

GROWING DISRUPTION:

Climate change, food, and the fight against hunger



Pregnant mother Salma faces food shortages due to flooding in her village, Char Atra, in Bangladesh.
Photo: Dan Chung

This briefing paper explores how the failure to tackle climate change threatens all aspects of food security – availability, access, utilisation, and stability. The changing climate is already jeopardising gains in the fight against hunger, and it looks set to worsen. It threatens the production and distribution of food. It threatens people’s ability to access food by undermining livelihoods and destabilising prices, and it damages diets by harming human health and putting at risk the quality of food produced. Finally, the paper sets out how these impacts can be averted, through urgent action to avoid dangerous climate change, address our broken food system, and strengthen its resilience.

1. OVERVIEW: A HOT WORLD IS A HUNGRY WORLD

Food security at risk

The world faces a real and imminent risk of major setbacks in efforts to combat hunger because of climate change. That risk is *not* a remote future threat. It is emerging today and will intensify over the coming decades.

Using the accepted four pillars of food security – availability, access, utilisation, and stability – this issue brief draws on research and on Oxfam’s programme experience around the world to assess how climate change is likely to disrupt each of these four elements.¹ The paper sets out how climatic instability in the form of more extreme and volatile weather is already undermining food security. It also shows how in the absence of urgent action, it will load far more significant challenges onto already stressed food systems.

Box 1: Climate change and the four pillars of food security

Food security is achieved ‘when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life’.²

Availability: Both more extreme weather and slow-onset changes in the climate (increasing temperatures and changing rainfall) will hit food production and food distribution systems, reducing the amount, type, and quality of food available for consumption.

Access: By increasing food prices and at the same time undermining people’s means of making a living, climate change threatens people’s access to the required type, quality, and quantity of food.

Utilisation: By affecting human health and jeopardising the quality, variety, and even safety of food produced, climate change affects people’s ability to benefit nutritionally from consumed food.

Stability: By increasing shocks, stresses, and uncertainty around access to, availability, and utilisation of food (as stated above), climate change threatens people’s ability to have access to adequate food at all times.

‘Climate change is not just an environmental issue. It is an all encompassing threat to health and security, stability and prosperity, and our global food supply system. No nation, rich or poor, will escape its impact. And, as is increasingly clear, this impact is already being felt... Rising temperatures and changes to rainfall patterns are reducing harvests and increasing food and nutrition insecurity. As always, this is felt most by the world’s poorest and most vulnerable people.’

Kofi Annan, Oslo, November 2012

The climate is changing

Greenhouse gas emissions are changing the world’s climate by trapping heat, warming the oceans and the atmosphere, altering regional climates, and creating increasingly extreme and unpredictable weather. The probability of extreme weather events is increasing. The odds of an extremely hot northern hemisphere summer were about one in 300 during the period 1951 to 1980, but increased to nearly one in ten by 1981 to 2010.³ If the remainder of the 21st century unfolds like its first decade, we will soon experience climate extremes well outside the boundaries of human experience, ever since agriculture was first developed.

Despite global recognition that warming must be kept below the critical 2°C threshold, emissions are rising rapidly, and much higher levels of warming are likely. The earth's atmosphere has just reached a carbon dioxide (CO₂) concentration of 400 parts per million for the first time in about three million years. The last time levels were so high, global temperatures were 2–3°C warmer than they are today, and sea levels were up to 25 metres higher.⁴

