

# Suffering the Science

## Climate change, people, and poverty

Climate change is damaging people's lives today. Even if world leaders agree the strictest possible curbs on greenhouse gas (GHG) emissions, the prospects are very bleak for hundreds of millions of people, most of them among the world's poorest. This paper puts the dramatic stories of some of those people alongside the latest science on the impacts of climate change on humans. Together they explain why climate change is fundamentally a development crisis. The world must act immediately and decisively to address this, the greatest peril to humanity this century.

# Foreword

Two years ago, thousands of scientists came together in the Intergovernmental Panel on Climate Change (IPCC). We agreed that the climate system was warming unequivocally, and that if current rates of greenhouse gas (GHG) emissions from human activity continue, the world would see further warming, accompanied by more extreme weather and sea-level rise, and risks of abrupt and irreversible change.

Earlier this spring, scientists meeting in Copenhagen reiterated and updated the evidence for climate change. We concluded that the scientific evidence has now become overwhelming and that human activities, especially the combustion of fossil fuels, are influencing the climate in ways that threaten the well-being and continued development of human society.

We reported that recent observations show that GHG emissions are at the higher end of those considered by the IPCC. Some of the most worrying new science focuses on the likelihood of more extreme droughts as a result of global warming, and of large-scale and possible abrupt changes in arctic, mountain, and tropical forest ecosystems.

Social scientists emphasized that vulnerability to these changes, especially in poor nations and communities, is high, and that because the effects of climate change have unequal impacts there is a clear need for strategies and funds for adaptation. Many of us now feel that if we do not act now there is a significant chance that we will be looking at a world warmer by 4°C, with profound social and ecological consequences.

All of these reasons for concern have added urgency to the search for the political will to implement the solutions already identified by the IPCC and others, including the decarbonisation of our societies, and the reduction of vulnerabilities through adaptation and poverty alleviation.

This Oxfam study reflects the latest science and adds powerful human stories to our understanding of climate risk and vulnerabilities. It adds an important and authoritative voice to the urgent call for urgent reductions in emissions and attention to adaptation.

**Professor Diana Liverman, June 2009**

Diana Liverman holds Professorships at Oxford University, where she directed the Environmental Change Institute, and the University of Arizona where she is based in the Institute of the Environment. Professor Liverman was a contributing author and reviewer for three IPCC assessments; chair of the US National Academy of Sciences Committee on the Human Dimensions of Global Environmental Change; chair of the Scientific Advisory Committee for the international Global Environmental Change and Food Systems programme; and a member of the new National Academy of Sciences Committee on America's Climate Choices which is advising the US Government on responses to climate change. She is a co-author of the Copenhagen Science Congress synthesis report which brings together the latest scientific research on climate change and which informed this paper.

# Summary

## Cyclone Aila

As this paper was being prepared in late May 2009, Cyclone Aila hit Bangladesh and East India. The headline news was of deaths (more than 200, including many children), of 750,000 people made homeless, of landslides, floods, water contamination, threat of disease, the devastation of food crops and livelihoods – of 3.6 million people ‘affected’. The Satkhira district in Bangladesh was hit hard. Just weeks before Aila, Oxfam held the first of its international Climate Hearings in villages there. More than 12,000 people gave their personal experiences of climate change, many saying that the sea level was rising, the tides were higher, and salt water was steadily encroaching on their land. When it hit, Aila coincided with yet another unusually high tide and storm waters breached the embankments.

Before Aila, at the hearings, Baburam Mondal described how the encroachment of salt water had wiped out his mangoes and coconuts. Ashoke Kumar Mondal said he had lost his livestock and poultry because of extreme weather. Mahmuda Parvin hadn’t been able to grow vegetables for the past two seasons. After Cyclone Aila hit, Oxfam staff in Satkhira found Baburam rummaging for his belongings in the mud, having lost his home. Mahmuda Parvin’s home was swept away too. We found Mahmuda living on a highway, searching for food and water.

Source: Oxfam International in Bangladesh

*‘We went to sleep the night before, and woke up in the morning with water everywhere. The only thing we were able to save was the roof of the house.’*

Magdalena Mansilla, a 51-year-old farmer in Lambayong town, Sultan Kudarat, in the south Philippines. She has lost her home in floods twice in four years, in 2008 and 2004.

Climate change is a reality and its effects are apparent right now. The scientific predictions are shifting continually – they almost always look bleaker. But Oxfam’s experience in nearly 100 countries is definitive: hundreds of millions of people are already suffering damage from a rapidly changing climate, which is frustrating their efforts to escape poverty. This paper is the story of the ‘affected’.

To tell this story we have brought together the voices of two communities – scientists who study the impact of climate change, and the people who are suffering harm now. In March 2009, 2,500 leading scientists gathered in Copenhagen to present updated research across the entire spectrum of climate change. This paper is based on their work, and as much as possible upon the latest science, set alongside the first-hand stories that emerge from Oxfam’s work with poor people.

## A life behind every statistic

*'Nature has got much worse, people have offended Nature. Spring comes 2-3 weeks earlier than before. Spring is getting harsh; it is raining or snowing all the time. The first thaw is at the end of April. The first rain is in May; it has never been like that before.'*

Gregory Rykhtyn, Vankarem Settlement, Siberia, 2006.

In 2009, a year of 'Climate Summits' for scientists, businesses, and governments, there has been no formal 'People's Summit'. The reality of life under climate change is largely missing from the big debate. No court of justice would hear evidence and then make a ruling without representation from the wronged party. Oxfam tells the stories of affected people in this paper in a modest attempt to help bridge the gap between science and policy. There are people behind every statistic:

- One report estimates that 26 million people have already been displaced because of climate change.
- 375 million people may be affected by climate-related disasters by 2015.
- 200 million people may be on the move each year by 2050 because of hunger, environmental degradation, and loss of land.
- Several major cities that are dependent on water from mountain ranges face collapse.

A new Oxfam study called 'What Happened to the Seasons?' – whose findings are included in this paper – quotes farmers from all over the world who are experiencing seasons that appear to have 'shrunk', to either 'hotter and dry' or 'hotter and wet'. Seasons, they say, are becoming less distinct. They are uncertain when best to cultivate, sow, and harvest.

This is where climate change becomes as real as a redundancy or a repossession notice, or a daily missed meal, or a parent's fear for the safety of a child. People's stories make us realise just how little we are doing to address the causes and effects of this crisis, although it has been bearing down on us for a quarter of a century.

Ultimately the stories of Magdalena Mansilla and Joseph Abellar, Iha and her daughters, Li Zhuang, Fred Kabambe, Lomaada Nakorilung, and all the other people quoted in this paper are empowering. People are determined to survive the impacts of climate change. Through them, we begin to understand that climate change is an added burden – yet another threat to their ability to cope with poverty. It is interacting with existing problems and making them worse.

*'Global sea level is rising, and faster than expected. We need to honestly discuss this risk rather than trying to play it down.'*

Professor Stefan Rahmstorf, Potsdam Institute for Climate Impact Research, March 2009.

## The scientific certainty of harm

Scientists are observing increasing evidence of changes and breakdowns in natural systems from a changing climate caused by rising carbon emissions. For the poor countries in the tropics and sub-tropics particularly, almost every observation and prediction about health, food security, water shortage, natural disasters, famine, drought, and conflict is worsening at an alarming rate.

*Mukelabai, 25, is still stunned as she looks at what remains of her home. 'We put all our children in the canoe and paddled about 25km. We could not save our crops, so we have no food. We are eating nothing.'*

Mukelabai Liywalii, whose family was driven out of their home by floods, Zambia, April 2009.

Most scientists now believe that limiting the global average temperature rise to 2° C is unlikely – not because we are technically or socially incapable, but because they do not believe that politicians are genuinely willing to agree to the necessary cuts in carbon emissions. Indeed, politicians' performance so far in international negotiations has been appalling, although this can be turned round through concerted pressure from the public, the private sector, and civil society.

Two degrees is the 'target' upon which more than 100 governments are basing their strategies because the rich world has deemed this could be an 'economically acceptable' one. However, even warming of 2°C entails a devastating future for at least 660 million people.

Lord Stern, former chief economist to the World Bank, says there is 'a big probability of a devastating outcome' and that 'the likelihood of global warming in the 21st century even beyond the threshold of a 2.4°C increase is dangerously high'. Hans Joachim Schellnhuber, the advisor to the German chancellor on climate change, says that on the basis of the new evidence, he thinks anything up to 5°C of warming is 'likely' by 2100 under a 'business as usual' scenario. Under such a scenario, Schellnhuber expects the human population of the world to fall to just one billion.

Science *is* now as certain as it can be of harmful climate change. The only real uncertainty is about how much climate change and human suffering we are willing to allow and bear.

## Hunger, disasters, disease – 'the new normal'

Without action, most of the gains that the world's poorest countries have made in development and ameliorating the harmful effects of poverty in the past 50 years will be lost, irrecoverable in the foreseeable future.

Climate change's most savage impact on humanity in the near future is likely to be in the increase of **hunger**. Some of the world's staple crops, such as maize and rice, are very susceptible to rising temperatures and to more unpredictably extreme seasons. Almost without exception, the countries with existing problems in feeding their people are those most at risk from climate change.

The impacts on people's **health** are frighteningly diverse. Climate change is bringing water- and insect-borne diseases of the tropics to hundreds of millions of people with no previous knowledge of them. In hotter temperatures people will be unable to work for as long due to heat stress, and if they do their health may suffer.

Climate-related **disasters** have been increasing in frequency at an extraordinary rate. Extend the line of the graph that charts such events between 1975 and 2008, and it says that in 2030 we will experience more than three times as many such disasters as today.

*'We used to get three good rains. Now we don't even get two. There's no more rainy season, just the hurricane season. As soon as people see clouds forming, they put together their stuff and head for the hills.'*

Gary Novamn, farmer, Gonaives, Haiti, April 2009.

**Water** supply is now so acutely challenged that several major cities that are dependent on the Himalayan and Andes glaciers will face crippling shortages within decades.

Climate-driven **migration** is already a reality, destroying livelihoods, communities, and cultures, and leaving women alone and vulnerable to deal with agricultural work, and to look after children. Governments are concerned that climate change will spark increasing conflict between countries as scarcity of vital water supplies brings bitter disputes over their control.

## Loose change – stop harming and start helping

*'Climate change is a threat multiplier and one of the greatest threats to development: 53 per cent of African disasters are climate-related and one-third of African people live in drought-prone areas. By 2020 yields from water-fed agriculture in Africa could be down by 50 per cent.'*

Dr Balgis Osman-Elasha, Higher Council for Environment and Natural Resources, Sudan, Copenhagen Science Conference, March 2009.

We need to stop harming and start helping. In December 2009 the world's politicians will meet in Copenhagen to sign a deal to tackle climate change. This deal must ensure that global carbon emissions peak by 2015, and then begin falling. Rich countries must commit to reduce their own emissions by at least 40 per cent from 1990 levels by 2020 and all countries must act to reduce global emissions by at least 80 per cent below 1990 levels by 2050.

As importantly, beginning immediately, developing countries will need at least \$150 billion a year to cope with the effects of climate change and to pursue their own low-carbon futures.

Today, most governments are woefully short on the action and ambition needed to achieve this. Helping to climate-proof the developing world is comparatively loose change: \$150 billion is about the same amount that was spent on bailing out just one company, AIG, during the financial turmoil of late 2008.

It is not only morally right, it is economically smart to adapt for climate change. The better developed a country, the better it copes with environmental disaster and recovers. The interventions needed to help poor people cope with harmful climate change are readily available. The world needs to invest wisely to protect all its markets and supply chains, and its consumers and providers. It needs to limit the anger and desperation that inequality and suffering bring. This is an investment in human and national capital, in good development, and in a sustainable future.

## No reason to give up

Climate change's effect on poor people is one of the most bitter ironies of our times. The nations that made themselves wealthy by burning fossil fuels are largely those that will, initially, suffer least from the effects of climate shift. The rise in global *average* temperatures is playing out differently over the poles, the tropics, the seas, and the big land masses. In the temperate zones, for instance, rich countries are buffered

by their wealth, and here climate change's impacts may result in milder or even beneficial weather conditions for a brief period. It is in the tropics where the bulk of humanity lives – many of them in poverty – that climate change is hitting now and hitting hardest.

*'The rich are still swimming in their pools while we are dying of thirst... We have got no toilets. I can't wash my children. I can't cook. I can't clean the mess off the floor. And the worst thing is, we have got almost nothing to drink.'*

Graciela Martinez, mother to a family of eight, Mexico City, April 2009.

Climate change doesn't yet much trouble the average citizen of the richest countries. It featured at number 20 on a list of people's concerns in a recent poll in the USA. Oxfam believes that it should be at the top of everyone's agenda because there is something we can do about it. The scientific consensus – which has sometimes been unfocused and on occasion indecisive – is firming up: it is nearly too late, but not quite. Now our political leaders have to firm up too.

Oxfam's message is: don't give up. Tell world leaders you want a fair and safe future. Rich countries must cut their emissions now, and give developing countries the means to pursue low-carbon futures and to cope with the harmful effects of climate change. The true cost of climate change will not be measured in dollars, but in lives and human potential. That price is being paid already.

# 1 Science and people

*'We can make this happen.  
It's ours to mess up.'*

Lord Nicholas Stern, former chief economist to the World Bank, May 2009.<sup>1</sup>

This paper is about the impact of climate change on humans. It does not seek to debate the science behind this or objectively review it. Much of the existing science is complex and by its nature speculative: what we present here is what we believe to be of the best quality, and, where possible, the consensus from the recent work of hundreds of academics in fields from nutrition to defence studies.

Most recent scientific research is based on conservative scenarios that broadly see global average temperatures rising by 2°C during this century (above pre-industrial levels)<sup>2</sup> and sea levels rising by up to 1 metre. Many scientists now believe this to be too optimistic. The Tyndall Centre for Climate Change Research says that to have a 46 per cent chance of preventing more than 2°C of warming, global emissions from energy must peak by 2015 and decline by between 6 per cent and 8 per cent per year from 2020 to 2040. Current commitments in the rich world are thought to promise only a 2 per cent per year reduction.<sup>3</sup>

However, most of the latest science of human impact prediction is based on the 2°C scenario, partly because the scientific work was commissioned before the remarkable accelerations in some factors we have seen since the mid-2000s.

*'Looking back, I probably  
under-did it in the Stern  
Review.'*

Lord Nicholas Stern, former chief economist to the World Bank, on his 2006 report for the UK Government.<sup>4</sup>

Lord Nicholas Stern, the economist turned climate change authority whose work since 2005 has directed UK government policy, said in a paper of recommendations for the April 2009 G20 meeting in London: 'Staying below a 2°C increase ... will be challenging because the climate system already contains more warming potential than previously assumed. Greenhouse gas emissions are increasing at a faster pace, the planet's capacity to sequester carbon in natural sinks is decreasing and the temporary cooling effects of aerosols in the atmosphere are likely to diminish... Thus the likelihood of global warming in the 21st century even beyond the threshold of a 2.4°C increase is dangerously high.'<sup>5</sup>

Two polls in April 2009<sup>6</sup> indicated that perhaps 90 per cent of scientists working in the field thought that the world was unlikely to be able to limit itself to warming of around 2°C, mainly because they doubted that governments and politicians would agree the necessary curbs on emissions, or achieve what they had pledged. 'In theory we could just make it,' said Martin Parry, co-chair of the IPCC. 'But this is the real world, not scientific theory – and who would bet on this, given our experience with the pace of [progress] in the past?'<sup>7</sup>

## Climate breakdown

Above a few degrees Celsius of warming, the nightmare scenarios build up. The IPCC has said that 'global mean temperature changes greater than 4°C above 1990–2000 levels' would 'exceed ... the adaptive capacity of many systems.'<sup>8</sup> The Tyndall Centre's more likely scenarios, based on current government strategies, point to 4–5°C of warming. Therefore



there is a genuine fear that the world may cross tipping points which make accelerated warming inevitable – such as the death of the rainforests and melting of the permafrost (both of which would then become sources of carbon emissions), the loss of almost all glaciers, and the melting of the polar ice caps.

The effects on human beings and the planet here become virtually unknowable – but the predictions of sea-level rise range from 5 metres to much more over the next 200–300 years. The lower level would wipe out most coastal cities; higher ones would ensure that human life as we know it ceases.

The advisor to the German chancellor on climate change, Hans Joachim Schellnhuber, in describing his 5°C scenario, envisages a planet with a ‘carrying capacity’ of below one billion people. But a 5°C warming scenario is possible in this century if nothing is done. Stern says: ‘This is not a “black swan” [an event beyond normal expectation]... This is not a small probability of a rather unattractive outcome. This is a big probability of a very bad outcome.’<sup>9</sup>

A 2°C level of warming has been called ‘economically acceptable’<sup>10</sup> – it is what most rich-world governments will settle for. But it still means death, suffering, and devastation for millions – 660 million people by 2030, according to one authoritative prediction.<sup>11</sup>

## Urgently needed – better analysis

Many of the papers submitted to this March’s scientific conference in Copenhagen, attended by 2,500 scientists in preparation for December’s UN Climate Change Conference, reveal a worrying bias in the focus of research towards the concerns of rich, chiefly Northern, nations. In fact climate change will affect these countries less, with some exceptions such as Spain and Australia. Partly as a result of this, the issue remains of comparatively little concern to the citizens of rich countries: it came at the bottom of a list of 20 concerns in a recent poll in the USA.<sup>12</sup>

Far more women than men die in disasters. Yet the work of women to help communities adapt to climate change is key. Humanitarian relief workers know well the importance of women and their networks in helping families to cope in times of crisis and to rebuild later. Research on the gender aspects of climate change is very limited and needs to be improved urgently.

We need powerful new research into the impact of climate change on poor countries. The meteorological data is scarce and scientific investment even less. Poor countries need more accurate information on likely climatic shifts in order to prepare more effective adaptation plans that will build on the resilience of the poorest and most vulnerable people.

