5.pdf

¹⁷ United Nations Development Programme Human Development Report 2006, *Beyond Scarcity: Power, Poverty and the Global Water Crisis* p14 <http://hdr.undp.org/en/media/HDR06-complete.pdf>

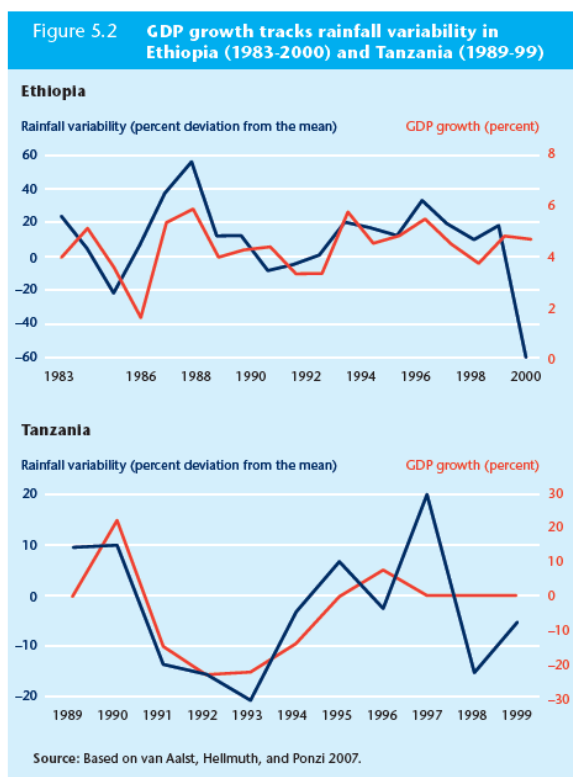
¹⁸ UN Development Programme Human Development Report, *Fighting Climate Change: Solidarity in a Divided World*, p 99 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

¹⁹ Institute for Development Studies, *Gender and Climate Change: Mapping the Linkages*, 2008, http://www.bridge.ids.ac.uk/reports/Climate_Change_DFID.pdf

²⁰ United Nations Development Programme Human Development Report 2007-8, *Fighting Climate Change: Human Solidarity in a Divided World* p171 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

Finance and GDP

- A study commissioned by the UNFCCC estimates the additional costs for adaptation in the water sector to be in the region of \$9 – 11 billion in 2030 ²¹
- The World Bank Economics of Adaptation to Climate Change study estimates costs of \$13.7 billion in drier scenarios, and \$19.2 billion in wetter scenarios for ‘Water Supply and Flood Management’. This represents the third most costly sector for adapting to climate change as identified in the study.²²



- GDP growth is demonstrated to be closely linked to rainfall in many developing countries. Increasing variability in rainfall patterns induced by climate change is therefore likely to impact negatively on economic growth and development in vulnerable countries.

²¹ UNFCCC: *Investments and Financial Flows to Address Climate Change*, 2007, p 105

<http://www.un.org/ga/president/62/ThematicDebates/gpicc/iffacc.pdf>

²² World Bank, *The Cost to Developing Countries of Adapting to Climate Change, New Methods and Estimates, The Global Report of the Economics of Adaptation to Climate Change Study, Executive Summary*, p6

<http://siteresources.worldbank.org/INTCC/Resources/Executivesummary.pdf>

Transboundary Impacts

- Water is not contained by political borders. An estimated 145 states have international basins within their territory, and 30 countries lie entirely within them. In addition, about 2 billion people worldwide depend on groundwater supplies, which include approximately 300 trans-boundary aquifer systems. In short, the majority of the world’s freshwater supply, essential for all human life, is contained in river basins and groundwater systems that are shared by two or more countries.²³
- Climate impacts including the decrease in water storage in glaciers and snow cover, together with shifts in the amplitude and timing of runoff in glacier and snowmelt fed rivers, affect more than one-sixth of the world’s population living in the impacted river basins.²⁴

Ecosystems and Forests

- Climate induced water scarcity in many regions will increase pressure on water resources, and reduce environmental flows further. Sea-level rise, flooding, changes in hydrology, and temperature of water bodies will further destabilize fragile ecosystems.
- Climate change impacts on the hydrological cycle will range from alterations in timings and volume of streamflow; to the lowering of water levels in many wetlands; the expansion of thermokarst lakes in the Arctic; and to a decline in mist water availability in tropical mountain forests.²⁵
- Changes in hydrology brought about by climate change stand to have wide-ranging impacts on a diversity of ecosystem types. For lakes and streams, climate change will alter inflows to lakes, and under climatic conditions which reduce precipitation and increase evaporation, lakes may disappear entirely. The devastation of the Aral Sea, influenced by a range of pressures including climate change, provides an example of the kinds of impact that can be expected in the future.²⁶
- The IPCC estimates that up to 40% of Amazonian forests could be affected by even slight decreases in precipitation.²⁷

²³ UN Water 2008, *Transboundary Waters: Sharing Benefits, Sharing Responsibilities*
http://www.unwater.org/downloads/UNW_TRANSBOUNDARY.pdf

²⁴ Water and Climate Coalition/Global Public Policy Network on Water Management, *Water World: Why the Global Climate Challenge is a Global Water Challenge* p 20 http://www.stakeholderforum.org/fileadmin/files/GPPN_2008-9/Papers/Water_World_Why_the_global_climate_challenge_is_a_global_water_challenge.pdf