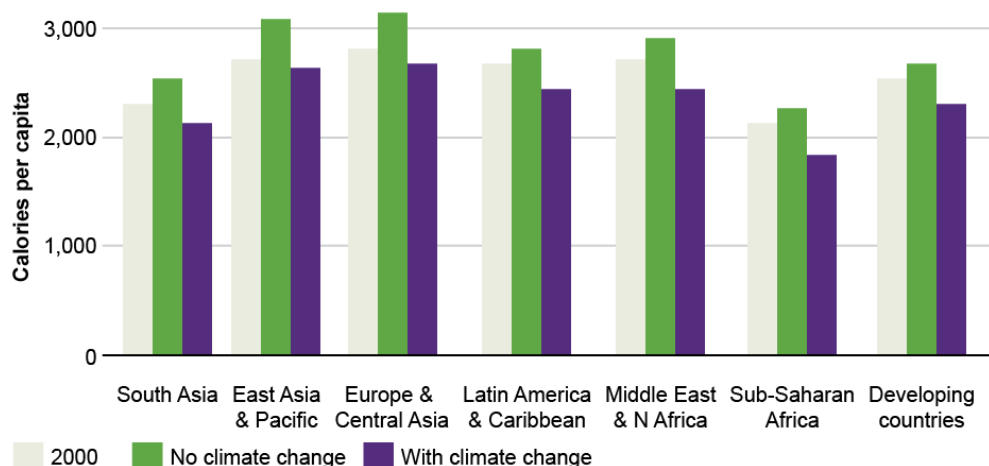
Poor people are most exposed

Climate change affects everyone, but developing countries will be hit harder than developed countries and the world's most food-insecure regions will be hit hardest of all.⁵ Although low-income countries in tropical and sub-tropical regions contribute least to climate change, in future they are likely to endure sharp changes in annual rainfall and climatic conditions that will put them at risk of greater food insecurity, especially in Africa and South Asia.⁶

Already, food production and prices are being hit globally by extreme climate events. Other climate impacts and climate change have also been shown to be a key factor in disasters, such as the 2011 Horn of Africa drought.⁷ According to one estimate, climate change and its impacts on hunger and communicable diseases are currently responsible for 400,000 deaths a year in the world's poorest countries.⁸ The poorest people are bearing the brunt as climate change exacerbates pre-existing conditions that make them more exposed to the risk of food insecurity.

Today one person in eight goes to bed hungry. Analysis suggests that the number of people at risk of hunger is projected to increase by 10–20 per cent by 2050 as a result of climate change (Figure 1).⁹ It is estimated that this could increase child malnutrition by 20 per cent relative to a world with no climate change, eliminating the improvements that may otherwise have occurred.¹⁰

Figure 1: Projected daily per capita calorie availability in 2050, with and without climate change



Source: G. Nelson et al. (2009). 'With climate change' is an average of National Center for Atmospheric Research (NCAR) and Commonwealth Scientific and Industrial Research Organisation (CSIRO) forecasts.

Climate change is transforming the hunger challenge

Those attending the World Food Summit in 1996, which came after nearly 30 years of progress in the fight against hunger, believed that food security was attainable.¹¹ For Oxfam and others, eradicating hunger is an achievable goal, and one that must be underpinned by an assessment that hunger occurs not because of the scarcity of food but because of inequalities and injustices in the way that food is distributed.

However, climate change is transforming the nature of the hunger challenge and, potentially, our ability to deal with it – and, alarmingly, it is happening at the same time as global demand for food is increasing.

Without urgent action to reduce emissions and build resilience, climate change will challenge the safety and security of the global food system and with it the prospect of ensuring that everyone's basic human right to food can be met. Our food system cannot cope with unmitigated climate change, which could lead to a permanent increase in yield variability, excessive food price volatility, and perpetual disruption to livelihoods that could leave many poor countries and communities with potentially insuperable food security challenges.

2. FOOD AVAILABILITY

Adequate food availability is a precondition for sustained food security. As set out in the sections below, climate change threatens food availability in two main ways. First, production is being hit by increasing temperatures and shifting rainfall patterns, which are expected to increasingly depress agricultural yields in most countries.¹² Production losses will also occur due to a projected increase in the frequency and severity of extreme weather events, such as heatwaves, droughts, and floods. In addition, extreme weather events are also likely to damage or destroy vital distribution and transport infrastructure, with severe consequences for food supply chains and availability of food at markets.

2.1 PRODUCTION HIT

Creeping declines in productivity

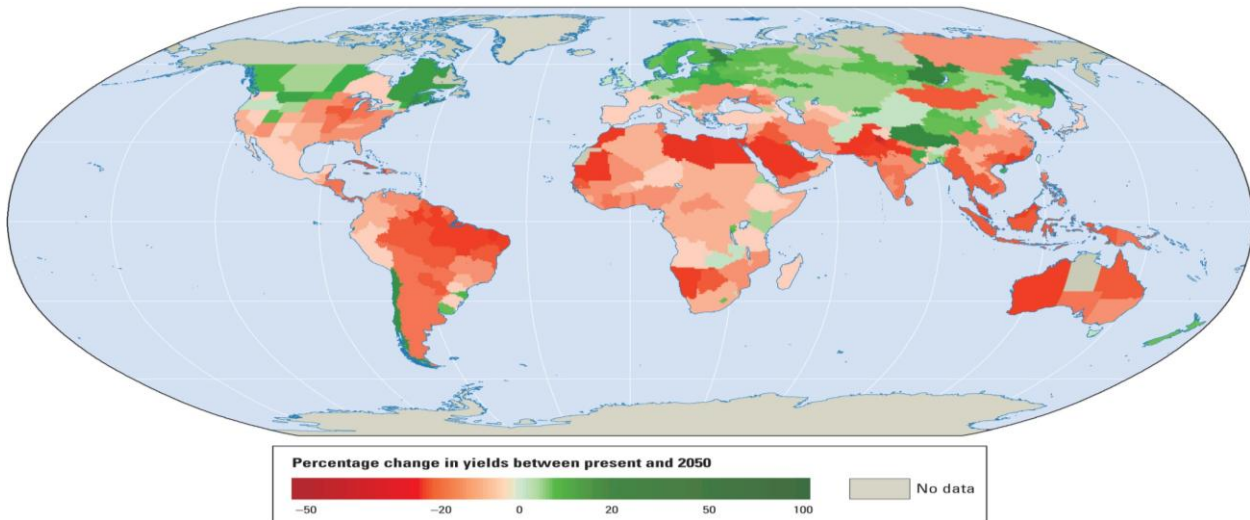
Climate change is a potent risk multiplier in agriculture. Whilst carbon fertilisation and certain climatic changes could benefit some crops in some regions of the world, its overall impacts are expected to be negative, threatening global food security.¹³