The problem, as many scientists admit, is that the overall message on climate change tends to shift as the science keeps advancing. The

concerned public can mistake this for uncertainty on the very nature of climate change, and politicians can use it as an excuse to postpone action. However, the truth is that science *does* agree about harmful, human-induced climate change – it is now simply a case of the experts agreeing on its finer detail.

Box 1. Climate change or unusual weather? A clarification

Throughout this paper there are stories and images taken from Oxfam programmes and the people with whom Oxfam works. All of the challenges described are caused or exacerbated by climate-related disasters or environmental degradation, which may have been caused by climatic changes brought about by human activity. Most problems faced by poor people have multiple causes: for example, a family may migrate because of poor prospects, conflict, crop failure, and poor health, and some or all of these problems can be related to climate. Climate change is increasing the day-to-day burdens that poor people endure in trying to make a living – and that is the reason these stories are cited here.

## 2 Climate change means hunger

Hunger will be one of the major impacts of climate change. It may be the defining human tragedy of this century. Millions of people in countries that already have food security problems will have to give up traditional crops and agricultural methods as they experience changes in the seasons that they and their ancestors have depended upon. The social upheavals that result – such as migration and conflict – may mean that this change in the functioning of our planet affects more people than any other.

Two-thirds of the world's one billion poorest people live in the rural areas of developing countries. According to the UN Food and Agriculture Organization (FAO), these people face immediate risks from increased crop failures and loss of livestock. More than 1.5 billion people who depend on forests, among the poorest in the world, are highly vulnerable, as are the millions of people dependent on fisheries for much of their nutrition.<sup>13</sup>

### Box 2. Drought, sandstorms, and crop change in North-West China

Farmer Li Zhuang and his family live in Jingyuan, in the centre of Gansu province, high on a sandy plateau above the Yellow River. People here are used to drought and sandstorms. Over the past three decades, streams have been drying up, and those who can afford it are migrating away.

Li, 41, has experienced severe drought before. In 1983 he and his parents had to rely on food aid. 'The past five years have been very dry. The wind is so strong that it drives away the rain clouds. Without rain, farming is difficult,' he says.

Li's family farms wheat on just over one acre of land. This only brings in a little income, so they receive a monthly allowance of Rmb30 (\$4.40) from the government. 'I don't know much about climate change,' Li says. 'I guess that our land is particularly dry mainly because evaporation is so intense here.' The farmland around Li's village is connected to an irrigation system that draws water from the Yellow River. However, Li's land is one of the plots furthest from the pump, so he often has less water than others. One way that he and other farmers are adapting to the drier climate is by planting less wheat and more potatoes.

There is another season in Gansu: sandstorm time. Vicious and unpredictable, sandstorms most frequently occur between March and May. But they are becoming more and more common. Some Chinese Government scientists believe that upland parts of the country have already experienced a 1.5°C rise in average temperature (i.e. double the global average) and that desertification as a result of this contributes to the increase in sandstorms.<sup>14</sup> 'No one dares to stay outdoors when the sandstorms strike, let alone take care of crops in the field,' says Li.

Li's family lost a third of their wheat crop this year because of the sand. After the spring planting, he had to work in a coalmine for a month to support the family. 'It is dangerous work but I had no choice. One day of work in a mine brings in as much as Rmb100 (\$14.60) – at other jobs, it's only around Rmb40,' he explains.

Oxfam and a local NGO<sup>15</sup> have been helping farmers to diversify. In 2007, Li's family invested Rmb750 to plant wolfberries on 1.5 acres of their land. Drought-resistant, the small red berry is used in medicines, soups, and wine, and the bush also functions as a sand barrier and soil fixer. Yet last year there was no crop. 'We just didn't have money to buy a net to protect the crop from birds,' Li sighs. 'I will work harder to make more money this year so that I can buy a net. We will get prepared for a big red harvest of wolfberries next autumn.'

Since the 1990s, up to 400 million people in China have been affected each year by weather-related disasters and secondary hazards, at a loss of \$30 billion,' says Chao Qingchen, deputy director-general of the Department of Science and Technology Development at the China Meteorological Administration 'The instability of Chinese agriculture has increased... (and) the issue of water resources is becoming increasingly serious,' she says.<sup>16</sup>

The IPCC says that the increasing frequency and intensity of droughts in many parts of Asia can be attributed largely to rising temperatures. There are large areas of arid and semi-arid lands, from western China and Mongolia to western Asia, making water scarcity one of the constraints for sustainable development. 'Asia has a very high population that is growing at a fast rate, low development levels, and weak coping capacity. Climate change is expected to exacerbate the water scarcity situation in Asia, together with multiple socio-economic stresses,' according to the IPCC's Fourth Assessment Report (2007).

Source: Interview by Fiona Shek, Oxfam International, 2009, and the IPCC's Fourth Assessment Report (2007).<sup>17</sup>

## Crops

### What happened to the seasons?

In a new Oxfam study to be presented to the Institute of Development Studies in the UK (July 2009),<sup>19</sup> farmers all over the world report that both the timing and the pattern of seasonal rains are changing dramatically. This 'changing seasonality' is a crucial influence on farmers' ability to decide when best to cultivate, sow, and harvest their crops. Seasons, farmers say, are becoming less distinct. Observations – which are strikingly consistent across entire geographies – include the following:

- Seasons appear to have shrunk in number and variety, to be replaced by seasons that are now seen simply as 'hotter and dry' or 'hotter and wet'. Winters are generally warmer.
- Rainfall is more erratic, coming unexpectedly in and out of season, and tending to be shorter in duration and more violent.
- Even within recognisable seasons, 'unseasonal' events such as heavier rains, drier spells, unusual storms, dense fogs, and temperature fluctuations are increasing.
- Winds and storms are felt to have increased in strength.

*'Before, it used to snow during the winter, and the winter was much colder. But in the last three years there has been no snow ... It should have rained between October and January last year, but there was no rain. So now the plants are dying.'*

Binita Bikrar, resident of Kapala village, Nepal, 2009.<sup>18</sup>

### Box 3. The weather is changing

Over the past three years, Oxfam staff across East and South Asia, all over Africa, and throughout Latin America have been hearing how farmers are perceiving that the weather is changing and how they are trying to cope.

'The results were striking because of the extraordinary consistency they showed across the world,' says Oxfam programme researcher John Magrath. 'Farmers are all saying very similar things: the seasons are changing. Moderate, temperate seasons are shrinking and vanishing. Seasons are becoming hotter and drier, rainy seasons shorter and more violent. We think that "changing seasonality" may be one of the most significant impacts of climate change for poor farmers, and that it is happening now.'

Magrath continues: 'Our material is primarily anecdotal. We have begun to compare it against meteorological data and there are consistencies, though in some cases the data are seriously lacking. Farmers say that the growing seasons are shortening, making it more difficult to grow crops, and that seasons are becoming more erratic, making it difficult for them to know when best to plant. These changes are connected to other pressures such as deforestation, the draining of wetlands, and soil erosion. Something extra and important is already happening.'

Mohammad Iliasuddin of Telkupi, Shibganj in Bangladesh tells Oxfam: 'I know I am supposed to sow by a certain date or time. That is what my forefathers have been doing. But then for several years the temperature and weather does not just seem right for what we have been doing traditionally. It is exasperating, as I do not know how to cope with the problems.'

Willington Wamayeye, managing director of Gumutindo Coffee Co-operative in eastern Uganda, says: 'I've lived near Mount Elgon all my life and I have never known the weather to be so unpredictable. Rains now fall heavily for a short period and our dry season is much longer. The coffee plants are badly affected – flowering is stopped. Last year alone (2007) we lost about 40 per cent of our production. As a result, people struggle for everything.'

In Bulirehe, Bundibugyo, western Uganda, Florence Madamu says: 'Because of the current weather changes the yields have completely gone down. All this is a result of long spells of sunshine – the sun is prolonged until the end of September – and whenever it rains it rains so heavily it destroys all our crops in the fields. You can plant a whole acre or two and come out with nothing.'

Asked how she has adapted farming methods, she throws up her hands and replies: 'We've stopped even adopting seasonal planting, because it's so useless. Now we just try all the time. We used to plant in March and that would be it [finished]. Now we plant and plant again. We waste a lot of seeds that way, and our time and energy... Sometimes you feel like crying...'

'Farmers rely on knowledge handed down over generations, making intimate links between nature and culture. When this is fractured, families and communities can lose their compass. In interviews, bewilderment, disorientation, and a sense of loss are palpable, along with sadness and fear for the future,' says Magrath.

Carlos Ling, an Oxfam project officer in Nicaragua, says that Miskito Indian communities 'are baffled by the changes. The crop season has been moving from the traditional dates and this is very important because it affects your understanding of the whole universe, not just your way of living. For people it's very important to understand that on a particular date you plant the seeds in the ground and it is magical, it involves a lot of energy and hope for the future, and also certainty of a new crop. When certainties move, you feel a loss of control of your life, which is demoralizing.'

Source: Oxfam report 'What Happened to the Seasons?'<sup>20</sup>

## To the rich, the advantage

Under the milder climate change scenarios, food production will largely increase in today's temperate zones. However, the world's population will increase too – to 9.2 billion by 2050 – and mostly in lands where food production will be adversely affected. Chronic hunger will become more prevalent. At the date that this paper was being written, some 1.02 billion people did not have enough food.<sup>21</sup> The most optimistic, authoritative prediction says that by 2080 between 740 million and 1.3 billion people may be chronically hungry.<sup>22</sup>

However, this forecast does not factor in the impacts of a whole set of other negative effects of climate change, such as weather catastrophes or increased pressure on water resources. Nor does it account for potential positives such as the technological innovations and institutional change that may boost agriculture and food production.

How climate change will affect our food supply is the most complex and heated debate in the prediction of the human impacts of changing climate. Some aspects of the global upheaval that is on its way will be beneficial to food production. Increased rainfall and warmer temperatures will – for a time – mean longer, more productive growing seasons, especially in the north of the planet. Increased CO<sub>2</sub> levels will boost some crop production, though the benefits of this are now widely said to have been overestimated.<sup>24</sup>

But let us be clear: any possible short-term agricultural advantages do not mean there will be increased food security for the bulk of the world's population. Across vast areas of the poorer world, food supplies will be more erratic and more expensive. It is always worth repeating that 3.6 million mothers and infants already die every year because of malnutrition and related disease.<sup>25</sup>

*'Only about half of the world's theoretical agricultural production is utilised now. Yet by 2050 with a population approaching 10 billion people, we will need about 20 gigatonnes of crop production; currently only 13 gigatonnes are available. To meet the demand, we will require ca. 20 per cent more crop land and 20 per cent more freshwater.'*

Dieter Gerten, Potsdam Institute for Climate Impact Research.<sup>23</sup>

## Crop shift

As a consequence of climate change, there has already been significant change in the types of crop that people grow,<sup>26</sup> because in the tropics it takes only 1°C of average temperature change to begin to alter the suitability of some key crops. Reduced crop yields become all the more grave when combined with large population growth and low economic prospects, which threaten disaster for many countries. One study combines all these factors to predict which African countries will be hardest hit by climate change in the future: it puts Mozambique, the Democratic Republic of Congo (DRC), and Tanzania at the top of that list by 2030.<sup>27</sup>

Poor farmers often have to gamble when deciding what might be better crops to shift to. In countries where rainfall patterns and cyclical dry spells are becoming increasingly unpredictable and extreme, even the 'common farming sense' of swapping from one crop to another to find a successful one can backfire.

## Unfair shares

Across the world, the effect of climatic changes on agriculture will be grossly unbalanced. Essentially, the further a person lives from the Equator, the better their prospects of being fed – and that's not just because the richer and less populated countries tend to lie in the higher latitudes of the Northern hemisphere, where precipitation will increase and winters will get warmer.

*'While higher temperatures will boost plant growth in cooler regions, in the tropics they may actually impede growth. A two-decade study of rainforest plots in Panama and Malaysia recently concluded that local temperature rises of more than 1°C have reduced tree growth by 50 per cent.'*

Fred Pearce, New Scientist magazine.<sup>28</sup>

Wheat production should rise considerably in northern Europe and Canada. Meanwhile on the Indo-Gangetic plain, where 15 per cent of the world's wheat is grown, production will shrink by more than half by 2050. This change alone will threaten the food security of 200 million people.<sup>29</sup> The Mediterranean countries and some parts of the USA are similarly threatened.

Adapting to these changes will be easier in sophisticated and richer agricultural economies. According to one forecast, US agricultural profits will rise overall by \$1.3 billion, or 4 per cent, per annum because of climate change, though some states, including California, will see substantial declines.<sup>30</sup> Meanwhile sub-Saharan Africa will lose \$2 billion per annum as the viability of just one crop – maize – declines.<sup>31</sup>

Government scientists in South Africa are now advising that countries in the region should prepare to see a 50 per cent drop in productivity of all cereals by 2080.<sup>32</sup>

Broadly, the current scientific predictions on the hunger threat can be summarised as follows:

- South Asia (the world's most populous region), Southern Africa, and the sub-Saharan region will see severe threats to food supply, mainly because of the threat to their staple crops, although there are other hazards of higher temperatures and shifting rainfall patterns.<sup>33</sup>
- North-eastern Brazil, many parts of South-East Asia, and the countries of the Mediterranean rim, including Spain, can expect a range of serious damage.
- The livelihoods of millions of African pastoralists, responsible for some of the world's most efficient and ecologically-friendly meat and dairy production, are under serious threat. In the mixed cultivation areas of Africa where pastoralists and agriculturalists exist side by side, 'season failures' are expected to extend from one year in six to one in three.<sup>34</sup>
- Disturbing new research is emerging on how a degree or two of temperature rise makes outdoor labour very difficult, and in some cases impossible and even life-threatening, during the hottest months of the year, which are the harvest season for some crops. This is explored further in the section on **health**.
- All low-lying coastal areas and islands are at risk because of sea-level rises and storms, as are populations where seafood is a protein source or a means of livelihood. Climate change is modifying the distribution and productivity of fisheries and altering food webs: fish provides essential nutrition for nearly 3 billion people.<sup>35</sup>

Bangladesh, beyond perhaps any other country, faces threats to all its food sources: to rice, which takes up 80 per cent of the cultivated land area of this low-lying, flood- and drought-prone country; to farmed fish, because of coastal storms and erosion; and to wild fish. Already half of Bangladesh's population exists on less food than the 'nutrition poverty line' of 2,122 kcal per day.<sup>36</sup>

## Rice

*'Especially when harvests are not good, girls are used to generate income. Some are forced to get married very young so the in-laws will bring bread and butter to their homes.'*

Jacqueline Ng'ambi, project officer for the Maphunziro Foundation, Malawi, 2008.<sup>37</sup>

More people on the planet depend on rice than on any other crop. Rice plants react very quickly to temperature change: they show a 10 per cent drop in yield for every 1°C rise in minimum temperature.<sup>38</sup> In parts of the Philippines, farmers have had to stop growing rice completely during the droughts caused by the 'El Nino' years,<sup>39</sup> and river delta and coastal rice production has already suffered badly across South-East Asia because of storms that overwhelm sea defences and salt-water intrusion into paddy fields.<sup>40</sup> An Asian Development Bank report warns that rice production in the Philippines could drop by 50–70 per cent as early as 2020.<sup>41</sup>

Chinese scientists believe that parts of the vast country have already seen up to 1.5°C of warming since 1990. But rice production will increase overall under moderate average rises in temperature. This may be of benefit, but there will also be major changes on the geographical distribution of rice: large numbers of people may have to move as the prime rice-growing terrain shifts to the north.<sup>42</sup>

## Maize

Maize – or corn as it is known in some countries – is one of the world's four most important food crops. It is the staple food for more than a quarter of a billion East Africans, and is also a hugely important animal feed across the world. Maize is particularly vulnerable to heat changes and to 'water stress'.<sup>43</sup> As one crop scientist puts it, 'When you look at the graph, under even small average heat rises, the [production] line for maize just goes straight down.'<sup>44</sup>

Drought damages maize especially at its seedling stage, when the farmer will find the leaves 'rolled' and the plant looking tired. There may be a decreased yield or no maize ears at all. A severe problem may mean no crop that year. In one of the best-documented heatwaves of modern times, the 2003 event in western Europe, when temperatures rose up to 6°C above average, maize production dropped by 20 per cent in France, and by up to 36 per cent in parts of Italy.<sup>45</sup> Other staples such as wheat were badly affected as well.

Even under milder scenarios, the viability of maize as a staple crop is under serious challenge in a range of Southern African countries, including Mozambique, Tanzania, and Zambia. The suitability of maize as a crop is forecast to drop by 15 per cent or more by 2020 in much of sub-Saharan Africa and in most of India.<sup>46</sup> One estimate puts the loss to Africa at \$2 billion a year.<sup>47</sup>



## Crop substitution – not so simple

*‘Farmers have become gamblers. The system has been disturbed and now they must take a gamble on when the rain will come. But they are gambling with their livelihoods.’* – Paul Thiao, cereals farmer, Thiès, Senegal, 2009.<sup>48</sup>

There are alternative crops that may survive better. For example, millet and sorghum are suited to cultivation in parts of Southern Africa as temperatures rise and rainfall decreases.<sup>49</sup> With the aid of Oxfam and government agencies, farmers are already trying different species in a number of countries. Some populations could, for example, substitute cassava or yam for carbohydrates; this is already being promoted by the government in Jamaica to address food security concerns.<sup>50</sup>

There are countries where almost all cereal production is either maize or rice, which is also an important export crop. Viet Nam loses on both counts, with both maize and spring rice yield in the south of the country forecast to drop about 6 per cent by 2050.<sup>51</sup> One thousand kilometres away, in the north of Viet Nam, spring rice yields are forecast to fall by twice as much, though maize yields could increase. So the crude solution might appear to be to switch rice-growing populations to maize, and to transport large numbers of people to northern Viet Nam.