²⁵ Intergovernmental Panel on Climate Change (IPCC): *Technical Paper on Climate Change and Water* p 67
<http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf>

²⁶ Ibid

²⁷ Ibid

Climate Change and Multiple Drivers

- The effects of rising temperatures against a background of a growing population are likely to cause changes in the water status of billions of people. According to one study, temperature rises of 2°C will result in 1 – 4 billion people experiencing growing water shortages, predominantly in Africa, the Middle East, Southern Europe, and parts of South and Central America.²⁸
- Demand for available freshwater resources is expected to rise from 54% of available resources in 2001 to 70% in 2025, and 90% in 2025 if per capita consumption is at developed country levels²⁹. This increasing demand constitutes competing pressures from a number of sectors, including agriculture, energy and domestic use. Climate change, which is predicted to alter precipitation patterns, accelerate glacial melt and change moisture availability, will exacerbate pressure on water resources further.
- As 700 million people already face water scarcity, and 900 million lack access to safe drinking water, climate change stands to exacerbate an already fragile situation, potentially depriving people of access to a reliable source of water for both personal and productive uses, threatening livelihoods and undermining progress towards poverty alleviation.

Mountain Populations and Glacial Melt

- Melting glaciers will increase flood risk during the wet season and strongly reduce dry-season water supplies to one-sixth of the world’s population, predominantly in the Indian sub-continent, parts of China, and the Andes in South America.³⁰
- Climate change will have serious consequences for people who depend heavily on glacier meltwater to maintain supplies during the dry season, including large parts of the Indian sub-continent, over quarter of a billion people in China, and tens of millions in the Andes. Initially, water flows may increase in the spring as the glacier melts more rapidly. This may increase the risk of damaging glacial lake outburst floods, especially in the Himalayas and also lead to shortages later in the year. In the long run dryseason water will disappear permanently once the glacier has completely melted.³¹
- Changed run-off patterns and glacial melt will add to ecological stress, compromising flows of water for irrigation and human settlements in the process. As a result, an additional 1.8 billion people could be living in a water scarce environment by 2080. Over 70 million people in Bangladesh, 6 million in Lower Egypt and 22 million in Vietnam could be affected.³²

²⁸ Stern, Nicholas, *The Economics of Climate Change*, Chapter 3 – How climate change will affect people around the world p63 http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/Chapter_3_How_climate_change_will_affect_people_around_the_world_.pdf

²⁹ United Nations Development Programme *World Development Report 2009*, Chapter 7: Evolution of Water Use

³⁰ Stern, Nicholas, *The Economics of Climate Change*, Chapter 3 – How climate change will affect people around the world p56 http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/Chapter_3_How_climate_change_will_affect_people_around_the_world_.pdf

³¹ Stern, Nicholas, *The Economics of Climate Change*, Chapter 3 – How climate change will affect people around the world p63 http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/Chapter_3_How_climate_change_will_affect_people_around_the_world_.pdf

³² United Nations Development Programme Human Development Report 2007-8, *Fighting Climate Change: Human Solidarity in a Divided World* p9 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

- Exceeding the 2°C threshold will fundamentally change the distribution of the world’s water resources. Accelerated glacial melt in the Himalayas will compound already severe ecological problems across northern China, India and Pakistan, initially increasing floods before reducing the flow of water to major river systems vital for irrigation. In Latin America, accelerated melting of tropical glaciers will threaten water supplies for urban populations, agriculture and hydroelectricity, especially in the Andean region. By 2080, climate change could increase the number of people facing water scarcity around the world by 1.8 billion.³³

Climate Migration and Displacement

- A global temperature increase of 3-4°C could cause floods resulting in 330 million people being permanently or temporarily displaced through flooding³⁴
- Climate-induced displacement is mostly related to too much or too little water – by droughts and water scarcity induced by changed rainfall patterns, to floods caused by rapidly melting glaciers, sea-level rise and extreme weather events.
- In Africa, an estimated 10 million people have migrated or been displaced over the last two decades mainly because of environmental degradation and desertification. Already 26 million people have been displaced as a direct result of climate change. By 2050, this number could grow to 200 million people – over 10 times more people than the number of refugees of concern to the United Nations High Commission for Refugees (UNHCR) at the beginning of 2009.³⁵
- Sudan suffers from a chronic shortage of freshwater. The past 40 years have seen rainfall decline by 30% across the country, which has been devastating for agriculture. Deserts have expanded south by as much as 200km since the 1930s, and pasture land is disappearing and water-holes are drying up. A recent UN study suggested a ‘very strong’ relationship between land degradation and desertification and conflict in Darfur, and some have even claimed it to be the first war linked to climate change. Sudan has been described by the UN as one of the worst humanitarian crises in the world. It continues to affect 4.7 million people, and has forced 2.7 million people from their homes.³⁶

³³ United Nations Development Programme Human Development Report 2007-8, *Fighting Climate Change: Human Solidarity in a Divided World* p27 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

³⁴ United Nations Development Programme Human Development Report 2007-8, *Fighting Climate Change: Human Solidarity in a Divided World* p9 http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

³⁵ Environmental Justice Foundation, *No Place Like Home: Where next for climate refugees?* P6 http://www.ejfoundation.org/pdf/climate_refugees_final.pdf (see publication for all further references on figures quoted)

³⁶ Ibid