Slow-onset changes, such as gradual increases in temperature and changing rainfall patterns, are expected to intensify over the coming decades, putting downward pressure on yields. However, these impacts are already being felt today. Research indicates that global yields of maize and wheat over the past three decades may already be 3.8 per cent and 5.5 per cent lower respectively than they would have been without the effects of climate change.¹⁴

Many studies have assessed the potential future impacts of climate change on productivity, and while projections vary at the country level, globally they point to Africa, South East Asia, and South Asia as being particularly vulnerable to impacts on food security.¹⁵

- In the tropics and sub-tropics in general, crop yields may fall by 10–20 per cent by 2050 because of climate change, and there are places where yield losses may be even more severe (Figure 2).
- Even with global warming of less than 2°C by the 2050s, total crop production in sub-Saharan Africa could be reduced by 10 per cent.¹⁶ With higher levels of warming, countries in sub-Saharan Africa could experience catastrophic declines in yield of 20–30 per cent by 2080. According to one estimate, it could rise as high as 50 per cent in Sudan and Senegal.¹⁷
- Fish is a crucial source of protein for some three billion people, many of whom live in developing countries.¹⁸ Recent research has shown that tropical marine fish are on the move towards the poles, seeking cooler waters as the oceans warm, and they are not being replaced by new species.¹⁹

Figure 2: Climate change could depress agricultural yields in most countries by 2050

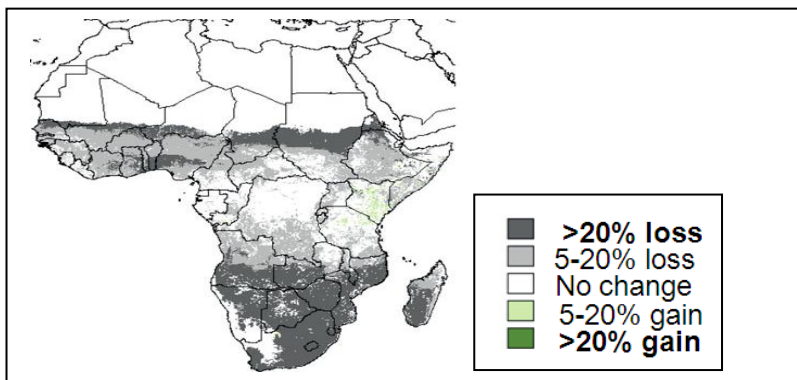


Source: C. Muller (2010)²⁰

Oxfam’s work with smallholders in developing countries indicates that these creeping, insidious changes in the seasons (such as longer, hotter dry periods), shorter growing periods, and unpredictable rainfall patterns are bewildering farmers, making it harder for them to know when best to sow, cultivate, and harvest their crops.²¹

- In the most vulnerable regions, research suggests 14.2 million hectares could see a significant change in the length of growing period due to climate change, with a potential population of around 400 million affected.²²
- A +4°C change in world temperatures could result in a massive reduction in the length of the growing period in many parts of Africa, including 20 per cent or more in some areas (Figure 3).