However, the social costs of trying to adapt whole agricultural systems to new crops, or the mass moving of entire farming populations, are considerable.<sup>52</sup> It will take ‘a pretty radical upheaval’, says one expert.<sup>53</sup>

## Fruits and nuts

Some agronomists complain that scientific study concentrates on the five or ten most important crops and ignores the fact that in many societies, other species, not least fruits, are an important part of people’s livelihoods and nutrition. One important study has shown that in South Asia, for example, seven out of nine of food crops ‘important to large, food-insecure populations’ would deteriorate in yield by as much as 14 per cent with just 1–2°C of warming by 2030.<sup>54</sup>

Other regions fare a little better, but the same calculation made for Southern Africa would see the deterioration of six crops out of eight. Sugar cane stands out as endangered in Southern Africa, while rapeseed and groundnut are threatened in South Asia. ‘Food and nutritional security depends on dozens of crops – not just the big three, rice, corn and wheat,’ says agronomist Andy Jarvis. ‘Farmers are continuously changing crop. Focus on a single crop and you miss the big picture.’<sup>55</sup>

### Box 4. The locust bean tree

The bright red flower and protein-rich seeds of the locust bean tree are valued by people across West and Central Africa, from Senegal and Guinea to Congo and Chad. The fruit pulp and seeds are rich in sugars, amino acids, and vitamins. They are good food for both humans and animals. The trees also provide fuel, building materials, and medicine. Even the twigs are used as toothbrushes. The broad branches of this beautiful tree also provide

shade for growing vegetables and play an important role in soil ecology. But drought in recent decades has caused the locust bean tree to retreat swiftly from the northern parts of the Sahel countries. Moussa Ouedraogo, a scientist at the Centre National de Semences Forestières in Burkina Faso, has run studies of the locust bean tree in the field. He says that urgent action is needed to develop improved seeds so that the tree can adapt to the coming climate change.<sup>56</sup>

## Export crops

Crops of course are not grown just for general consumption in the country of origin, but are also grown for export. Due to climate change effects, cash crops – which are crucial to many equatorial countries – are likely to suffer, so affecting income generation.

The regions most suitable for coffee production will shift; coffee yields and quality are likely to change with small temperature increases (1–2°C). Such intensively grown crops are likely to be affected by more diseases and pests.<sup>57</sup>

Tea production, which employs 500,000 people in Kenya, with perhaps two million more people dependent on their income, is also highly sensitive to changes in heat and water. In Sri Lanka, 700,000 workers and their families are dependent on the tea industry. With the country forecast to experience higher temperatures and more extreme rainfall, soil erosion will be a particular problem in the hilly tea estates. Production is expected to drop by more than 20 per cent during this century.<sup>58</sup>

## Empty nets, poisoned fish

*'The wind is heavier on the sea, and there have been more storms. Normally the storms start in September or October, but recently we have had storms in March and April. We have not been able to go out fishing as much in the last two years because of the weather.'* – Vo Viet Gia, 39, Viet Nam.<sup>59</sup>

Crops are only one part of the food story. Fish stocks are also endangered by climate change – threatening the loss of a significant source of protein and income for the 2.6 billion people who get 20 per cent of their protein from fish. In many poor countries, dependence on fish consumption increases with poverty.<sup>60</sup> In addition, 500 million people in developing countries depend – directly or indirectly – on fisheries for their livelihoods. Fish products are among the most widely traded foods, with more than 37 by volume of world production traded internationally.<sup>61</sup>

Both wild and farmed species of fish are threatened by a whole range of climate-driven problems – from raised sea levels and floods that damage fish farms on coasts and in river areas, to the increasing acidification of the oceans as a result of GHG emissions. The threat of higher temperatures to coral reefs and their ecosystems has been well documented: a recent study suggests that 90 per cent of the food resources of the 'coral triangle' of the western Pacific will be gone by

2050, potentially affecting 150 million people.<sup>62</sup>

'Dead zones' are already appearing in the Indian Ocean and the Gulf of Mexico, where acidification and other factors have destroyed marine habitats. Fisherfolk in Andhra Pradesh, India tell Oxfam that 15 years ago with their diesel-powered boats they found fishing grounds just 1km from shore. Now they must travel 30km.<sup>63</sup> Little-understood changes in ocean currents, oxygen levels, and salinity, and the consequent changes in behaviour of marine animals throughout the food chain are also causing alarm.

The Asia-Pacific region is the world's largest producer of fish, both farmed and wild. Studies suggest that fish stocks will decrease in the tropical oceans due to changes in oceanic circulation in a warmer atmosphere. Numbers of fish larvae are already said to be diminishing. A large-scale change to the ecosystem and migration patterns of one of the world's most important ocean fish, skipjack tuna, is projected in the Equatorial Pacific.<sup>64</sup>

Poor people who rely on fish for consumption and for their livelihoods will fare badly as climate change impacts on fish stocks increase.

## Adapting for a new food security

### Box 5. Changes for the better

Fred Kabambe, of Thyolo, southern Malawi, says that he sometimes used to get only half a 40kg bag of maize from his smallholding. In 2008, he harvested no less than eight bags of maize and this year, even if the rains prove to be not so good, he expects to beat that. He is growing an early-maturing, high-yielding maize variety, from seed provided to him by a local NGO partner of Oxfam. He has also been taught a crucial new skill: to prepare compost. He takes the old maize stalks, chops them finely, and puts them in a pit with soil and dung from the goats that he has also received. He mixes it all with water, and in three months' time the manure is ready and can be used.<sup>65</sup>

Overall, the world's agricultural potential is less than 60 per cent exploited: there is still enough land to feed everyone, even with population levels at the 9.2 billion currently predicted by the United Nations for 2050.<sup>66</sup>

Investment in agricultural adaptation can clearly have enormous and swift benefits in addressing the impacts of climate change. In developing countries, agriculture is still technologically unsophisticated and land is often under-used.<sup>67</sup> For instance, only 10 per cent of the arable land in Mozambique is currently in productive use, according to the World Bank. Only 17 per cent of the world's agricultural land is irrigated – yet that land produces 40 per cent of the world's food. In Africa, according to a World Bank study, rainwater-fed farms lose \$27 annually (which could be a month's income for the average poor farmer) with every 1°C rise in temperature, while irrigated farms gain \$35.<sup>68</sup>

African farmers use less than 1 per cent of the artificial fertilisers commonly used in the rich world. Systematic, low-technology irrigation is hardly used in the developing world, except in rice production. Agriculture in Malawi, for example, is 90 per cent rain-fed.<sup>69</sup> One study estimates that, at little cost, agricultural productivity could be increased by 20 per cent worldwide through education and investment in micro-irrigation and rainwater irrigation techniques.<sup>70</sup> There are many existing ideas of sustainable agriculture, such as agro-forestry, that should be developed, and organic farming also holds some answers.

Adapting plant species to changing weather patterns is also fruitful, if expensive. Maize adapts well to breeding techniques: new varieties have at times lifted production in Africa by 5 per cent a year for a number of years.<sup>71</sup>

## Hurry up

Climate-driven damage to crops, to the health of agricultural workers, to fish stocks, and to forests has been a reality for at least 20 years. It is only set to worsen, but there are things we can do.

*'Nature has got much worse, people have offended Nature. Spring comes 2–3 weeks earlier than before. Spring is getting harsh; it is raining or snowing all the time. The first thaw is at the end of April. The first rain is in May; it has never been like that before.'*

Gregory Rykhtyn, Vankarem Settlement, Siberia 2006.<sup>72</sup>

We can help people to adapt now. However, with some notable exceptions, there is a worrying lack of urgency in the work of crop substitution even though many scientists say that the need is immediate, given the changes in weather patterns that are already apparent.

We can put pressure on governments and donor nations to act now. Donor pledges for adaptation are being disbursed and spent shockingly slowly.<sup>73</sup> The IPCC's most recent report analysed crop productivity changes without looking at the prospects for crop substitution and adaptation,<sup>74</sup> even though these may offer the most likely route to maintaining food supplies. Hunger is a worrying and tangible impact of climate change, which hits poor people first and worst.

# 3 Bad for your health

*'The medical profession has to wake up if we're going to save billions of lives... Being a climatologist and jumping up and down pulling my hair out and saying "we're all going to die in a horrible way" does not work.'*

Professor Mark Maslin, University College, London, launching a joint report by climatologists and medical experts, May 2009.<sup>75</sup>

*'Representation on global task forces to address the health impact of climate change is heavily skewed to Northern institutions and we must redress this balance... Too many doctors have been silent for too long about the importance of climate change to the future of health and health services'*

Managing the Health Effects of Climate Change, University College, London/The Lancet, June 2009.<sup>81</sup>

Arguably, the effects of climate change on health will reach wider and faster across the world than any other fall-out from climate change. Estimates of how many people die each year of causes related to climate change are disputed: according to the Global Humanitarian Forum, that figure could be as high as 300,000;<sup>76</sup> a 2003 report to the World Health Organisation (WHO) said: 'The modest climate change that occurred between the mid 1970s and the year 2000 is estimated to have caused the annual loss of over 150,000 lives...'<sup>77</sup>

In the last few months, several bodies including the Commonwealth countries' health ministers have concluded that climate change is the greatest threat to health globally this century.<sup>78</sup>

The poorest and hottest countries will suffer most. The loss of healthy life years as a result of global environmental change is predicted to be 500 times greater amongst poor African populations than amongst European populations.<sup>79</sup> Climate change-driven alterations in patterns of disease and illness are already occurring globally, and 99 per cent of the casualties of climate change now are in developing countries.<sup>80</sup>

The same WHO-derived forecast states that the health of 235 million people is currently affected by climate change every year, principally because of malaria, diarrhoeal disease, and malnutrition.<sup>82</sup> There are 150,000 extra deaths per annum because of these issues, including fatalities caused by flooding. Over 85 per cent of the dead are children.<sup>83</sup> Women are particularly vulnerable to the health and psychological impacts of climate and migration.

Both climate change and poverty intensify health risks. In this section we examine some of the areas of particular concern:

- 1. Diseases are shifting geographically and seasonally.** Illnesses well known in some parts of the world come into contact with new populations that do not have immunity to them. They may lack the knowledge and public health systems to cope.
- 2. Climate catastrophes put people at greater risk of health problems.** Storms and floods destroy homes and livelihoods and lead to illness and malnutrition. They also cause injury and psychological damage. Death tolls in such events always include a disproportionate number of women and children. The 2005 Indian Ocean tsunami, though not climate-related, is indicative: Oxfam found that in some areas 80 per cent of fatalities were women.<sup>84</sup> Heat stress and drought also act to damage livelihoods and will affect health and nutrition, as incomes drop. All these disasters can lead to forced migration and security problems, which have their own charted disease burden, including an added risk of HIV infection.

**3. Cities foster disease and are prone to climate disaster.** Mega-cities are swelling because people are leaving the countryside to seek new ways to make a living. These cities are often polluted, overcrowded, and lacking in basic infrastructure such as clean water and sewage treatment. In African cities, 72 per cent of residents live in slums that have particularly poor drainage facilities, making them especially prone to flooding and ill health.<sup>85</sup> Around 800,000 people already die every year because of urban air pollution.<sup>86</sup> Mega-cities in the tropical world may become some of the most dangerous habitats for poor people affected by climate change because most of them are threatened by storms, floods, and rising sea levels. The threat to water supply in cities is covered further in the section on **water**.

## Disease creep

As the climate shifts, diseases that have long had geographical boundaries start to migrate. Temperature rises alone make a difference: cases of diarrhoeal disease in Lima, Peru go up 8 per cent for every rise of 1°C.<sup>87</sup> New populations lack immunities, as well as the knowledge and often the health infrastructure to cope. Schistosomiasis, or bilharzia – which does not kill, but which damages the liver and impairs growth and cognitive development in children – is said to be the world's most economically devastating disease after malaria. It is endemic in many places where the temperature does not drop below 0°C, because at that temperature the snail that carries the parasite cannot survive. Bilharzia follows global warming: it is spreading, for example, through new areas of China, where a predicted 210 million more people will be threatened by the disease by 2030.<sup>88</sup> A mass surveillance and education plan is being discussed.

There are reports of rising numbers of cases of malaria in Moscow and St Petersburg in Russia. Elsewhere in Russia there have been unprecedented outbreaks of West Nile fever (in the Volga, Ural, and Siberia regions) and viral haemorrhagic fever has been reported in central Russia, from where it is forecast to spread northwards with warmer winters. There are now 10,000 cases a year of tick-borne encephalitis; in the summer of 2007 there were 35 fatalities. This disease is also said to be spreading through Siberia and southern Russia.<sup>89</sup>

**Table 1: Climate change and vector-borne diseases**

Disease	Vector	Population at risk (million) <sup>i</sup>	Number of people currently infected or new cases per year	Present distribution	Likelihood of altered distribution
Malaria	Mosquito	2,400 <sup>ii</sup>	300–500 million	Tropics and subtropics	Highly likely
Schistosomiasis	Water snail	600	200 million	Tropics and subtropics	Very likely
Onchocerciasis (River blindness)	Black fly	123	17.5 million	Africa, Latin America	Very likely
Dengue	Mosquito	1,800	10–30 million per year	All tropical countries	Very likely
Lymphatic Filariasis	Mosquito	1,094 <sup>iii</sup>	117 million	Tropics and subtropics	Likely
African Trypanosomiasis (Sleeping sickness)	Tsetse fly	55 <sup>iv</sup>	250,000 to 300,000 cases per year	Tropical Africa	Likely
Leishmaniasis	Phlebotomine sand fly	350	12 million infected, 500,000 new cases per year <sup>v</sup>	Asia, southern Europe, Africa, Americas	Likely
American Trypanosomiasis (Chagas disease)	Triatomine bug	100 <sup>vi</sup>	18 million	Central and South America	Likely
Yellow fever	Mosquito	450	More than 5,000 cases per year	Tropical South America, Africa	Likely
Dracunculiasis (Guinea worm)	Crustacean (Copepod)	100 <sup>vii</sup>	100,000 per year	South Asia, Arabian Peninsula, Central-West Africa	Unknown

Climate change and vector-borne diseases. Intensity, and seasonality of many major tropical vector-borne and other infectious diseases, such as malaria and dengue fever.

Source: Oxfam graphic based on diagram by Philippe Rekacewicz, UNEP/GRID-Arendal. <http://maps.grida.no/go/graphic/climate-change-and-vector-borne-diseases>. UNEP and WMO (1996) 'Climate change 1995, Impacts, adaptations and mitigation of climate change: scientific-technical analyses, contribution of working group 2 to the second assessment report of the IPCC' Cambridge University Press: Cambridge.

i Top three entries are population-prorated projections, based on 1989 estimates.

ii WHO, 1994.

iii Michael and bundy, 1995.

iv WHO, 1994.

v Annual incidence of visceral leishmaniasis; annual incidence of cutaneous leishmaniasis is 1–1.5 million cases/year (PAHO, 1994).

vi WHO, 1995.

vii Ranque, personal communication.

Rapid urbanisation – which can be spurred by climatic factors as people seek new livelihoods in cities – brings disease with it. Urban sprawls often lack health infrastructure, and migrant workers may not be able to afford care and medicine. Some of the worst health statistics emanate from cities: HIV rates are usually higher there, and so are diarrhoeal diseases.

In some Asian and African countries, 80 per cent of people depend on traditional medicines in primary health care, chiefly from plants.<sup>90</sup> An example is the use of the highly effective plant *Artemisia annua* as a palliative for malaria. It is forecast that the availability of some of these plants could change. An estimated 14,000 species are currently under threat for a variety of reasons, including habitat loss.<sup>91</sup>

*‘To a large extent, public health depends on safe drinking water, sufficient food, secure shelter, and good social conditions. A changing climate is likely to affect all of these conditions.’*  
WHO.<sup>92</sup>

Two-thirds of people in South-East Asia live next or close to the sea. It is said that the risk of mortality and morbidity due to climate change (attributable to diarrhoea and malnutrition) in some parts of the region is already the highest in the world. Disasters displace people, putting them at additional risk of gastro-intestinal disease.<sup>93</sup> Diarrhoeal disease is a near-automatic result of floods and other water-related catastrophes, including drought; contaminated water is the primary cause of amoebiasis, cholera, giardia, shigellosis, and typhoid fever.

Sea-level advances will contaminate groundwater, just as floods contaminate wells, streams, and springs. A newly identified danger lies in the phytoplankton blooms that are a feature of the oceans around South-East Asia as the waters warm. These clusters of micro-organisms have been found to provide a habitat for cholera and other infectious diseases.

In the Philippines, rates of malaria, dengue fever, cholera, and typhoid consistently rose in the years of the El Nino and La Nina weather phenomena. In 1998 and 2003, the number of dengue cases rose by six- to seven-fold, to 35,500 and 30,000 respectively.<sup>94</sup>

#### Box 6. A new threat: dengue fever in Indonesia

Dengue is carried by mosquitoes and it is spreading through the highly-populated Indonesian island of Java. It is a new problem for many people who are unaware of the risks or the means of prevention. Local health systems appear overwhelmed.

Iha’s daughter hands her mother a tissue to wipe her tears. ‘Last month my youngest daughter was infected by dengue fever, now my third daughter is. It’s been too heavy for me.’ Twelve-year-old Laila has been in hospital for nine days after being brought in with a high fever. ‘They said that this is a new type of dengue fever. Poor Laila, she has already had 30 bags of infusion water. After nine days her condition is still not stable.’

‘It hurts,’ says Laila. ‘Please pray for me.’

Twenty-three-year old Mila, Iha’s oldest daughter, talks to the doctor. Iha herself is too afraid to hear more bad news. ‘I hope that this disease doesn’t get worse. Laila was the third victim this month in the neighbourhood, and some other people are also diagnosed with dengue fever.’

‘The change of the disease pattern is because of the change in the environment,’ says Tjandra Yoga Aditama, director-general of disease control and environmental health at Indonesia’s Ministry of Health. ‘The vitality of the dengue virus depends on the temperature and environment.’



Back at the hospital, the corridors seem full of the sound of children crying, 'I've already spent 4.5m rupiah (\$430) for Laila's medications. I could not afford any more,' Iha says. 'I wish the government could help with hospital fees.' She looks sadly at Laila. 'I just want my daughter cured.'