Figure 3: Variation in length of growing period in Africa to 2090 (%) in a +4°C world



Source: P. Thornton (2010)²³

Production shocks

On top of the slow-onset changes set out above, climate change will increase the frequency and severity of extreme weather events such as heatwaves, droughts, and floods, which can wipe out harvests. In March 2012, a special report on extreme weather by the Intergovernmental Panel on Climate Change (IPCC) warned of ‘unprecedented extreme weather and climate events’ in the future.²⁴ The impacts of future extreme events on food production cannot be forecast with precision. But many parts of the world have seen new extreme – and ominous – weather records set in recent years, with devastating consequences for food production. These events offer a glimpse of potential future impacts:

- In 2012 the US Midwest experienced its worst drought in 50 years, which reduced the expected maize crop by 25 per cent.²⁵ This contributed to global maize prices rising by around 40 per cent.²⁶ Drought in major wheat-producing countries such as Kazakhstan in the same year contributed to record wheat price increases of around 22 per cent.²⁷ This left low-income, import-dependent countries such as Yemen – which imports 95 per cent of its consumed cereals – highly exposed.²⁸
- In the record-breaking drought in Yunnan, China, which lasted from October 2009 to May 2010, 2.1m hectares of crops and 450,000 hectares of forest and fruit trees suffered serious impacts. The direct economic losses to agriculture exceeded RMB 20bn (around \$2.9bn).²⁹
- The drought in Russia in 2012 cut the grain harvest by nearly 25 per cent,³⁰ causing domestic prices of grain and bread to rocket. Losses caused by this drought have been estimated at between £294m and £937m.³¹ Oxfam research shows that the cumulative effects of the 2010 and 2012 droughts in Russia have driven many farmers into significant debt.³²
- 2012 was the UK’s second wettest year on record, and the wettest ever in England.³³ UK wheat yields fell to their lowest levels in 20 years³⁴ and the country had to import 2.5m tonnes of wheat.³⁵

‘In 2010, we were not so bound by loans, we had fewer debts, but now [after the 2012 drought] the situation is completely different. We had to take money from the Mafia and now that we go to bed, we are afraid they could cut our heads off or the bailiffs could come and take everything from our homes. Today, we could basically declare ourselves bankrupt and close down the farm.’

Alexander D., Altai region, Russia

Box 2: Loss and damage in agriculture

‘Loss and damage’ is a concept used in the UN climate change negotiations, which refers to the negative effects of climate change that adaptation will not overcome. In terms of impacts on food, it includes unavoidable losses of crops, fisheries, and livestock, as well as reduced productive capacity (sometimes permanent) due to saltwater intrusion in coastal areas, desertification and increased aridity, and extreme weather events. Loss and damage in agriculture is not only felt in economic terms – it also affects food security and jeopardises the right to food.

Many countries are already experiencing loss and damage, and as climate change progresses the threat will intensify. The Mekong Delta in Viet Nam, for example, which accounts for around 50 per cent of the country’s agricultural production, is at severe risk of saltwater intrusion. It has been estimated that a sea-level rise of 30cm, which could occur as early as 2040, could result in the loss of about 12 per cent of crop production.³⁶

2.2 DISTRIBUTION DISRUPTED

Even where food exists, extreme events can disrupt vital infrastructure, meaning that food cannot reach markets and for consumers availability is limited. Oxfam's programme and humanitarian work in climate-related emergencies indicate that the effects on transport, storage, bridges, fuel supplies, and other vital food-related infrastructure can in some instances be a bigger constraint on availability, and a bigger driver of food price increases, than impacts on food production.

A key lesson from Oxfam's work during the 2010–11 flooding in Colombia, for example, was that the greatest problem was not an absolute lack of food but rather interruptions in distribution due to infrastructure damage and transport limitations. For instance, the price of green beans increased in every market where they were sold – by more than 50 per cent in Bogotá and elsewhere – due to supply interruptions caused by landslides on roads.³⁷ The president of the Colombian Society of Agricultural Producers, Rafael Mejía López, said at the time that the food supply was sufficient but that transport infrastructure was 'a disaster'.³⁸

The effects of infrastructure disruption on food availability are widely recognised, but they remain a "known unknown" in the context of understanding potential future climate change impacts on food security. This is an area of major vulnerability that urgently needs more attention and research.³⁹

3. ACCESS TO FOOD

Adequate availability of food does not in itself guarantee that people have enough to eat. People's ability to obtain food is also dependent on whether or not they have sufficient resources to buy it at prices they can afford. Climate change challenges people's access to food by increasing and destabilising food prices, and by undermining livelihoods and people's ability to earn a living and to provide food for themselves and their families.

3.1 INCREASING AND VOLATILE PRICES

World food prices are a useful barometer of how the effects of climate change might play out within the food system. Food prices also have a major bearing on hunger and nutrition because they influence the capacity of poor people – and poor and highly import-dependent countries – to gain access to calories and nutrients.

Food price spikes can be a matter of life and death to many people in developing countries, who spend as much as 75 per cent of their incomes on food.⁴⁰ Even food-producing smallholder farmers are vulnerable to price spikes because in most developing countries they are net buyers of food (an estimated 73 per cent of smallholders in Ethiopia and 74 per cent in India, for example).⁴¹

As the 2012 drought in the USA shows, weather-related shocks, especially in major crop-exporting countries, can drive up prices precipitously in the short term. Shocks can also trigger responses affecting both producer and consumer countries, such as an export ban in the case of the Russian drought in 2010, which escalate prices further. The strain that price spikes have put on the global food system in recent years has aggravated political instability and social strife in many parts of the world.⁴²

Average price of staple foods set to rise

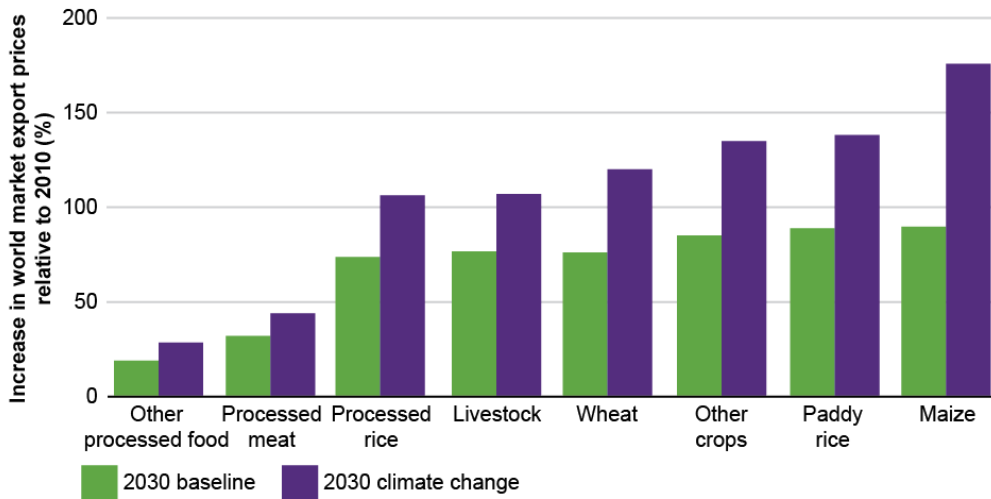
Oxfam commissioned research from the UK's Institute of Development Studies explored a range of food price scenarios for 2030 using international trade models. This found that, in the absence of urgent and aggressive action to tackle global warming, the average price of staple foods could more than double in the next 20 years compared with 2010 trend prices – with up to half of the increase caused by climate change (changing mean temperatures and rainfall patterns).⁴³ Analysis of the long-term impacts of climate change by the International Food Policy Research Institute (IFPRI) and others also indicates that food price rises of this magnitude are a likely corollary of rising temperatures and changing rainfall patterns.⁴⁴

'There are reasons to expect more frequent food price spikes, given that it will be more common to see [weather] conditions that are considered extreme.'

David Lobell, Assistant Professor of Environmental Earth System Science, Stanford University

The average price of staple foods could more than double in the next 20 years – with up to half of the increase caused by climate change

Figure 4: Predicted impact of climate change on world market food export prices to 2030