Dengue fever is an increasing problem throughout South-East Asia, especially among poor people in the mega-cities of the region. In Singapore, Bangkok, and the cities of Indonesia, dengue rates have risen continually over the past 20 years, with spikes usually showing during unusual rainy seasons. Australia's Lowy Institute, meanwhile, says that since the 1970s, climate change has contributed to 150,000 more deaths every year just from disease, with over half of those happening in Asia.<sup>95</sup>

There are already an estimated 50–100m cases of dengue fever each year and approximately 25,000 deaths, with about two-fifths of the world's population currently living in dengue-affected areas. The Lowy Institute says that scientific models are predicting that by 2085 an estimated 52 per cent of the world's population, or about 5.2 billion people, will be living in areas at risk of dengue. In May 2009, a study by Brandeis University in the USA, in collaboration with other institutions, said that the collective economic burden of dengue fever in just eight countries amounted to \$1.8 billion a year.

Source: Interview by Devi R. Ayu, Oxfam International.

## Malaria

Malaria is synonymous with poverty. In poor countries prone to the disease, it is said to reduce annual Gross National Product (GNP) growth by between 0.5 and 2.3 per cent.<sup>96</sup> Malaria and its side-effects kill up to 6 million people per annum. Three-quarters of these people are children.<sup>97</sup>

Driven by local practices such as deforestation, and exacerbated by the changing climate, malaria is now affecting people who have previously had little experience of it, for example in the East African highlands and in the Andean foothills. Large average temperature increases in the uplands of Tanzania since the 1960s have brought the *Anopheles* mosquito and the parasite *P. falciparum* (which cannot survive below 16°C) to a new population. By 2000, according to one report, infection rates had increased 1,000 per cent.<sup>98</sup>

Malaria is on the move, with incidence rising fastest in southern Europe and in African cities. In Colombia, it is estimated that 18–24 million people are now at risk of the disease. Malaria spikes in the wetter years brought by El Niño:<sup>99</sup> in some years in the 1990s, incidence doubled due to climatic events to as many as 250,000 cases. In some coastal municipalities of Colombia, two in every five people contracted the disease.<sup>100</sup>

### Intervention works

Countries in Latin America and the Caribbean have had great success in addressing malaria by mounting region-wide campaigns. Deaths have declined by 40 per cent since 2000. But it is the 32 per cent drop in the number of cases that is equally significant, because the form of malaria prevalent in the region does not kill, but instead is seriously debilitating, harming livelihoods and long-term health.

Latin America's experience has shown that low-cost interventions and education can effectively address the malaria menace. Spraying with insecticide, free distribution of treated mosquito nets – which can cost less than \$5 each – and teaching about the causes and symptoms of malaria have cut cases and mortality dramatically. Collaboration between Latin American countries on drug resistance and new therapies has helped too.<sup>101</sup>

## Too hot to handle – heat stress

Small increases in temperature hit human beings hard. None of us, no matter how well acclimatised, can do heavy work effectively above 35°C or so. A couple of degrees higher than that, and our bodies soon get exhausted.<sup>102</sup> Once core body temperature passes 38°C, heat stress may set in.<sup>103</sup> The body tries to cool down by sweating; dehydration may follow. People's work rate slows. Ultimately, production and incomes decline.

We are not good at recognising the symptoms of heat stress. In the European heatwave of 2003, when temperatures rose some 5°C above normal, there were 35,000 extra deaths. In London, the mortality rate rose 40 per cent. Older people, children, and people with heart and lung problems are particularly at risk.<sup>104</sup>

Cities are particularly dangerous in heatwaves because of the 'heat island' effect, where heat retention in concrete, and use of air-conditioning combine to raise night-time temperatures – in tropical cities by as much as 10°C.<sup>105</sup> Projections suggest a six-fold rise in heat-related deaths in Lisbon by the summer of 2050, a five-fold increase in Greater London, 2–7 times more deaths in California, and a 75 per cent increase in deaths among old people in Australian cities.<sup>106</sup>

### The research gap

There is much less research on the effects of heat stress on poorer countries, despite the fact that the burden of disease and death, and the impact on workers' productivity will be much higher in mega-cities such as Sao Paulo, Manila, Mexico City, and Mumbai.

In Delhi, mortality rates rise by up to 4 per cent with every 1°C of temperature rise above a 'heat threshold'.<sup>107</sup> The figure is nearly 6 per cent in Bangkok.<sup>108</sup> On 29 April 2009, the temperature reached 43.5°C in Delhi – the hottest April day in 50 years – and a full 5°C hotter than doctors would say was the maximum safe heat for outdoor work.

## The threat to farmers, to women, and to family life

*'Working under the open sky during summer has become nearly impossible in the past four years or so – for farmers and their cattle alike.'*

Mir Ahmed, farmer, St Martin's Island, Bangladesh.<sup>109</sup>

The threat to farmers and other outdoor workers, and particularly to women is troubling and little researched. Some 67 per cent of the world's one billion poorest people are agricultural workers – and in many cultures women make up the bulk of this agricultural workforce (60–80 per cent in sub-Saharan countries),<sup>110</sup> especially in subsistence farming. If, as has happened in some countries during the hottest months, women find it impossible to labour for longer periods of the day, this becomes a significant threat to their family life and security, as well as their incomes.

Tord Kjellstrom, a scientist at the Australian National University, has pioneered work on the subject of heat stress and productivity. He suggests that in Delhi we may see a 30 per cent drop in the productivity of outdoor workers (compared with 1980), purely because of the lengthening of the hot season, and a further predicted 2°C rise in temperature.

Workers untrained in the dangers of heat stress are particularly at risk. Almost all labourers in large-scale commercial agriculture in the developing world – for instance, tea pickers in Malawi, Kenya, India, and Sri Lanka – are under pressure to work as hard as possible because they are paid not by the hour, but by results. Kjellstrom cites various studies, including one on seasonal sugar plantation workers in Central America, who suffer high levels of kidney malfunction due to heat-related dehydration. Car assembly workers in South India now need longer siesta times.<sup>111</sup>

## Mind and body

*'Thank you for the food. Can you give me the will to eat it?' – Woman from Myanmar (Burma) after Cyclone Nargis.*<sup>112</sup>

*'The water exhausted me. Since then, even until now, I am still exhausted by that experience. One of the people who escaped was able to return to the house and is living in the mud now, but I can't do it. I can't go back.'*

Filomen Omelius, an elderly woman displaced by the September 2008 tropical storm Hanna, at Camp Ebenezer, Savanne Désolé, Haiti, April 2009.<sup>113</sup>

Extreme weather events and disasters affect mental health. These psychological effects tend to be much longer-lasting and may be worse than the direct physical effects.<sup>114</sup> A study concentrating on the psychological effects of flooding – a disaster that affects more than 140 million people a year, and notably tends to result in disproportionate casualties among women and children – says that even minor floods can result in 'negative psychological outcomes' that may last over four years.<sup>115</sup> These outcomes will include fear, lethargy, depression, post-traumatic stress disorder, and in extreme cases suicide.

Mothers often bear the burden of keeping family life going after a disaster, and rebuilding the family's livelihood. When a child falls ill, it is usually the mother who takes responsibility for caring for them, which adds to the stress and extra labour caused by losing a home.<sup>116</sup> Displaced families who have lost mothers are more likely to disintegrate. Women are more likely to be affected by insecurity as a result of climate change – an issue that is explored further in the sections on **migration** and **disaster**.

*'The people in our village have lost the feeling of helpfulness towards each other, and there is no community feeling any more... We need to think about how we can get back the feeling of helping each other in times of floods.'*

Chulhi Devi, mother, Gangti Bishanpur, Bihar State, India, 2007.<sup>117</sup>

A sociologist who studied the effects of the 2007 floods in Nepal on displaced people commented on how women complained of anxiety, sleeplessness, and feelings of helplessness.<sup>118</sup> There is evidence from accounts of major floods that the disruption of social networks that follows when families flee to safer ground is very damaging to women.

## Cost-effective

The health risks posed by climate change do not need a silver bullet to tackle them. There are no new climate change diseases – only existing ones that are being visited on new populations. The technology to prevent and treat these diseases is well known. In the case of malaria, prevention is extremely cost-effective.

## 4 Disasters – ‘the new normal’

*‘During the hurricane there was flooding that covered the rice crop – 2 or 3 metres deep. I lost my crop. I lost a lot of money, we had a lot of mud and my house was destroyed. Now we are living in misery and we don’t have enough food. This year has been the worst. There was a drought before which destroyed the sorghum. When we were young it was better, we used to have a lot to eat.’*

Sedye Desir, a rice farmer with six children, near the town of Anse-à-Veau, who survived Haiti’s 2008 hurricanes.<sup>119</sup>

*‘We used to get three good rains. Now we don’t even get two. There’s no more rainy season, just the hurricane season. As soon as people see clouds forming, they put together their stuff and head for the hills.’*

Gary Novamn, farmer, Gonaives, Haiti, April 2009.<sup>123</sup>

Climate-related disasters – storms, floods, and droughts – have been increasing in frequency at an extraordinary rate. Oxfam estimates that by 2015 the average number of people affected each year by climate-related disasters may increase by over 50 per cent to 375 million.<sup>120</sup>

Extend the line of the graph that charts the occurrence of such disasters between 1975 and 2008, and it shows that in 2030 we will experience more than three times as many such disasters as today.<sup>121</sup> However, the impacts of climate change are unlikely to follow such a predictably linear trend, but will instead be much more erratic and severe as other impacts accelerate: it is reasonable to assume that this estimate of more climate-related disasters is a conservative one.

Another projection states that by 2030, some 660 million people (more than twice the current population of the USA) will be affected by climate change, most of them because of short- or long-term disasters. That figure will increase by 500,000 people a year.<sup>122</sup>

Poor people suffer worst from natural disasters. In rich countries, the average number of deaths per disaster is 23, while in the poorest the average is 1,052. When the Hanshin earthquake struck Japan in 1995, it claimed the lives of some 6,000 people. But in 2005, the Kashmir earthquake in Pakistan, measuring about the same on the Richter scale, claimed 75,000 lives – 12 times as many – despite the fact that the earthquake affected areas with much lower levels of population density.<sup>124</sup>

### Women and disaster

Women and their networks are vital in disaster mitigation and reduction. They are often the most effective agents of the social change needed to help communities cope and rebuild. Women displaced from Darfur have played a pivotal role in Oxfam’s public health activities in camps in Chad, assessing needs and organising the response. They were given a rare opportunity, in their culture, to obtain paid employment and to learn marketable new skills.

However, women are disproportionately the victims in disasters (see **health** section). Not only do women and children generally suffer a higher mortality rate in catastrophes such as floods and hurricanes: in the aftermath of disasters, they are liable to become victims of trafficking, and of violence, both domestic and at the hands of strangers.<sup>125</sup>

#### Box 7. Bangladesh – rising sea water destroys a family

In the coastal district of Satkhira, flood waters from the sea have brought salt into the rice paddies. Many families have lost their land and have had to migrate to towns. Fahima Begum, a 28-year-old widow and mother of children aged eight and five, is considering her troubles and her options.

'My husband used to be a rice farmer [until the salinated land was taken over for shrimp farms]. He had to go to the Sundarbans forest to collect honey. One afternoon three years ago he found a beehive. He went to climb the tree, but then he was caught by a tiger and killed. He was 30 years old.

'It's very difficult to send my children to school. There are no fish in the river, no jobs in the village. Now we are suffering a lot, especially due to the lack of clean water. When the embankment broke, salt water got into the fresh water. We collected the water from more than a kilometre away, near the primary school – about a mile away. My daughter brings the water from the pond. My children are suffering from diarrhoea. On one hand they starve and the water makes it worse.

'Sometimes I feel like killing myself. We have a lot of pain. If I told you everything you would hardly be able to walk with the burden of my story. How do we survive these days? I have lost my husband and parents at a young age. Now there is nobody for me in this world. All seems dark. Most of the people have moved away now. Maybe I could leave. If I can't provide food for my children, can't give them good shelter, sometimes it comes into my mind because there is no other way. But I don't know where I would go, because I haven't even crossed the river. I don't know how to go, because I don't know where to go.'

Source: Oxfam International in Bangladesh, 2008.

## Mega-fires and mega-droughts

*'Climate change is a threat multiplier and one of the greatest threats to development: 53 per cent of African disasters are climate-related and one-third of African people live in drought-prone areas. By 2020, yields from water-fed agriculture in Africa could be down by 50 per cent.'*

Dr Balgis Osman-Elasha, Higher Council for Environment and Natural Resources, Sudan, March 2009.<sup>126</sup>

As climate change accelerates, and various tipping points are reached, new forms of natural catastrophe are widely predicted. In the USA and many countries in Asia, the number of forest fires is already increasing dramatically. They have turned from being a natural seasonal hazard to a destroyer of livelihoods and a driver of migration.

Huge and damaging forest fires in Nepal and throughout the Himalayan region were reported in the winter of 2008 and blamed largely on drought. Their smoke trails were visible by satellite. The Nepalese government admitted that it had none of the equipment or resources common in rich countries to tackle and control the fires.<sup>127</sup>

A report on the enormous increase over 35 years in large fires in the western USA concluded that it was 'another part of a chain of reactions to climate warming', specifically the effects of earlier spring, higher temperatures, and lower rainfall. The wildfire season in 2003 was 78 days longer in 2003 than between 1970 and 1986.<sup>128</sup>

If the earth heats up by more than 2.5°C, recent research says that tropical forests may become a net source of carbon emissions as their vegetation starts to degrade. At the moment, these forests absorb 25 per cent of the carbon produced every year. There is no research, however, on the effect that forests burning or rotting away will have on the 1.5 billion people dependent on indigenous forest for their livelihoods. Analysis of the sediment of African lakes recently revealed a cycle of century-long 'mega-droughts' going back 3,000 years. It is suggested that the West African Sahel drought, which has killed perhaps 100,000

people since the latter part of the 20th century, is one of them. The scientists believe that the droughts are driven in part by circulation of the ocean and atmosphere in and above the Atlantic. If climate models for such circulation patterns hold true, the study suggests, global warming could create conditions that favour extreme droughts.<sup>129</sup>

## Water, water everywhere

Coastal erosion will rapidly increase with rising sea levels. In some Asian regions a 30cm sea-level rise could result in 45 metres of landward erosion. This is likely to destroy many structures built by humans for flood protection.<sup>130</sup>

Professor Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research said in March 2009: 'Global sea level is rising, and faster than expected. We need to honestly discuss this risk rather than trying to play it down.'<sup>131</sup> Rahmstorf represents a group of eminent oceanographic scientists who now agree that sea levels will rise by around 1 metre this century. They speculate on a further 3.5 metre rise by 2200. 'Sea-level rise doesn't stop in 2100. We are setting in motion new processes that will mean sea-level rise for centuries to come,' Rahmstorf warned the Copenhagen Science Summit in March this year.<sup>132</sup>

Rising sea levels and other factors paint the climate change vulnerability maps for the entire typhoon-prone island nation of the Philippines a uniform red – that of 'maximum risk'.<sup>133</sup> A 30cm sea-level rise would affect 500,000 people in the Philippines, and a 1 metre rise 2.5 million people – leaving aside the ongoing effects of hurricanes and storm waves. The consensus of scientists since March 2009 is that the global average sea-level rise by 2100 will be 1 metre,<sup>134</sup> and that that rise will continue no matter how much carbon emissions are curbed.

Rising sea levels and cyclones can combine with deadly consequences for poor people. In late May 2009, Cyclone Aila hit Bangladesh and East India. More than 200 people were killed, including many children, and 750,000 people were made homeless.<sup>135</sup> Before the storm, people in the Satkhira district in Bangladesh had told Oxfam researchers that the sea level was rising, tides were higher, and salt water was encroaching on their land. When the storm hit – even though not a particularly strong cyclone in comparative terms – it coincided with yet another unusually high tide, and storm waters breached the embankments, destroying villages, crops, and lives.

Research has not caught up yet with this new forecast. The IPCC's 2007 report imagined a rise of 18–59cm during this century due to just one major cause – thermal expansion of the water. Most researchers have been working on the basis of a 40cm rise. Even under these projections, the number of coastal dwellers globally at risk from flooding has increased from 13 million to 94 million.<sup>136</sup> Clearly the effects of a rise of more than twice that will be devastating: a 1 metre rise might affect 17 per cent of Bangladesh's land area, destroying the homes and

livelihoods of 25 million people.<sup>137</sup> Forty per cent of people in West Africa live in coastal cities: a great many of them will be at risk.

Box 8. Floods in Zambia and Uganda: from celebration to hunger and poverty

On the plains of western Zambia, the annual rains and flooding of the Zambezi River are traditionally seen as a life-affirming event, heralding prosperity. The water makes the lowlands more fertile for grazing livestock and cultivating crops, and its arrival was a time of ritual celebration. But in the past two years, the rains have arrived much earlier than usual. The floodwaters have risen to cover even the high ground to which the villagers usually retreat. The result has been hunger, disease, and the loss of hard-earned possessions.

In April 2009 the Liywalii family had just returned to the village of Liyoyelo after an absence of four months. The floodwater had sloughed away the clay walls of their house up to waist height, leaving just the bare ribs of reeds and wooden poles. In a corner of the house an ancient radio lies coated with a thick layer of mud.

'In December the rains came very fast. Within 12 hours the whole yard was flooded. This is the first time we have ever seen that,' says Liywalii Liywalii, 29. 'Our house was completely destroyed. Our maize crop is gone and we lost our blankets and clothes because we had to leave so quickly. The wind blew away the zinc from the roof. I will have to save up to buy more.'

His wife Mukelabai, 25, is still stunned as she looks at what remains of her home. 'We put all our children in the canoe and paddled about 25km. We could not save our crops, so we have no food. We are eating nothing.' The family eats the fish that Liywalii catches each day, but it is not enough to feed their three children. This is the second year in a row that the water has risen so high. But moving away permanently is not an option, says Mukelabai. 'This is our land, this is our ancestral village.'