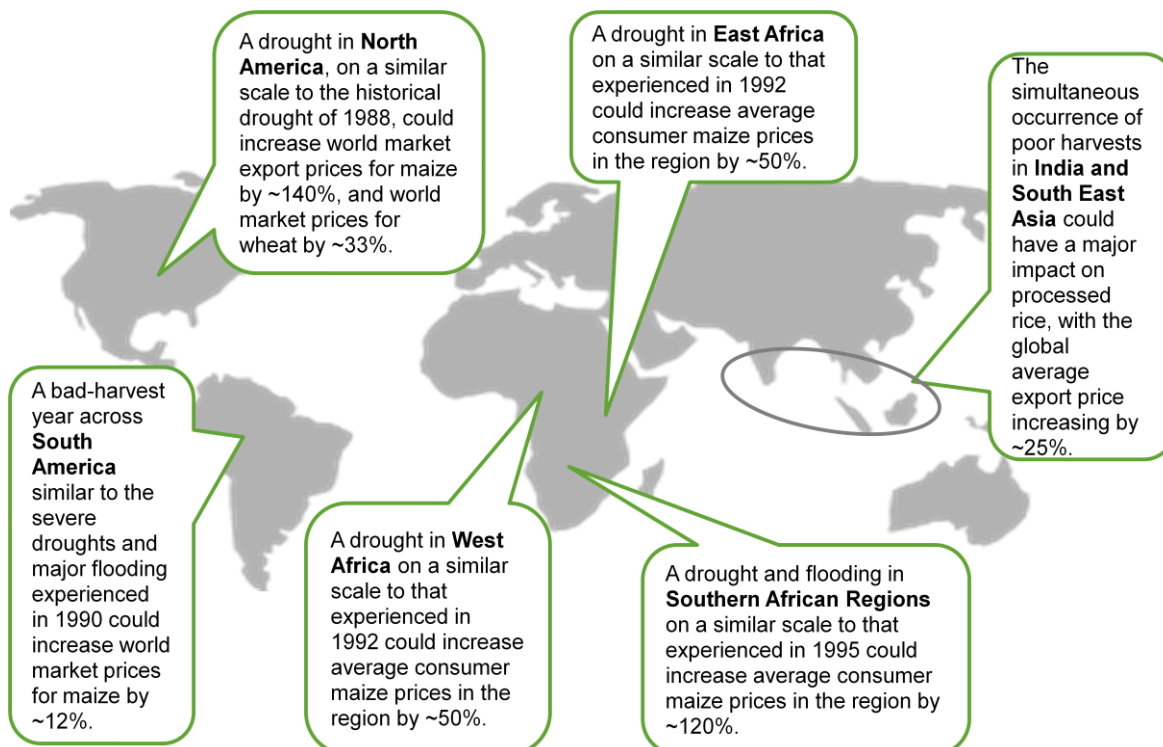
Source: D. Willenbockel (2011)

Food price spikes set to increase

On their own, these structural price rises could spell disaster for many people living in poverty – but they represent only baseline price increases. On top of baseline increases, additional research recently commissioned by Oxfam offers a snapshot of how extreme weather events could further compound the impact on prices.⁴⁵ This modelling suggests that in 2030 one or more extreme events in a single year could bring about price spikes of a magnitude comparable to two decades of projected long-run price increases (Figure 5).⁴⁶ This could have the effect, for example, of increasing domestic maize prices in Central American and Andean maize-importing countries by more than 80 per cent.⁴⁷

Extreme weather events in a single year could bring about price spikes of comparable magnitude to two decades of projected long-run price increases.

Figure 5: Modelled price impacts of extreme weather event scenarios in 2030



Source: D. Willenbockel (2012)

3.2 UNDERMINING LIVELIHOODS

The effects of price rises cannot be viewed in isolation. Climate change also disrupts livelihoods and people's capacity to earn a living and to provide food for themselves and their families.

Box 3: Brutal heatwave ruins livelihoods in parts of Pakistan

Zulekhan Mumtaz has seen her livelihood as a seller of camel milk wrecked because of a severe heatwave that left Pakistan sweltering for three weeks in May 2013 with temperatures of up to 51°C.

'My customers say they can no longer buy spoilt milk and squander their money,' the 31-year-old said. 'How can I buy fodder for the camel and food for my two children if the heatwave damages my milk?'

She said that even her camel had become sick because of frequent bouts of dehydration and its milk capacity had dropped by 70 per cent. Such extreme temperatures make almost every function of daily life a near-intolerable struggle – including, for millions of people, trying to earn a daily living. Residents in most cities, towns, and villages have been forced to stay indoors, leaving typically bustling shopping areas and business centres closed, and roads and highways deserted between 10am and 6pm.⁴⁸

'The temperature is changed greatly. Summer times never used to be so hot five years back, but this year we can hardly work on the fields in the morning. It is so hot that we get blisters all over our bodies.'

Seken Ali, Pangsha, Rajbari, Bangladesh

Increasing work burden and insecurity

Climatic uncertainty can lead farmers to try to plant more and more often, which increases the work burden – especially for women – and costs due to the need to buy more seeds or hire labour.⁴⁹ Rising temperatures and humidity also have direct effects on people's ability to work outdoors for long periods.⁵⁰

Box 4: Coffee-based livelihoods at risk in Uganda and Central America

Coffee is a major cash crop in Uganda. Recent research by Oxfam shows that the 500,000 smallholder farmers who produce 90 per cent of the crop could have their already vulnerable livelihoods made even more precarious by climate change. Interviews with coffee farmers in the Rwenzori Mountains found that many are already witnessing a changing and less predictable climate, with longer droughts as well as shorter and more erratic rains. Pests and plant diseases are increasing. Climate change mapping shows that areas suitable for growing Arabica coffee could diminish drastically in the future, incurring economic losses that could amount to tens of millions of dollars annually and sinking smallholder farmers further into poverty and increased risk of hunger.⁵¹

In Central America, *la roya* coffee rust is attacking Arabica coffee plants at ever higher altitudes as the climate warms.⁵² According to the International Coffee Organization, most coffee in Central America is grown by smallholder farmers, who will find it difficult to absorb the expected losses. It is expected that some 374,000 jobs will be lost in 2012/13 due to the rust, and the subsequent loss of income by farmers will increase food insecurity in many areas and will exacerbate migratory pressure towards North America.⁵³ Oxfam programmes in several Central American countries are gearing up to respond to the impending crisis.

'Too much rain and too much sun make the prawns get sick easily. The owner lost the prawns so I lost my job. Earlier this year my wife and eldest daughter had to go to Ho Chi Minh City to find jobs because I don't get a regular income.'

Nguyen Thanh Nhan, 39, Viet Nam

Increasing burden on women

Women are especially vulnerable to climate change. Worldwide, women do the bulk of farm work, so they have to work harder and for longer in hotter conditions.⁵⁴ Existing gender inequities may be worsened as climate change increases.

For example, Oxfam field surveys of communities in Nepal shows how disruption to the monsoons creates further pressure on men to migrate, leaving women alone to look after their families.⁵⁵ As physical labour is one of the few resources that women control, they have to undertake more daily waged labour, which is often extremely onerous and pays less than men's work. The increasing burden of work for women has knock-on effects on their time and energy to look after their children and run the care economy, which impacts on the nutritional status of children. As water sources dry up, they must travel further for longer to get water. Girls, especially, may be pulled out of school to help keep the household running.⁵⁶

Furthermore, it is often the case that within the household women and girls, who prepare the food, are the last to eat, giving priority to feeding men and boys first. When there is less to eat, women can fall into a downward spiral of poor diet, poor health, and loss of strength and energy.⁵⁷

It is also important to recognise that climate change is happening at the same time as vulnerabilities are changing drastically with changes in demography. Along with population increases, declining fertility rates and increasing survival at older ages have led to ageing populations. Women account for the majority of older persons – a phenomenon referred to as 'the feminisation of ageing', particularly in rural areas⁵⁸

Increasing risk of food crises

Of the three billion people who live in rural areas in developing countries, 2.5 billion are involved in agriculture, and 1.5 billion live in small farmer households.⁵⁹ Many are perilously exposed to changes in the climate, meaning that too much rain, or too little, can be the difference between having enough food or living in hunger. When a weather event drives local or regional price spikes, people living in poverty often face a double shock: having to cope with higher prices at a time when the direct effects of the weather may also have depleted their assets, destroyed their crops, or stripped them of their livelihood.

The 2011 emergency in the Horn of Africa and the 2012 Sahel food crisis show how this toxic mix can bring about hunger on a massive scale. Pastoralists and small-scale subsistence farmers were hit hard in both regions, where the loss of livestock and crops reduced the amount of food available. It also drastically reduced the value of their assets, so that they could not afford to buy food either.

Successive droughts in the Sahel and the Horn of Africa expose the hardship of cumulative shocks and slow-onset changes in the climate, which erode resilience and people's capacity to recover from one crisis to the next.

The devastating 2010 mega-flood in Pakistan destroyed over 570,000 hectares of cropland in Punjab and affected more than 20 million people. It caused a massive 75 per cent reduction in income across all households affected, primarily because of the destruction of crops and animals.⁶⁰ 80 per cent of food reserves were lost.⁶¹ Recently the World Food Programme warned that three consecutive years of floods mean that about half of Pakistan's population still do not have secure access to enough food (up from a little over one-third a decade ago).⁶²

Box 5: 2011 East Africa food crisis made more likely because of climate change

Droughts in East Africa have increased in frequency in recent years, occurring in 2005, 2006, 2008, and 2011.⁶³ The 2011 drought affected over 13 million people and led to a famine in Somalia that killed over a quarter of a million people⁶⁴ – and it was partly caused by climate change, according to a recent climate attribution study.⁶⁵ Climatologists at the Met Office Hadley Centre in Exeter, UK, found that climate change is likely to have increased the risk of the drought occurring.⁶⁶ In East Africa, no food crisis can ever be attributed to a single causal factor. But drought is a trigger and this is the first occasion that a portion of the blame for a humanitarian crisis has been attributed to climate change. Uncertainty remains over the precise future impacts of climate change on the East Africa region, but evidence points to climate change continuing to have significant adverse impacts on food security.