Janet Ajojo from Amuria district in Uganda suffered from a huge and unprecedented flood in late 2007. Her experience was typical of many. She says: 'We grew cow peas, sweet potatoes, millet, cassava, green gram, sorghum, ground nuts, and sesame. But our plots were flooded; we lost all of our crops. Even our compound was flooded and we couldn't dry what little we managed to rescue. We just felt helpless, our houses collapsed, we were soaked. We took refuge in a primary school.'

Janet and her household, a total of 10 people, received 50kg of maize dropped by helicopter. But for some six months, the food that they have depended upon has been termites. She says: 'We take spear grass and put it in the ants' nest and pull it out. If you get two cupfuls of ants, lucky you! Not everyone can stomach them. We sell some termites and buy beans with the money.' The family were making bricks – the men loading bricks, the women fetching water – to earn money to buy enough seeds to sow in the hope of a good rainy season. Asked what she expects if the floods come again she replies: 'Just death.'

When hit by floods, poor people suffer most acutely because they have fewer options open to them to cope. They tend to get into heavier debt and have to sell their assets, like livestock, at knockdown prices. They often have to forego medicines, school fees, and meals in order to get by.

'Widespread increases in heavy precipitation have been observed even in places where total amounts have decreased,' says the IPCC's Fourth



Assessment Report. What this sober assessment means, in human terms, is that Jane Ajojo and Liywalii Liywalii, and millions like them, start rebuilding their lives again, poorer than before.

Source: Oxfam International in Zambia and Uganda, 2009.

## Risk to small islands

The nine coral atolls that make up the island nation of Tuvalu are home to 12,000 people. Most of the land is less than 1 metre above the sea. In 50 years it will be gone. The only thing that will remain of Tuvalu is its '.tv' suffix in websites: it will be a virtual country.<sup>138</sup> Already, 3,000 Tuvaluans have resettled in Australia.

These are among the territories that the world has already effectively consigned to oblivion. Even if the most intensive carbon-emitting countries do manage to agree the policies that will keep warming to around 2°C this century, the sea-level rise of 1 metre forecast by 2100 (and more subsequently) will overrun these islands, or make life on them impossible.

Indonesia will lose at least eight of the 92 small islands that mark its seaward frontier.<sup>139</sup> Java, the largest and most heavily populated island in South-East Asia, will be drastically affected.<sup>140</sup> Some nations are liable to lose all or a significant part of their territory, they include: Tuvalu, Fiji, the Solomon Islands, the Marshall Islands, Papua New Guinea, the Maldives and, in the Caribbean, some of the Lesser Antilles.

*'It is likely that the annual numbers of tropical storms, hurricanes and major hurricanes in the North Atlantic have increased over the past 100 years, a time in which Atlantic sea surface temperatures also increased. It is very likely that the human induced increase in greenhouse gases has contributed to the increase in sea surface temperatures and in the hurricane formation regions.'*

US Climate Change Science Program Assessment, June 2008.<sup>141</sup>

Economic impacts will be severe, and there are no plans as yet for how to resettle the people forced to migrate from these disasters. From American Samoa to the Maldives and Barbados, there are forecasts of enormous economic impacts as fishing and tourism are affected and beaches are lost. In the Maldives, it has been suggested that higher sea levels will reduce Gross Domestic Product (GDP) by 40 per cent. Rising temperatures and the encroachment of the sea may make islands uninhabitable as their fresh water supplies disappear. Particularly at risk are Tarawa Atoll and Kiribati, which are forecast to face average annual damages of up to 18 per cent of their economies by 2050. Most people on small islands live on low land near the sea, and they will be at risk from the hazards experienced by all coastal populations.<sup>142</sup>

### Hurricanes and poverty

When Grenada was hit by Hurricane Ivan in September 2004, the loss of life was limited: 29 people died among a population of 90,000. But behind that headline there was a huge impact to the economy and to the island's infrastructure: 90 per cent of housing stock was damaged, including hotel rooms; and 60 per cent of people working in tourism, the majority of them women, lost their jobs. The cost was equivalent to two years of this small nation's GDP. Prior to Hurricane Ivan, Grenada was on course for an economic growth rate of approximately 5.7 per

cent per annum. Following Hurricane Ivan, it experienced negative growth of around minus 1.4 per cent.<sup>143</sup>

There is some observational evidence that the intensity – although not frequency – of tropical cyclones (hurricanes, tropical storms, typhoons, and cyclones) has increased in recent decades, and the number of disasters associated with tropical cyclones has also increased. It is not yet determined whether this increased cyclone intensity is caused by global warming, but under climate change scenarios, the intensity of tropical cyclones are predicted as being likely to increase, with higher wind speeds, more heavy rain, and sea-level rise, making storm surges more severe. So, although a single specific tropical cyclone cannot be attributed to global warming, many more people in Asia, Africa, Latin America, and southern North America will face suffering and destruction if GHG emissions are not cut.

#### Box 9. Flood after flood in the South Philippines

Typhoons aren't supposed to visit southern Mindanao. But weather doesn't conform to the rules any more. In the spring of 2008, Typhoon Frank brought severe rain and wind to the area, even though it is off the official 'typhoon path'. Seven thousand families were forced from their homes by flash floods along the Allah River in Visayas region, and 2,000 remain homeless a year later.

Magdalena Mansilla is a 51-year-old farmer in Lambayong town, Sultan Kudarat. She has lost her home in floods twice in four years, in 2008 and 2004. 'We just went to sleep the night before, and woke up the morning after with water everywhere. The only thing we were able to save was the roof of the house.'

A year on, Magdalena is living in a temporary site with her husband and three children. Another child is on the way. There's no farming, because their land is still underwater. She doesn't believe that the farmland can be productive again.

Joseph Abellar, from the same village, says the 15 hectares of farmland he co-owns with his brothers is now covered with sand from the river. He cannot sell even a parcel of the land rendered useless by sand. And he has no guarantee that, if he restores his fields, the floods will not come and do the same again.

Many farmers say that slash-and-burn farming has destroyed the river banks' defence against erosion. Joseph recalls the time when 'there used to be a lot of trees along the banks and in the upland.'

But other people are convinced that climate shift is a factor too. Julian Asion, municipal environment officer, says that in his area, South Cotabato, 'Rains come more frequently, even in months when we least expect it. There have been days when a two-hour downpour will bring water equivalent to what was once a month's average.'

The IPCC's Fourth Assessment Report said that, although there was 'as yet no convincing evidence in the observed record of changes in tropical hurricane behaviour, a synthesis of the recent model results indicates that, for the future warmer climate, tropical hurricanes will show increased peak wind speed and increased mean and peak precipitation intensities.'<sup>144</sup>

Source: Oxfam International in the Philippines, 2009.

## Spend before the storm

Weather-related disasters wreak havoc with lives, livelihoods, and infrastructure, but good pre-planning and investment in projects plus human capacity to reduce disasters can mitigate their worst effects to some extent, and often very effectively. The effects on developing world economies of weather-related disasters are greater than any other current climate-driven problem: the worldwide cost has ranged between \$50 billion and \$230 billion a year over the past five years.<sup>145</sup>

John Holmes, the UN Under-Secretary-General for Humanitarian Affairs, wrote this April under the headline ‘Disasters – The New Normal’: ‘When China spent \$3.15 billion on reducing the impact of floods between 1960 and 2000, it averted losses estimated at about \$12 billion. In the US, the Federal Emergency Management Agency (FEMA) calculated that \$1 spent on hazard mitigation saves an estimated \$4 in future benefits. Similar results have been recorded in Brazil, India, Vietnam and beyond.’<sup>146</sup>

Disasters are the high drama of climate change – during this century the effects of storms and floods will bring home the reality of the changing world, and the awful uncertainty that the new climate brings to hundreds of millions of people. There is enough evidence, in the effects of sea-level rise alone, to compel the world to act. Indeed, rich countries are already doing so. The low-lying Netherlands is planning to spend \$1.3 billion per annum this century on strengthening its sea defences.<sup>147</sup> If Bangladesh or the Philippines could spend a tenth as much, there is no doubt that lives and livelihoods would be saved.

### Box 10. Flood-related disasters in the 2000s

One industry with a vested interest in tracking climate change – the insurance business – is unequivocal. ‘The world is getting warmer. The upshot is not only more storms and larger amounts of precipitation generally, but also extreme rain intensities... Flooding is responsible for a greater number of damaging events than any other type of natural hazard,’ says Wolfgang Kron, head of the Geo Risk Research Unit at insurance company Munich Re.<sup>148</sup>

The unit has collected data from 25,000 ‘loss events’ over several decades and is the largest database of its kind in the world. The 2005 hurricane season saw losses hit a record \$165 billion, and, says Kron, ‘We have to accept that climate change ... will increasingly make the situation worse.’

Munich Re ranked the most costly floods in the 21st century (in \$ billions):

1.	USA, Hurricane Katrina, 2005	\$125
2.	Central Europe, Elbe, and Danube river basins, 2002	\$21.5
3.	Southern Switzerland, northern Italy, 2000	\$8.5
4.	China, Yangtze, 2002	\$8.2
5.	United Kingdom, 2007	\$8
6.	China, Yangtze, and Huai 2003	\$7.9
7.	China, Yangtze, Huai, and Yellow Rivers, 2004	\$7.8
8.	China, Huai 2007	\$6.8

9.	USA, Texas, Tropical Storm Allison, 2001	\$6
10.	India, Gujarat, Orissa, 2006	\$5.3
11.	India, Bangladesh, Nepal, 2004	\$5
	China, Pearl River, 2005	\$5
	India, Mumbai, 2005	\$5
14.	Myanmar (Burma), Cyclone Nargis, 2008	\$4 (est)
15.	Oman, Cyclone Gonu	\$3.9
16.	Bangladesh, Cyclone Sidr, 2007	\$3.8

It is not until the end of Munich Re's list that the damage to least-developed countries is registered because property and land is valued so much less than it is in rich and middle-income countries. Fewer than 100 million people (or just 3 per cent) of the world's poor people have access to insurance. But the human cost is vastly higher – far more people died in Myanmar's (Burma's) Cyclone Nargis than in the top three floods combined.

The NGO Germanwatch analyses other indicators from Munich Re's database to come up with a very different 'catastrophe impact' table. By basing calculations on levels of development and people's vulnerability, Germanwatch shows that poor countries are hit disproportionately much harder by flood and storm catastrophes, both in terms of deaths and economic losses.

Germanwatch measures storm and flood damage in every country against the average death toll, and average deaths per 100,000 people, and the average economic cost both in purchase parity and as a percentage of GDP. Its 'Global Climate Risk Index 2009'<sup>149</sup> shows that the countries most affected by extreme weather events from 1998 to 2007 were: 1. Honduras; 2. Bangladesh; 3. Nicaragua; 4. Dominican Republic; 5. Haiti; 6. Viet Nam; 7. India; 8. Mozambique; 9. Venezuela, and 10. the Philippines.

## 5 Water and community

*'Now that the sun is so hot, the glacier is melting, and we worry that there will be no more water. And even the rains that used to come on time are late, which is affecting what we can grow.'*

Valerio Quispe, high-altitude farmer, Choquecota, Bolivia, April 2009.<sup>150</sup>

As stories of how climate change and its effect on people come in from Oxfam offices around the world, we realise how central water is to community and to survival. We hear how cities like La Paz and Kathmandu – fed by water from glaciers, and whose remaining lifespan may be just a few decades – will cease to exist in their current form, just as drought was key to the collapse of the great Mayan cities of Central America. All over the world these ice rivers are in retreat – their higher melt rates are disrupting fresh water supplies and causing floods. Eventually, of course, the supply will run out. The Colombian Andes, for example, will have no glaciers left in ten years.<sup>151</sup> This will compromise the water supplies of hundreds of towns and cities.

The damage to community takes many forms – but all of them related to climatic problems. We hear of rice-farming villages in the Sundarbans of Bangladesh being deserted as inhabitants flee to the cities, terrified of the tigers that prey on humans who must enter their habitat to seek food. And of how children miss school in Africa because of the need to go and find water instead.

What may be the oldest surviving culture in the Andes, that of the Uru Chipaya tribe, faces oblivion simply because the glacier-fed river that has sustained it for 4,000 years has dried up.<sup>152</sup> And the creeping salination seen as seawater levels rise and infiltrate coastal land in South Asia, has meant that daughters of families affected cannot find husbands, because they cannot bring productive farmland to the marriage.

### Box 11. The death of a glacier, Bolivia

For centuries the villagers in Choquecota have lived in a valley high in the 'Altiplano' of Bolivia. Valerio Quispe lives here with his wife Leonarda and their three children. They make their living as farmers. His family, like others in Choquecota, already know about climate change because they are experiencing it first-hand.

'Mururata glacier is Mother Earth to us,' says Valerio. 'It is where we get our water to cook, wash, drink, water our gardens, feed our animals. Without Mururata we won't be able to survive here.'

However, the glacier – a source of water for at least nine communities – has been gradually shrinking. Scientists estimate that in 40 to 50 years it will have disappeared forever – together with the communities that have depended on it for their existence.

'Now that the sun is so hot, the glacier is melting, and we worry that there will be no more water,' explains Valerio. 'And even the rains that used to come on time are late. This is affecting what we can grow.'

Valerio's family and their community are not sitting idle – they are diversifying the crops they plant. With the help of an organisation called Agua Sustentable (Sustainable Water), they are mounting a human rights case against the USA for the damages that climate change has caused and will continue to cause to their community.

Edwin Torrez, a researcher for Agua Sustentable, explains: 'The Choquecota community want people in Bolivia and all around the world to know about the injustice they are facing. People here are taking positive steps to adapt but they need their actions to be met with urgency from the US and other rich countries to cut emissions and avoid even more catastrophic impacts in years to come.'

Source: Oxfam International in Bolivia, 2009.

## Water, wealth, and conflict

*'Access to water will increasingly be seen as a potential strategic weapon.'*

Lloyds of London risk analysis, April 2009<sup>153</sup>

The lack of water, or an excess of it, destroys livelihoods, communities, and families, the social structures that are so important in the way that poor people cope with change and disaster. Also, rainfall levels are intimately linked to wealth. Across Africa, except in central regions, GDP is down in dry years, but up as much as 3 per cent (in East Africa and the Sahel) in average years. Overly wet years can reduce GDP, but not by as much as dry ones do.<sup>154</sup>

Water shortages destroy agriculture much more quickly than any other factor, and so they drive migration and the flight of affected people to cities. Water shortage is a perpetual source of conflict – both local and international. Tensions already exist in the Mekong basin between upstream and downstream countries. Cambodia has accused Viet Nam of withholding water by building dams on its side of the border, and all the Mekong countries have voiced concerns about China's activities on the upper reaches of a river upon which 65 million people depend.

There is potential for conflict around many rivers that run through a range of nations, especially the Indus, the Nile, and the Tigris-Euphrates.<sup>155</sup> A recent study of 60 years of records of 925 major rivers, between them providing 73 per cent of the world's water supply, found that a third of them were significantly affected by climate change, mainly in terms of diminished flow. These included the Ganges, the Niger, the Colorado, and the Yellow River.<sup>156</sup>

The IPCC's Fourth Assessment Report says that the Himalayan glaciers – which form the largest body of ice outside the polar caps and which are the source of water for the 'innumerable rivers that flow across the Indo-Gangetic plains' – are receding faster than in any other part of the world, primarily because of climate change. The report adds that, at their current rate, the glaciers are likely to disappear by 2035, if not sooner. The Ganges basin alone is home to 500 million people. Between one and two billion people in China face water shortages this century if supplies from the Himalayan glaciers begin to fail.<sup>157</sup>

*'I know of two wives who have been divorced because their husband missed his washing water. Girls miss classes because they have to fetch water a long distance before they go to school.'*

Neema Kobo, 38, a mother in Morogoro, north Tanzania, talks of the conflict and disruption brought to her village by drought, April 2009.<sup>158</sup>

*'The rich are still swimming in their pools while we are dying of thirst... We have got no toilets. I can't wash my children. I can't cook. I can't clean the mess off the floor. And the worst thing is, we have got almost nothing to drink.'*

Graciela Martinez, mother to a family of eight, Mexico City, April 2009.<sup>162</sup>

*'Nepal is currently a dark country – one where the rich are buying generators and the poor are having to re-plan the patterns of their lives.'*

Charles Haviland, BBC News website, 28 January 2009.<sup>165</sup>

In 2007 the European Environment Agency estimated that around one-third of Europeans already live in water-stressed areas where water demand exceeds supply.<sup>159</sup> The USA, already in 'water deficit', will become increasingly dependent on the resources of Canada.<sup>160</sup>

Finding and transporting clean water is a central occupation in the working day of many people in developing countries, especially women. When a community is short of food, or suffering an outbreak of disease, there are immediate ways in which they can be helped. However, scarcity of water is a much greater problem. According to the UN Development Programme, over one billion people lack access to safe water today,<sup>161</sup> and that number can only increase.

Some of the issues around water and climate change are dealt with in other sections of this paper, including **hunger** (agriculture and food), **health**, and **disasters**.

## Impact on cities and towns

Mexico City, the biggest city in the Americas with a population of 22.9 million, has effectively run out of water. Taps have run dry during every month so far of 2009. All the mega-cities have water supply problems and the causes are multiple; Mexico City is a typical example. A decaying infrastructure cannot reliably supply its ever-growing populace, and, though water is already harvested from hundreds of miles away, continuing drought in the region is exhausting the supply.

In the spring of 2009, Kathmandu and other parts of Nepal (only 40 per cent of the country is electrified) suffered power cuts for up to 20 hours a day. These were caused in part by the decay of the country's aging hydroelectric system, but also by an exceptionally dry winter. The collapse of the natural dams, called moraines, that hold Nepal's glacial lakes, not only caused devastating floods but also damaged power-generating facilities.<sup>163</sup> As always, poor people have been most affected by the lack of power. In Kathmandu, house fires have increased because people there have had to use oil lamps. Small businesses are failing, and thousands of people who are dependent on battery-powered public transport – introduced to cut pollution levels – are unable to get to work.<sup>164</sup>

Water, climate change, and community are intimately inter-related. If a community breaks down, its chances of coping with and surviving a disaster collapse too – which is one of the reasons why water supply is so often Oxfam's first concern when it gets engineers to the scene of a crisis. Water supply affects hunger, migration, and health. It must be central to global plans to adapt to the impacts of climate change.

## 6 Migration, vulnerability, and security

*'[Route] 66 is the path of a people in flight, refugees from dust and shrinking land, from the thunder of tractors and invasion, from the twisting winds that howl up out of Texas, from floods that bring no richness to the land and steal what little richness is there.'* – John Steinbeck, *The Grapes of Wrath*, 1939.

The story of humanity can be told through migrations. Throughout history, climate has been one of the primary motivating forces for movements of people. Three million are said to have migrated in the USA during the late 1930s, to escape the nightmare of the Dust Bowl that the hitherto fertile farmlands of that part of the Great Plains became almost overnight. Many of the families had fled rural poverty in Europe only a generation or two earlier.

This was a textbook example of a multi-cause migration: a catastrophic drought exposed a farming system that had exploited the land in an unsustainable way. It destroyed the livelihoods of a poor farming population without any safety nets. Forced in desperation to move to new land, whose inhabitants were themselves suffering an economic collapse, the migrants encountered exploitation and violence. The social upheaval was enormous, as was the damage, psychological and economic, that followed. That great catastrophe of the Dust Bowl still resonates in the USA today.

### Climate change migration is now

*'[A threat to] livelihoods is the most common pathway to migration, followed by rapid onset environmental disaster. Mass migration could be a coping strategy when ecosystems change irreversibly. But the border between forced and voluntary migration is blurred: we have a limited amount of empirical evidence that environment is forcing migration. We need more research.'*

Dr Koko Warner, EHS-UNU.<sup>166</sup>

Similar things are happening now. In 2007, nearly two years after Hurricane Katrina hit the Gulf Coast, 1.7 million people were still displaced.<sup>167</sup> Today the population of New Orleans is still only 74 per cent of its pre-Katrina levels.<sup>168</sup> Meanwhile, one of the great ongoing migrations of the past 50 years, driven by interlinked economic and climatic factors, continues on from Mexico to across the USA's southern border.<sup>169</sup>

### What is a 'climate-change refugee'?

It has been estimated that worldwide there are already 26 million people displaced, some temporarily, some long-term, as a direct result of climate change<sup>170</sup> – and that each year a million more are displaced by weather-related events. For example, in 2008 Cyclone Nargis in Myanmar (Burma) forced 800,000 people out of their homes.<sup>171</sup> By 2050 the most widely accepted forecast for the number of 'environmentally induced migrants' is 200 million.<sup>172</sup> There are, researchers agree, significant areas of uncertainty. But some things are definite: rising sea levels, for a start, make migration inevitable (see section on **disasters**). According to the World Bank, the 1 metre sea-level rise now predicted for the 21st century will force 16 million Egyptians to leave their homes.<sup>173</sup>



Being displaced by changes in the environment is usually a complex and multi-factored event, unless it is in reaction to an immediate disaster. Reports emanating from central Somalia in April 2009 suggested that flows of over 60,000 internally displaced persons (IDPs) were thought, wrongly, to have been propelled singly by conflict. They turned out to have moved primarily because of lack of food, or because all their cattle had died due to the lack of rain.<sup>174</sup> Conflict certainly paid a part in making the Somalis vulnerable, but it was not the first direct cause of their migration.

## **Migration and resettlement around the world**

There are many problems in isolating the precise causes of migration linked to climate change. It is also a fact that no-one knows precisely how many people are likely to have to move now, and in the near and distant futures. Professor Norman Myers' most authoritative estimate of 200 million climate change migrants by 2050 was calculated from the best data, but that, he said, still required 'heroic extrapolations'.<sup>175</sup>

But all this must not distract from the fact that people today are moving away from the harmful impacts of climate change and it will get worse. We need to understand the real impact that migration has on poor people, especially women and children, and strive for better data in order to be better prepared.

Whether migration is forced, voluntary, or as a result of state resettlement, people can escape the physical danger of storms or floods only to face other difficulties. Farmers or fishers are often moved from their flood-prone but otherwise fertile riverbank lands, to higher drought-prone areas. People often try to return to their fields in order to maintain their land ownership claims and livelihoods. Displaced people can become dependent on aid. Families can be broken up. Women are often left behind to deal alone with agricultural work, and to care for children. Vulnerable children and women can fall prey to violence and trafficking in their attempts to cross the border; people often have to resort to begging or to crime.

A recent American report pointed out: 'Unlike some people displaced by conflict or persecution who may one day return home, those displaced by the chronic impacts of climate change will require permanent resettlement.'<sup>176</sup>

*'None of these challenges can be solved by military means. The knowledge of the north has to be shared if we want to avoid millions of people without prospects coming to Europe. If you analyse climate change in terms of who is a threat to security, it is us, the rich world – our consumption, our use of carbon fuels, our systems.'*

Professor Hans Guenter Brauch, security studies expert, UNU Institute on Environment and Human Security.<sup>177</sup>

There are regions around the world where patterns are now playing out of migration and displacement because of environmental challenges caused or exacerbated by climate change:

- The 10.5m people who live in the Ferghana Valley – on the Uzbekistan, Kyrgystan, and Tajikistan border – have unclear property rights and access to water, and face many environmental threats such as earthquakes, mudslides and landslides, and particularly from melting glaciers. Added to that the contamination of the land and the pollution of soils and rivers, and 'a significant part of this population may potentially be affected by forced migration.'<sup>178</sup>
- Islanders from Vanuatu and the Bay of Bengal have already been forced to move because of sea-level rises. Island communities in Alaska are contemplating moving inland in the face of storms and rapid coastal erosion. The existence of entire island countries such as Kiribati, the Maldives, and Tuvalu (where just 12,000 people now remain) are now threatened. 'For global environmental change, many islands are expected to experience such severe and irreversible changes that return would not be possible for centuries to come.'<sup>179</sup>
- Nomadic people, who already derive their livelihoods from marginal lands, are particularly concerned by climate change. At a meeting of the UN Permanent Forum on Indigenous Issues, Bedouin from Jordan said that their traditional way of life can no longer cope with changing extremes of temperature, diminished flora and fauna, and fewer buffer zones. Mongolian pastoralists said that the climate change was resulting in large-scale livestock mortality. Nomadic people in Iran talked about 'strange weather and wind patterns that are drying out wetlands and grasslands'. A representative of India's 100 million nomadic people talked about a 'new imperialism brought on by climate change and government disregard for mobile peoples' issues'.<sup>180</sup>

Migration is not stoppable. Neither is it always negative – in fact, migration is a legitimate way that people have used through the ages to cope with lands and lives that have for one reason or another become unsustainable. But the main impacts of sudden mass migration are invariably, overwhelmingly and profoundly damaging.

*'Climate change will result in cases that do not fit into current distinctions between voluntary and forced migration. At present, people who move due to gradually worsening living conditions may be categorized as voluntary economic migrants and denied recognition of their special protection needs.'*

'In Search of Shelter: Mapping the Effects of Climate Change on Human Migration and Displacement', 2009.<sup>181</sup>

*'There is a risk of mass migration from the developing to the developed world... there will be workforce implications for companies with operations in the developing world, and social and political tensions could impact operations locally.'*

Lloyds of London risk analysis, April 2009.<sup>185</sup>

Countries' fears of mass migration induced by climate change are real. But they just add to the argument that action must be taken now to mitigate by cutting global carbon emissions, and spending money on helping poor countries to adapt to the harmful effects of climate change and pursue their own low-carbon futures. Developing countries need support to improve their environmental management, and ensure that the issue of migration and resettlement is included.

## Security, conflicts, and climate change

There is much money and thought going into examining what the effect of migration may be on national security during this century. The consensus – for what it's worth – is that 46 countries, with a combined population of 2.7 billion now, 'face the threat of violence' due to climate change.<sup>182</sup> Already today 40 per cent of all intra-state conflicts are linked to disputes over natural resources.<sup>183</sup> At least 35 institutions and university departments around the world are currently engaged in predictive studies in the area of conflict and climate change, on the national, regional, and geopolitical levels.<sup>184</sup> None of them are optimistic.

### Box 12. Conflict in Karmoja, northern Uganda

In Kotido water scarcity is a perpetual problem. Cattle herders have to roam far to find water and grazing for their animals. Banditry is common.

The pastoralists around Longorkipi dam in Abim have suffered a double tragedy. Early in 2009, cattle rustlers raided their *kraal* at night and killed three herders before stealing some of the cattle. The air is still full of the smell of rotting carcasses of cattle, along with millions of flies hovering over the thousands of animals. Vultures walk around the edge of the *kraal*.

Despite the brief rains that came in April, the elders are insisting on moving 100km to Pader district because the grass and water are running out where they are. But this is risky because of the cattle raiders and the weather.

'These days, the heat is too much. It is unbearable,' says 40-year-old Lomaada Nakorilung, the *kraal* leader. 'The seasonal calendar for rain has changed much. We used to have rain in January, more rain in March that would bring white ants, a delicacy, and much more rain in April with plenty of mushrooms. But 2009 is going to be the fourth year of drought.'

Earlier, in March, when the rains came there was hope in the community. 'We were excited ... Women were preparing their gardens, waiting for rain. They have a lot of faith in what they do,' he says.

In a move to provide security, the government has provided an army detachment, but Nakorilung says that sometimes the cattle rustlers overwhelm the army and steal their cattle. 'There are places where we can no longer graze animals because of the rustlers. The government should remove guns from all the rustlers and stop incursions of pastoralists from Sudan and Kenya.'

Source: Gerald Tenywa, 2009, Uganda.

## The spectre of climate-driven conflict

*'Climate change can act as a threat multiplier for instability in some of the more volatile regions of the world and it presents significant national security challenges for the US.'*

United States Center for Naval Analysis (2008)<sup>186</sup>

Authoritative voices, such as those of the British diplomats John Ashton and Sir Crispin Tickell, have blamed both the Darfur conflict and the Rwandan civil war and genocide in part on climate-derived factors. In 2007 a UN Environment Programme report stated that 'there is a very strong link between land degradation, desertification and conflict in Darfur'.<sup>187</sup>

Some scientists<sup>188</sup> point to the fact that there was no change in rainfall in Darfur that could have acted as a short-term trigger to the conflict, and therefore they reject the assertion that Darfur is a 'climate change conflict.' It is nevertheless true that the conflict in Darfur was made worse by the increasing scarcity of water and pasture – and that it was the exploitation of these tensions in the struggle for political power in Sudan that greatly exacerbated the conflict. Environmental change was cruelly mishandled, so that some groups suffered far more than others, and tensions increased.

And it also remains true that rich world governments are increasingly concerned that climate change will lead to scarcity of natural resources, of the kind seen in Darfur, that could help to spark conflict and war. As Ole Waever, of the Centre for Advanced Security Theory at the University of Copenhagen, puts it, 'Security is about violent conflict; we have found a new powerful causal variable [in climate change].'<sup>189</sup>

# 7 What can we do?

## What Oxfam wants

- Fair mitigation policies to keep the world as far below 2°C as possible to avoid catastrophic climate change – with rich countries moving first, fastest, and furthest.
- At least \$150 billion in annual funding for developing countries – over and above their promised aid commitments – to help developing countries adapt, and to pursue low-carbon pathways to development.

## A fair and safe deal in Copenhagen

2009 is one of the most important years in human history. In Copenhagen in December, politicians will meet at the 15th Conference of the Parties (COP) to the UN Climate Change Convention. This meeting will decide whether we face a future on a hot glowering planet, or whether we set a course for climate safety for everyone.

Rich countries – those most responsible for causing climate change and those most able to assist – must undertake their fair share of the global effort. A multilateral commitment must be made to ensure that global emissions peak by 2015, and that they decline thereafter.

Beginning immediately, developing countries will need at least \$150 billion a year to cope with the effects of climate change (at least \$50 billion a year in adaptation) and to pursue their own low-carbon futures. In addition, rich countries must commit to reducing their own emissions by at least 40 per cent from 1990 levels by 2020, and all countries by at least 80 per cent globally by 2050.<sup>191</sup>

Helping to fund the world's developing countries to adapt to the effects of climate change would cost less than the bailout of the AIG insurance company alone in late 2008. Or as UNEP executive director Achim Steiner says: 'We waited perhaps a decade to get \$5 billion to accelerate development of renewable energy. We now see \$20 billion paid [to] a car company simply to keep it alive.'<sup>192</sup>

Today, most governments are woefully short of the action and ambition needed to achieve this. 'We have,' writes the former director of the London School of Economics, Anthony Giddens in the recent *The Politics of Climate Change*, 'no politics of climate change... It is as if the 'global deal' will be reached as soon as the nations of the world see reason.'<sup>193</sup> For Oxfam, Giddens' 'reason' is already there to be seen in the lives of affected people.

*'The grand question here is who compensates? Because we are not culpable for climate change. It's not fair that a country like Bolivia, which emits 0.02 per cent of global greenhouse emissions, already has annual economic losses from the impacts of climate change equivalent to 4 per cent of our GDP.'*

Oscar Paz, director of Bolivia's National Climate Change Program, May 2009.<sup>190</sup>

## Turning talk into action

*'If we don't get the 80 per cent target of emissions reductions, we must admit we have condemned the poor to suffer an even larger dose of injustice, because they will suffer first.'*

Professor Dan Kammen, University of California at Berkeley.<sup>194</sup>

*'It's a scandal. The amount the developed countries have provided is peanuts. It is poisoning the UN negotiations. What [the rich countries] offer to the poorest is derisory, the equivalent of one banker's bonus. It's an insult to people who are already experiencing increasing extreme events.'*

Bernarditas Muller of the Philippines, the chief climate change negotiator for the G77 and China group of developing countries.<sup>196</sup>

One crucial area where we have to hold politicians to account is in funding for the developing world to prepare for the damage that is inevitable, even with only 2°C of climate change.

Despite largely causing global warming because of their 150-year history of carbon emissions, government responses from rich countries have been woefully inadequate so far, despite much high-flown talk of providing funds for adaptation and mitigation. Money has been pledged but not delivered. According to one study, governments have promised nearly \$18 billion in the past seven years, but handed over less than \$0.9 billion.<sup>195</sup>

And there is evidence of double-counting. Governments win political capital by pledging money for climate change, but it turns out to be just part of money already committed in their overseas aid spending. Or the reverse happens – last year's climate change funds pledge gets counted in this year's headline-grabbing development aid increase. Better arrangements for monitoring and legally binding agreements must feature in the December meeting.<sup>197</sup>

Even where there is money, performance by the international funds has been disappointing. The UN's Least Developed Countries Fund, announced with great fanfare in 2002, has received a paltry \$172m and has spent only \$47m. Africa, the poorest continent, has received less than 12 per cent of the money spent by all the multilateral funds since 2005.<sup>198</sup>

'Woefully inadequate', is the European Parliament's verdict on the Global Climate Change Alliance body, set up by the European Commission to fund adaptation as part of poverty reduction. It has a budget of just €60m (\$84m) for its first two years. In October 2008, the Parliament denounced this sum in the light of what is really needed, given that the EU's stated aim is to be a global leader on climate change.<sup>199</sup>

The Global Environmental Facility (GEF),<sup>200</sup> which administers most of the international funds, has been widely criticised for being slow and unaccountable.<sup>201</sup> Requests for information for this paper were not answered, and much of the GEF's website does not appear to have been updated for over two years.

## What is Oxfam doing?

Oxfam is working with hundreds of organisations and communities of poor people to mobilise millions to demand a fair and safe deal in Copenhagen. In global negotiations, the voices of poor people, poor countries, and future generations are hardly heard. Since climate change will hit them first and hardest, Oxfam will work to make sure that these voices get a hearing.

Together with others, Oxfam is campaigning throughout these negotiations to make sure that people's voices are heard. It will track and influence the people with the power, making sure that they deliver on its demands. Wherever possible, Oxfam will support and amplify messages from people affected by climate change, making sure that they are never forgotten or ignored.

*'It requires a mobilisation effort that normally is only achieved in wartime. Don't let people have any excuse to take their foot off the pedal.'*

John Ashton, UK Foreign Office  
special adviser on climate change,  
March 2009.<sup>202</sup>

So far, rich countries appear to be negotiating solely to minimize their costs, and pass them on to poorer countries. This is the kind of self-interest tactic they routinely employ in trade negotiations. A global climate change deal is a fundamentally different imperative. We need massive public pressure to shift rich countries' strategy to one that is based on scientific evidence – and informed by the harm that climate change is already causing poor people today – in order to create a fair and safe future for the planet.

Of course, no matter what the outcome of the Copenhagen meeting, people will have to adapt to climate change over decades to come. Oxfam will continue to support this work in any way it can, campaigning for justice and fighting poverty.

### **Will the real world leaders please stand up?**

In 2009, we must convince world leaders that political action is non-negotiable. We must use every opportunity to tell them that we want a fair and safe deal in Copenhagen, particularly for billions of poor and vulnerable people whose governments cannot afford to pay to fix a problem they played no significant part in causing. The true cost of climate change will not be measured in dollars, but in millions or billions of lives. This is the real human cost of climate change. The clock is ticking.

# Notes

- <sup>1</sup> Lord Stern (2009) 'Wealthy nations must lead on climate change: economist', *The Star*, Toronto, 1 May.
- <sup>2</sup> The IPCC calculates that stabilisation of CO<sub>2</sub>e at below 450ppm is required to give an even chance of keeping warming below 2°C, compared with pre-industrial levels. Oxfam is pushing for 350–400ppm. See IPCC(2007): 'IPCC Fourth Assessment Report: Climate Change 2007', Cambridge University Press: Cambridge, box 19.2, p.783, for an explanation of current accepted temperature level usages. [www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter19.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter19.pdf)
- <sup>3</sup> K. Anderson and A. Bows (2008) 'Reframing the climate change challenge in light of post-2000 emission trends', *Philosophical Transactions of the Royal Society*. [www.tyndall.ac.uk/publications/journal\\_papers/fulltext.pdf](http://www.tyndall.ac.uk/publications/journal_papers/fulltext.pdf)
- <sup>4</sup> Lord Stern (2009) 'Wealthy nations must lead on climate change: economist', *op. cit.*
- <sup>5</sup> Lord Stern and O.Edenhofer (2009) 'Towards a Global Green Recovery: Recommendations for Immediate G20 Action', report submitted to the G20 London Summit, 2 April 2009. [www.pik-potsdam.de/globalgreenrecovery](http://www.pik-potsdam.de/globalgreenrecovery)
- <sup>6</sup> D.Adam (2009) 'World will not meet 2C arming target, climate change experts agree', *The Guardian*, 14 April. <http://www.guardian.co.uk/environment/2009/apr/14/global-warming-target-2c> and A.Doyle and G.Wynn (2009) 'POLL-Warming set to exceed EU's "dangerous" threshold', *Reuters/Alertnet*, 7 April. <http://www.alertnet.org/thenews/newsdesk/L7444674.htm>
- <sup>7</sup> Quoted in F. Harvey (2009) 'Climate scientists warn of looming disaster', *Financial Times*, 29 April.
- <sup>8</sup> IPCC (2007) 'IPCC Fourth Assessment Report Volume 2:Climate Change 2007: Impacts, Vulnerability and Adaptation' (Working group II report) Key findings.
- <sup>9</sup> Lord Stern, (2009), Speech at the Copenhagen Science Conference, March 2009.
- <sup>10</sup> The phrase first appeared in Lord Stern's 2006 review for the UK government (as entailing mitigation costs of about 1 per cent of GDP in the rich world) and has since gained widespread currency.
- <sup>11</sup> Global Humanitarian Forum (GHF) (June 2009) 'Human Impact Report: Climate Change – The Anatomy of a Silent Crisis', GHF: Geneva, p12. [http://www.ghfgeneva.org/Portals/0/pdfs/human\\_impact\\_report.pdf](http://www.ghfgeneva.org/Portals/0/pdfs/human_impact_report.pdf)
- <sup>12</sup> A.C.Revkin (2009) 'Environmental issues slide in poll of public's concerns', *New York Times*, 22 January. [www.nytimes.com/2009/01/23/science/earth/23warm.html](http://www.nytimes.com/2009/01/23/science/earth/23warm.html)
- <sup>13</sup> WFP (December 2007) 'UN food agencies urge climate change action to avert hunger'. [www.wfp.org/news/news-release/un-food-agencies-urge-climate-change-action-avert-hunger](http://www.wfp.org/news/news-release/un-food-agencies-urge-climate-change-action-avert-hunger)
- <sup>14</sup> Conversations at Copenhagen Science Conference, March 2009. See also China Tibet Online (2009) 'China Meteorological Administration Chief: Tibet is the biggest victim of global warming', May 6. <http://chinatibet.people.com.cn/96069/6652232.html>
- <sup>15</sup> Jingyuan County Association for Science and Technology.
- <sup>16</sup> Qingchen Chao (2009), China Meteorological Administration, address to Copenhagen Science Conference, March 2009, [http://climatecongress.ku.dk/speakers/qingchen\\_chao\\_10march2009.pdf](http://climatecongress.ku.dk/speakers/qingchen_chao_10march2009.pdf)
- <sup>17</sup> 'IPCC Fourth Assessment Report' (2007), *op.cit.*,
- <sup>18</sup> Oxfam programme research in Nepal, 2009.
- <sup>19</sup> S.Jennings and J.Magrath (forthcoming, July 2009) 'What Happened to the Seasons?' Oxfam GB paper for presentation at the Future Agricultures Consortium/Centre for Social Protection Conference on Seasonality, Institute of Development Studies, University of Sussex, Brighton, 8-10 July 2009.
- <sup>20</sup> *Ibid.*
- <sup>21</sup> BBC Online (2009) 'World hunger "hits one billion"', 19 June. <http://news.bbc.co.uk/1/hi/world/europe/8109698.stm>
- <sup>22</sup> 'IPCC Fourth Assessment Report' (2007), *op.cit.*, p.275.
- <sup>23</sup> D. Gerten et al. (2009) 'Hydrologic Limitation of Global Food Production and the Potential of Water Management in Rainfed Agriculture', Presentation at Copenhagen Science Conference, March 2009.
- <sup>24</sup> Among the many sources for this assertion: S. Long et al (2006) 'Food for thought: lower-than-expected crop yield stimulation with rising CO<sub>2</sub> concentrations', *Science* 312 (5782): 1918:21. [www.sciencemag.org/cgi/content/abstract/312/5782/1918](http://www.sciencemag.org/cgi/content/abstract/312/5782/1918); M. Parry et al. (2005) 'Climate change, global food supply and risk of hunger', London: Royal Society. <http://rstb.royalsocietypublishing.org/content/360/1463/2125.full?sid=0f4b4fa3-0d6d-4be9-90e9-6434f9ec57eb>
- <sup>25</sup> R. Black et al., 'Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences', *The Lancet* 371 (9608): 243-60.
- <sup>26</sup> D.B. Lobell et al. (2008) 'Prioritizing Climate Change Adaptation Needs for Food Security in 2030', *Science*



- 319, (607).
- <sup>27</sup> J. Liu (2008) 'Global and Planetary Change', doi:10.1016/j.gloplacha.2008.09.007, quoted *New Scientist*, 1 November 2008, p.7. The study also assesses 'the lowest increase in calories from their crops'.
- <sup>28</sup> F. Pearce (2005) 'Climate change warning over food production', *New Scientist*, 26 April. [www.newscientist.com/article/dn7310-climate-change-warning-over-food-production.html](http://www.newscientist.com/article/dn7310-climate-change-warning-over-food-production.html)
- <sup>29</sup> Consultative Group on International Agricultural Research (CGIAR) (2009) 'Global Climate Change – Can Agriculture Cope?', briefing papers. Washington: CGIAR. [www.cgiar.org](http://www.cgiar.org)
- <sup>30</sup> In year 2002 \$. O. Deschenes and M. Greenstone (2007) 'The Economic Impacts of Climate Change: Evidence from Agricultural Profits and Random Fluctuations in Weather', *American Economic Review*, 97(1): 354-385. For more on projected positive changes in US agriculture, see US Global Change Research Programme at [www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewagriculture.htm](http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewagriculture.htm)
- <sup>31</sup> P. Jones and P. Thornton (2008) 'Croppers to livestock keepers: livelihood transitions in Africa to 2050 due to climate change', *Environmental Science and Policy*. [www.elsevier.com](http://www.elsevier.com)
- <sup>32</sup> Reuters, reporting conference in Durban and quoting South Africa's Council for Scientific and Industrial Research (CSIR) (2009), 'Climate change may halve southern Africa cereal crop', 15 April. <http://af.reuters.com/article/idAFLF71461820090415?pageNumber=2&virtualBrandChannel=0>
- <sup>33</sup> Lobell et al. (2008) *op. cit.*
- <sup>34</sup> Jones and Thornton (2008) *op. cit.*
- <sup>35</sup> World Fish Centre (2009) 'Climate change and fisheries'. <http://www.worldfishcenter.org/wfcms/HQ/article.aspx?ID=548>
- <sup>36</sup> FAO (2008) 'Bangladesh – Community Based Adaptation in Action, Project Summary Report (Phase 1)', FAO: Rome. <ftp://ftp.fao.org/docrep/fao/010/i0481e/i0481e.pdf>
- <sup>37</sup> Oxfam International programme research in Malawi.
- <sup>38</sup> Asian Development Bank (April 2009) 'The Economics of Climate Change in Southeast Asia: A Regional Review', p.37. <http://www.adb.org/Documents/Books/Economics-Climate-Change-SEA/>
- <sup>39</sup> *Ibid.*, p.19.
- <sup>40</sup> *Ibid.*, subsequent pages.
- <sup>41</sup> Asian Development Bank (2009) *op. cit.*, p.74.
- <sup>42</sup> H. Yao, Institute of Atmospheric Physics, Beijing, China (2009) 'A Primary Assessment of Climate Change Impact on Rice Production in China', presentation given at Copenhagen Science Conference, March 2009.
- <sup>43</sup> See F. Mousseau (2004) 'Roles of and Alternatives to Food Aid in Southern Africa: A review of the Southern Africa food crisis', A Report to Oxfam, p.3. [www.sarprn.org.za/documents/d0000998/index.php](http://www.sarprn.org.za/documents/d0000998/index.php)
- <sup>44</sup> Andy Jarvis, CGIAR (interview with author).
- <sup>45</sup> 'IPCC Fourth Assessment Report' (2007), *op. cit.* p.277.
- <sup>46</sup> A. Jarvis, CGIAR, CIAT, and GBIF (2009) Presentation at Copenhagen Science Conference, March 2009.
- <sup>47</sup> Jones and Thornton (2008) *op. cit.*
- <sup>48</sup> IRIN (2009) 'Senegal: Forecasting the Future in an Erratic Climate', 5 January.
- <sup>49</sup> One study found millet yields up 27 per cent in some higher-temperature scenarios. J. Liu (2008) *op. cit.*
- <sup>50</sup> Fresh Plaza News (2008) 'Jamaica: Spotlight on Yam and Cassava', 18 September. [www.freshplaza.com/news\\_detail.asp?id=28916](http://www.freshplaza.com/news_detail.asp?id=28916)
- <sup>51</sup> Asian Development Bank (2009) *op. cit.*, table, p.41.
- <sup>52</sup> M.E. Brown and C.C. Funk (2008) 'Climate: Food security under climate change', *Science*, 319 (5863): 580-581. [www.sciencemag.org/cgi/content/full/319/5863/580](http://www.sciencemag.org/cgi/content/full/319/5863/580)
- <sup>53</sup> Andy Jarvis, CGIAR (interview with author).
- <sup>54</sup> Lobell et al. (2008) *op. cit.*
- <sup>55</sup> A. Jarvis et al., Global Biodiversity Information Facility (GBIF) (2009) 'Infrastructure, Standards and Access to Data and Tools to Forecast Changes in Agricultural Production', Presentation given at Copenhagen Science Conference, March 2009.
- <sup>56</sup> M. Ouedraogo, A. Ræbild and E.D. Kjær, 'Will the Native Fruit Tree *Parkia biglobosa* Remain Adapted in the West African Parklands? – Preparing for the Future', Poster presentation at Copenhagen Science Conference, March 2009.
- <sup>57</sup> L. Fulco et al. (2007) 'Climate Change Impacts on Developing Countries – EU Accountability', study for European Parliament Policy Department, Economic and Scientific Policy.

- 58 J. Ratnasiri (2008) 'Vulnerability of Tea Plantations in Sri Lanka to Climate Change', paper presented at Climate Science and Policy Workshop, AIT, Pathumthani, Thailand, 12–13 January 2008.
- 59 Oxfam International programme research in Viet Nam, 2009.
- 60 E. Allison et al. (2009) 'Vulnerability of National Economies to the Impacts of Climate Change on Fisheries', *Fish and Fisheries*, Oxford: Blackwell Publishing.
- 61 World Fish Centre (2009) *op.cit.*
- 62 Prof. O. Hoegh-Guldberg, Director of the Centre for Marine Studies at the University of Queensland (2009), 'Warning of wave of climate change refugees from Asia-Pacific region', *ABC Radio Australia*, 13 May. [www.radioaustralia.net.au/asiapac/stories/200905/s2569683.htm](http://www.radioaustralia.net.au/asiapac/stories/200905/s2569683.htm)
- 63 Oxfam India, 'Climate change affecting fisherfolk in coastal Andhra Pradesh', undated article. [www.climatechangeindia.in/](http://www.climatechangeindia.in/)
- 64 Asian Development Bank (2009) *op. cit.*, p.42.
- 65 Oxfam International (July 2009), 'The Winds of Change: climate change, poverty and the environment in Malawi'. Oxford: Oxfam. [http://www.oxfam.org.uk/resources/policy/climate\\_change/poverty-environment-malawi.html](http://www.oxfam.org.uk/resources/policy/climate_change/poverty-environment-malawi.html)
- 66 United Nations 'World Population Prospects: The 2008 revision'. <http://esa.un.org/unpp/>
- 67 Jones and Thornton (2008) *op. cit.*
- 68 A. Dinar (2007) 'Climate Change: The Final Blow for Agriculture in Africa? Sustainable Rural and Urban Development', Research Brief, Washington: World Bank. <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTPROGRAMS/EXTIE/0,,contentMDK:21425514--pagePK:64168182--piPK:64168060--theSitePK:475520,00.html>
- 69 Oxfam International programme in Malawi.
- 70 D. Gerten et al. (2009) 'Hydrologic Limitation of Global Food Production and the Potential of Water Management in Rainfed Agriculture', Presentation at Copenhagen Science Conference, March 2009.
- 71 Jones and Thornton (2008) *op. cit.*
- 72 WWF and Oxfam (2008), joint report, 'Russia and Neighbouring Countries: environmental, economic and social impacts of climate change', Moscow: WWF and Oxfam. <http://www.wwf.ru/data/pub/climate/oxfam-eng-210x297.pdf>
- 73 J. Vidal (2009) 'Rich nations failing to meet climate aid pledges', *The Guardian*, 20 February. [www.guardian.co.uk/environment/2009/feb/20/climate-funds-developing-nations](http://www.guardian.co.uk/environment/2009/feb/20/climate-funds-developing-nations). Data in article from the Overseas Development Institute (ODI), updated at [www.climatefundsupdate.org](http://www.climatefundsupdate.org).
- 74 Andy Jarvis, CGIAR, Interview with author.
- 75 BBC Online (2009) 'Climate "biggest health threat"', 14 May. <http://news.bbc.co.uk/1/hi/sci/tech/8049061.stm>
- 76 Extrapolation from WHO data by GHF (June 2009), *op. cit.*, p.30.
- 77 D.Campbell-Lendrum, A.Pruss-Ustun, C.Corvalan(2003) 'How much disease could climate change cause?', in: A.J. McMichael, D. Campbell-Lendrum, C. Corvalan, K.L. Ebi, A.K. Githeko, J.S. Scheraga, *et al* (eds). *Climate change and health: risks and responses*. Geneva: WHO.
- 78 A consensus seems to have emerged. BBC Online (2009) 'Climate "biggest health threat". See also N. Ebi (2009) 'The Health Risks of Climate Change', Commonwealth Health Ministers' Update 2009', chapter 2.
- 79 A.J. McMichael, S. Friel, A. Nyong, and C. Corvalan (2008) 'Global environmental change and health: impacts, inequalities, and the health sector', *BMJ*, Jan 26;336 (7637):191-4, quoted in 'The Health Risks of Climate Change, Commonwealth Health Ministers' Update 2009'. Also the UCL/*The Lancet* commission on Managing the Health Effects of Climate Change (June 2009).
- 80 Rajendra Pachauri, of the GHF and chair of the IPCC (2009) 'Few doubt the science of climate change – but its impact on the world's poor is largely ignored', *The Guardian*, 29 May.
- 81 UCL/The Lancet commission on Managing the Health Effects of Climate Change (June 2009).
- 82 Extrapolation from WHO data by GHF (June 2009) *op.cit.*, p.12.
- 83 WHO Director-General Dr Margaret Chan (April 2009, blog post: 'COP 15 Human Health is at Stake'. <http://en.cop15.dk/blogs/view+blog?blogid=1014>
- 84 Oxfam International (2005) 'The Tsunami's Effect on Women', briefing note. Oxford: Oxfam.
- 85 N. Ebi (2009), *op. cit.*
- 86 'Urban pollution', briefing note, World Bank Study (undated). <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTENVHEA/0,contentMDK:21158393--pagePK:210058--piPK:210062--theSitePK:3662880,00.html>
- 87 W. Checkley et al. (2000) 'Effects of El Nino and ambient temperature on hospital admissions for diarrhoeal

- diseases in Peruvian children', *The Lancet*, 355(9202):442-450.
- <sup>88</sup> X.N. Zhou (2009), Presentation at Copenhagen Science Conference, March 2009. Also see X.N. Zhou *et al.* (2008) 'Potential impact of climate change on schistosomiasis transmission in China,' *American Journal of Tropical Medicine and Hygiene*, 78(2), 2008, p.188-94, The American Society of Tropical Medicine and Hygiene.
- <sup>89</sup> B. Revich (2008) Professor of Medicine, Institute of National Economy: Forecast to the Russian Academy of Science 'How and why climate changes influence infectious diseases frequency', *World Energy*, No. 11-12 (59) November/December 2008. [www.worldenergy.ru/doc\\_20\\_55\\_2882.html](http://www.worldenergy.ru/doc_20_55_2882.html)
- <sup>90</sup> WHO (December 2008), 'Traditional Medicine', Fact sheet No.134. [www.who.int/mediacentre/factsheets/fs134/en/](http://www.who.int/mediacentre/factsheets/fs134/en/)
- <sup>91</sup> Plantlife International (2008) 'Medicinal Plants in Conservation and Development'. [www.plantlife.org.uk/portal/assets/News%20Sue%20Nottingham/Medicinal%20plants%20report%20Jan%202009.pdf](http://www.plantlife.org.uk/portal/assets/News%20Sue%20Nottingham/Medicinal%20plants%20report%20Jan%202009.pdf)
- <sup>92</sup> WHO (August 2007) 'Climate and Health', Fact sheet No.266. <http://www.who.int/mediacentre/factsheets/fs266/en/index.html>
- <sup>93</sup> Asian Development Bank (2009) *op. cit.*, p.53, quoting Pascual *et al.* (2002).
- <sup>94</sup> *Ibid.*, p.52.
- <sup>95</sup> Lowy Institute quoting a study cited in: J.A. Patz *et al.* (2005) 'Impact of regional climate change on human health', *Nature* 438 (7066): 310-17. <http://www.nature.com/nature/journal/v438/n7066/abs/nature04188.html>
- <sup>96</sup> Sources quoted by Gollin and Zimmerman (2007) 'Malaria: Disease Impacts and Long-Run Income Differences: Discussion Paper No. 2997', IZA: Bonn, p.2.
- <sup>97</sup> N. Ebi (2009), *op. cit.*, p.10.
- <sup>98</sup> L.Wen, Kilima Institute of Public Health, Muhimbili University College of Health Sciences (2000) 'Highland and Urban Malaria in Africa', Presentation given at Malaria Control in Africa workshop, The ENRECA Health Network. [http://enreca.pubhealth.ku.dk/2000\\_Malaria\\_Control.pdf](http://enreca.pubhealth.ku.dk/2000_Malaria_Control.pdf)
- <sup>99</sup> G. Poveda (2009) 'Evidence of climate and environmental change on water resources and malaria in Colombia', National University of Colombia, Department of Geosciences and Environment, Medellin, Colombia. [www.iop.org/EJ/article/1755-1315/6/29/292054/ees9\\_6\\_292054.pdf?request-id=6287e787-41a9-41be-b1c3-83709f0d2de7](http://www.iop.org/EJ/article/1755-1315/6/29/292054/ees9_6_292054.pdf?request-id=6287e787-41a9-41be-b1c3-83709f0d2de7)
- <sup>100</sup> Pan-American Health Organisation report (2001) [www.paho.org/English/HCP/HCT/MAL/cartagena-4-col.pdf](http://www.paho.org/English/HCP/HCT/MAL/cartagena-4-col.pdf)
- <sup>101</sup> Pan-American Health Organisation (November 2008) 'Malaria in the Americas: No Time to Ease Up', Washington. [http://new.paho.org/hq/index.php?option=com\\_content&task=view&id=393&Itemid=259](http://new.paho.org/hq/index.php?option=com_content&task=view&id=393&Itemid=259)
- <sup>102</sup> T. Kjellstrom and B Lemke (2009) 'Loss of Worker Productivity Due to Projected Climate Change'; Australian National University, Department of Epidemiology and Population Health, IOP Publishing. [http://www.iop.org/EJ/article/1755-1315/6/52/522003/ees9\\_6\\_522003.pdf?request-id=23814f12-1514-40bb-bd65-6e80c36d3741](http://www.iop.org/EJ/article/1755-1315/6/52/522003/ees9_6_522003.pdf?request-id=23814f12-1514-40bb-bd65-6e80c36d3741) Also: K. Parsons (2003) 'Human Thermal Environment', New York.: CRC Press.
- <sup>103</sup> T. Kjellstrom *et al.* (2009) *op. cit.*;
- <sup>104</sup> N. Ebi (2009), *op. cit.*, chapter 2.
- <sup>105</sup> S. Kovats and R. Akhtar (2008), 'Climate, climate change and human health in Asian cities', *Environment and Urbanization* 20 (1): 165-75. <http://eau.sagepub.com/cgi/content/abstract/20/1/165>
- <sup>106</sup> Sources quoted in K. Knowlton *et al.* (2007) 'Projecting heat-related mortality impacts under a changing climate in the New York City region', *American Journal of Public Health* 10.2105. <http://www.ajph.org/cgi/content/abstract/AJPH.2006.102947v1>
- <sup>107</sup> Kovats and Akhtar (2008), *op.cit.*
- <sup>108</sup> McMichael *et al.* (2008) 'International study of temperature, heat and urban mortality: the "ISOTHURM" project', *International Journal of Epidemiology* 37(5): 1121-1131. Advance access, published 3 June 2008. <http://ije.oxfordjournals.org/cgi/content/abstract/dyn086>
- <sup>109</sup> Oxfam International programme work in Bangladesh, 2009.
- <sup>110</sup> According to FAO 'Women's contributions to agriculture production and food security'. [www.fao.org/docrep/X0198E/x0198e02.htm](http://www.fao.org/docrep/X0198E/x0198e02.htm)
- <sup>111</sup> T. Kjellstrom (2009) 'Climate change, direct heat exposure, health and well-being in low and middle-income countries', guest editorial, *Global Health Action*, Vol. 2, 1-3.
- <sup>112</sup> Speaking to Mediciens sans Frontières. A. Crabtree (2009) 'Well-being and Climate Change: The Psychological Consequences of Flooding', Poster presentation at Copenhagen Science Conference, March 2009.
- <sup>113</sup> Oxfam International programme work in Haiti, 2009.
- <sup>114</sup> N. Ebi (2009), *op. cit.*, chapter 2.

- 115 A. Crabtree, Poster presentation at Copenhagen Science Conference, March 2009. 'Minor' in this case means floods lasting less than 26 hours, and 30–60cm deep.
- 116 J. Parikh (2007) 'Mainstreaming Gender into Climate Change Policies', paper by Integrated Research and Action for Development (IRADe), New Delhi, commissioned by UNDP, India.
- 117 Oxfam International programme work in India, 2009.
- 118 D. Gautam (2007) 'Floods and need assessment, a sociological study from Banke, Bardiya and Kailali of mid and far-western Nepal', Lutheran World Federation, Nepal (quoted in 'We Know What We Need: South Asian women speak out on climate change adaptation', Action Aid/IDS).  
<http://www.actionaid.org/main.aspx?PageID=982>
- 119 Oxfam International's programme work in Haiti, 2009.
- 120 The figure derives from a calculation of the historic increase in the number of disasters per year, factored with the increasing vulnerability of populations, according to a range of factors.
- 121 Extrapolation from WHO data by GHF (June 2009) *op.cit.*, p.3.
- 122 *Ibid.*, p.13.
- 123 Oxfam International's programme work in Haiti, 2009.
- 124 Oxfam International (April 2009) 'The Right To Survive' campaign report, Oxford: Oxfam.  
<http://www.oxfam.org.uk/resources/papers/right-to-survive.html>
- 125 Sources quoted in 'IPCC Fourth Assessment Report' (IPCC), *op.cit.* p.398.
- 126 B.Osman-Elasha (2009), Presentation at Copenhagen Science Conference, March 2009.
- 127 BBC Nepali Service (2009)'Climate change "fans Nepal fires"', 1 April.  
<http://news.bbc.co.uk/1/hi/sci/tech/7968745.stm>
- 128 S.Goudarzi (2006) 'Global warming fuels U.S. forest fires', *LiveScience* magazine, 6 July, quoting report from Scripps Institution of Oceanography, California.  
[http://www.livescience.com/environment/060706\\_globalwarming\\_fire.html](http://www.livescience.com/environment/060706_globalwarming_fire.html)
- 129 J. Overpeck et al., (2009) research findings reported in 'Mega-droughts in sub-Saharan Africa normal for region: droughts likely to worsen with climate change', *ScienceDaily*, 17 April.  
[www.sciencedaily.com/releases/2009/04/090416144520.htm](http://www.sciencedaily.com/releases/2009/04/090416144520.htm)
- 130 F. Ludwig et al. (2007) 'Climate Change Impacts on Developing Countries – EU Accountability', study for European Parliament Policy Department, Economic and Scientific Policy.
- 131 S.Rahmstorf (2009) 'We must shake off this inertia to keep sea level rises to a minimum' *The Guardian*, 3 March. [www.guardian.co.uk/environment/cif-green/2009/mar/03/sea-levels-rising](http://www.guardian.co.uk/environment/cif-green/2009/mar/03/sea-levels-rising)
- 132 S.Rahmstorf (2009), Presentation at Copenhagen Science Conference, March 2009.
- 133 A. Yusuf, H. Francisco (2009) 'Climate Change Vulnerability Mapping for Southeast Asia: Economy and Environment Program for Southeast Asia (EEPSEA)'.
- 134 Research announced on the basis of new information on ice sheet loss at the Copenhagen Science Conference, March 2009, by Prof. E. Rignot, Dr. J. Church, Prof. S. Rahmstorf, and others.
- 135 Oxfam GB (2009), 'Impending health crisis in Cyclone Aila-affected areas', press release, 4 June.  
<http://www.oxfam.org.uk/applications/blogs/pressoffice/?p=5273&v=newsblog>
- 136 Asian Development Bank (2009) *op. cit.*, p.49.
- 137 Author's interviews with Bangladesh environment and land scientists, March 2009.
- 138 A.Roberts (2007) 'What will become of Tuvalu's climate refugees?', *Der Spiegel*, 14 JSeptember.  
[www.spiegel.de/international/world/0,1518,505819,00.html](http://www.spiegel.de/international/world/0,1518,505819,00.html)
- 139 Kepala, Dolangan, Manterawu, Fani, Faniido, Brass, Laag, and Nipah islands are 'highly vulnerable'. Asian Development Bank (2009) *op.cit.*, p.50.
- 140 A. Yusuf, H. Francisco (2009) *op. cit.*
- 141 US Climate Change Science Program (2008) 'Weather and Climate Extremes in a Changing Climate, North America, Hawaii, Caribbean and US Pacific Islands', Synthesis and Assessment Product 3.3, June 2008.
- 142 'IPCC Fourth Assessment Report' (2007), *op.cit.*,chapter 16.
- 143 *Ibid.*
- 144 Hurricanes are called typhoons in Asia. [www.aoml.noaa.gov/hrd/tcfaq/A1.html](http://www.aoml.noaa.gov/hrd/tcfaq/A1.html)
- 145 GHF (2009) *op.cit.*p.2.
- 146 J.Holmes, UN Under-Secretary-General for Humanitarian Affairs (April 2009), 'Disasters: the New Normal', blog on Copenhagen COP 15 website. <http://en.cop15.dk/blogs/view+blog?blogid=1018>

- <sup>147</sup> L.Abboud (2009) 'Before the deluge', *Wall Street Journal*, 9 March.  
<http://online.wsj.com/article/SB123620725724333601.html>
- <sup>148</sup> W. Kron (2008) 'Flood Insurance: From Clients to Global Financial Markets', Geo Risks Research, Munich Re, Presentation at the 4th International Symposium on Flood Defence, Ontario, Canada, 6–8 May 2009.
- <sup>149</sup> S.Harmeling (2009) 'Global Climate Risk Index 2009' briefing paper, Germanwatch: Bonn.  
<http://www.germanwatch.org/klima/cr1.htm>
- <sup>150</sup> Oxfam International programme work in Bolivia.
- <sup>151</sup> Because of climate change and volcanic activity. G. Poveda (2009) *op. cit.*
- <sup>152</sup> Oxfam International programme work in Bolivia and R. Carroll (2009), 'Bolivia: water people of Andes face extinction', *The Guardian*, 24 April. <http://www.guardian.co.uk/world/2009/apr/24/andes-tribe-threat-bolivia-climate-change>
- <sup>153</sup> G Dyer (2009) 'Climate Change and Security: Risks and Opportunities for Business April 2009', Lloyds of London 360 Risk Analysis, Lloyds and IISS 2009, p.19.
- <sup>154</sup> F. Ludwig et al. (2009) 'Impacts of Climate Variability and Change on Development and Water Security in Sub-Saharan Africa', presentation given at Copenhagen Science Conference, March 2009. Earth System Science and Climate Change Group, Wageningen University and Research Centre.
- <sup>155</sup> *Ibid.*
- <sup>156</sup> National Center for Atmospheric Research (2009) 'Water Levels Dropping in Some Major Rivers as Global Climate Changes', press release, preliminary findings, 21 April 2009. (to be published in American Meteorological Society's *Journal of Climate*). <http://www.ucar.edu/news/releases/2009/flow.jsp>
- <sup>157</sup> 'If warming exceeds two degrees', UK government chief scientist John Beddington, reported (2009) in *China Daily*, 2 April. [www.chinadaily.com.cn/china/2009-04/02/content\\_7642477.htm](http://www.chinadaily.com.cn/china/2009-04/02/content_7642477.htm)
- <sup>158</sup> Oxfam International programme work in Tanzania, 2009.
- <sup>159</sup> 'IPCC Fourth Assessment Report' (2007), *op.cit.*
- <sup>160</sup> G. Dyer (2009) *op.cit.*, p.19.
- <sup>161</sup> UNDP figure, cited by UN Sec-Gen Ban-Ki Moon (2008) 'Greater efforts needed to provide safe water for more than 1 billion people', 1 September.  
<http://www.un.org/apps/news/story.asp?NewsID=27888&Cr=zaraqoza&Cr1>
- <sup>162</sup> I. Grillo (2009) 'Dry Taps in Mexico City: A Water Crisis Gets Worse', *Time* magazine, 11 April.
- <sup>163</sup> C. Webersik and M.Thapa (2008) Nepal Climate Change and Security Factsheet UNU-IAS.
- <sup>164</sup> C.Haviland (2009) 'Nepal becomes land of the blackout', BBC Online, 28 January.  
[http://news.bbc.co.uk/1/hi/world/south\\_asia/7854167.stm](http://news.bbc.co.uk/1/hi/world/south_asia/7854167.stm)
- <sup>165</sup> *ibid.*
- <sup>166</sup> K. Warner (2009), Presentation at Copenhagen Science Conference, March 2009.
- <sup>167</sup> US Department of Homeland Security statistics (2007).  
[www.fema.gov/hazard/hurricane/2005katrina/statistics.shtm](http://www.fema.gov/hazard/hurricane/2005katrina/statistics.shtm)
- <sup>168</sup> Survey for Greater New Orleans Community Data Center, January 2009.  
<http://gnocdc.s3.amazonaws.com/NOLAIndex/ESNOLAIndex.pdf>
- <sup>169</sup> Climate's role as one of the factors driving permanent or temporary migration in Mexico has been explored in a number of recent papers including: UN University Institute for Environment and Human Security, CARE International, and CIEISIN at Colombia University (May 2009) 'In Search of Shelter: Mapping the Effects of Climate Change on Human Migration and Displacement', CARE. <http://www.careclimatechange.org/> and IOM (May 2009) 'Migration, Climate Change and the Environment' briefing paper, IOM: Geneva.  
[http://www.iom.int/jahia/webdav/shared/shared/mainsite/policy\\_and\\_research/policy\\_documents/policy\\_brief.pdf](http://www.iom.int/jahia/webdav/shared/shared/mainsite/policy_and_research/policy_documents/policy_brief.pdf)
- <sup>170</sup> GHF (2009) *op. cit.*
- <sup>171</sup> *ibid.*, p.48.
- <sup>172</sup> IOM (2008) quoted by K. Warner (2009) 'Advancing Human Security Through Knowledge-Based Approaches to Reducing Vulnerability and Environmental Risks', Presentation given at Copenhagen Science Conference, March 2009. United Nations University Institute for Environment and Human Security (UNU-EHS).
- <sup>173</sup> *Ibid.*
- <sup>174</sup> IRIN (2009) 'Somalia: Drought-affected flock to towns in central region', 22 April.  
[www.irinnews.org/Report.aspx?ReportId=84045](http://www.irinnews.org/Report.aspx?ReportId=84045)
- <sup>175</sup> Forced Migration Review, 'Climate change and displacement', Issue 31 October 2008; Oxford: Refugee Studies centre, University of Oxford.

- 176 'In Search of Shelter' *op.cit.*
- 177 H.G. Brauch (2009), Presentation at Copenhagen Science Conference, March 2009.
- 178 Forced Migration Review, 'Climate change and displacement', Issue 31 October 2008; Oxford: Refugee Studies centre, University of Oxford.
- 179 *ibid.*
- 180 *ibid.*
- 181 'In Search of Shelter' *op.cit.*
- 182 Sources cited in GHF report (2009) *op. cit.*, p.54.
- 183 UNEP (2009) 'From conflict to peacebuilding', United Nations Environmental Programme: Kenya. [http://postconflict.unep.ch/publications/pcdmb\\_policy\\_01.pdf](http://postconflict.unep.ch/publications/pcdmb_policy_01.pdf)
- 184 Author's observation.
- 185 G. Dyer (2009), *op. cit.*
- 186 Quoted in *ibid.*, p.14.
- 187 Quoted in UNU-IAS (2008) 'Sudan Climate Change and Security Factsheet'.
- 188 M. Kevane and L. Gray (2008) 'Darfur: rainfall and conflict'; IOP Publishing, Environmental Research Letters, 29 August.
- 189 O. Waever (2009) 'Human Migration – Geopolitical Conflicts – Climate Security', Presentation given at Copenhagen Science Conference, March 2009.
- 190 Quoted in C.Kormann (2009) 'Retreat of Andean Glaciers Foretells Global Water Woes'. *Yale Environment* 360, 9 April. <http://e360.yale.edu/content/feature.msp?id=2139>
- 191 Oxfam International (June 2009) Hang Together or Separately? How global co-operation is key to a fair and adequate climate deal at Copenhagen, Oxford: Oxfam. [http://www.oxfam.org.uk/resources/policy/climate\\_change/fair-climate-deal-copenhagen.html](http://www.oxfam.org.uk/resources/policy/climate_change/fair-climate-deal-copenhagen.html)
- 192 S.Duke (May 2009) Interviewing Achim Steiner for the BBC 'UN "stunned" by scale of bail-out'. <http://news.bbc.co.uk/1/low/sci/tech/8036559.stm>
- 193 A. Giddens (2009) *The Politics of Climate Change*, Cambridge: Polity Press UK.
- 194 D.Kammen (2009), Speech at Copenhagen Science Conference, March 2009.
- 195 J. Vidal (2009) *op.cit.*
- 196 *ibid.*
- 197 Confidential interviews with international development practitioners.
- 198 J.Vidal (2009) *op.cit.*
- 199 European Parliament Resolution of 21 October 2008 on Building a Global Climate Change Alliance (2008/2131(INI)). [www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008-0491+0+DOC+XML+V0//EN](http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008-0491+0+DOC+XML+V0//EN)
- 200 As the financial mechanism of the Climate Convention, the GEF allocates and disburses about \$250m per year and manages two special funds under the UNFCCC *United Nations Framework Convention on Climate Change* (the Least Developed Countries Fund and the Special Climate Change Fund), as well the Adaptation Fund under the Kyoto Protocol. [www.gefweb.org/What\\_is\\_the\\_GEF/what\\_is\\_the\\_gef.html#Funding](http://www.gefweb.org/What_is_the_GEF/what_is_the_gef.html#Funding)
- 201 See, for example, Z.Young (2002) *A New Green Order*, London: Pluto Press. [www.newgreenorder.info/](http://www.newgreenorder.info/)
- 202 J.Ashton (2009), Speech at Copenhagen Science Conference, March 2009.

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