Cities becoming climate change hotspots

Crowded cities are particularly vulnerable to climate shocks, especially storms, floods, and heatwaves.⁶⁷ Floods can inundate the myriad small enterprises and street stalls that sustain livelihoods in low-lying, low-income areas. Low-income communities are disproportionately affected by such events and may also receive the least help in their aftermath, as was the case when Hurricane Katrina struck New Orleans.⁶⁸

Urban dwellers purchase nearly all of their food. For them, food security depends on being able to earn enough money to buy food, and on food being available at affordable prices. Often one or the other – or both – does not happen, as was seen in Bogotá in 2010 and 2011.⁶⁹ Low-income urban residents living in slums are particularly vulnerable because they rarely have the facilities to store food.⁷⁰ High prices exacerbated or caused by weather-related disasters can be calamitous for those on low and irregular incomes, who may suddenly be laid off following a flood or an economic crash.

4. FOOD UTILISATION

'Utilisation' is the way in which the body makes the most of the nutrients in food. There are at least two routes by which climate change can undermine successful utilisation of food. One is through impacts on the quality and safety of food itself, which undermine its nutritional benefit. Another is by jeopardising people's health, as an unhealthy person is less able to digest food thoroughly and obtain maximum goodness from it.

Threats to the quality and safety of food

Crops are vulnerable to extreme heat: a few days of extreme temperatures can cause physiological damage and crop failure. A new study estimates that within about 20 years, 31 per cent of the global harvested area of maize, 16 per cent of all rice, and 11 per cent of all wheat could be exposed to at least five days per year of extreme temperatures above the critical thresholds for these crops. For maize, this will rise to 44 per cent of the global harvested area exposed by the 2050s.⁷¹ Higher average temperatures can cause crops to mature more quickly, but if the right levels of nutrients or water are not available during the critical growing period, growth can go into stems rather than the grain or fruit, thereby reducing yields and food quality.

'Carbon fertilisation' increases the productivity of most crops, especially tubers⁷² like potato, but the effects will vary by region and models may exaggerate the benefits compared with what actually happens in the field.⁷³ Elevated carbon levels can actually reduce the protein concentration of wheat, barley, rice, and potato.⁷⁴ High heat and humidity also affect livestock health and output; animals eat less, put on less weight, reproduce less, and produce less milk or fewer eggs.

Hotter conditions are also likely to increase crop contamination by poisonous fungal mycotoxins. Around a quarter of the global annual maize crop is already contaminated with mycotoxins, which are dangerous to human health and responsible for substantial harvest losses.⁷⁵

Threats to human health

Extreme weather jeopardises human health, both immediately and directly through injuries and trauma and also indirectly and over the longer term by contaminating water supplies and increasing disease.⁷⁶ Climate change impacts on sanitation systems and access to clean drinking water, especially in urban areas, may be particularly serious.⁷⁷ Sickness impedes a person's ability to digest food thoroughly and obtain maximum benefit from it.

Tragically, children are the hardest hit: in particular, climate change is intensifying the threat from the three biggest killers of children – diarrhoea, malnutrition, and malaria.⁷⁸

People's observations of how climates are changing and their first-hand experiences of shocks, extremes, uncertainties, and unusual events may also bring about psychological distress. Fear, anxiety, sleeplessness, loss of confidence, lethargy, and depression may all occur, which in turn inhibit people's capacity to produce or obtain food.⁷⁹

'Whenever it rains at night, my whole family has no peace of mind, we can hardly sleep... That night our family lost everything. I don't know what climate change is all about – just that the weather is getting worse and worse'

E Mun Mun Tie, rice farmer, survivor of a landslide, Sichuan, China

5. BUILDING A RESILIENT FOOD SYSTEM: RECOMMENDATIONS

The climate change impacts on food security set out in this brief are not inevitable. It is within our power to ensure that every person's right to food is realised. But a dramatic shift in political ambition and a significant scale-up in resources are urgently needed to avoid dangerous climate change, address our broken food system, and strengthen its resilience.

Crucially, ensuring the long-term prospects for eradicating hunger means cutting emissions, and fast. Our food system cannot cope with unmitigated climate change and urgent action is needed to keep global temperature rises within safe levels. Deep cuts in emissions by 2020 are needed and require government and private sector action to:

- Decarbonise our global energy system by increasing investment in clean energy (wind and solar) and significantly curbing use of, and investment in, fossil fuel use (gas, oil, coal), which globally account for around two-thirds of emissions, principally CO₂.⁸⁰
- Reduce emissions equitably from industrial agriculture, which is a major driver of the approximately one third of global emissions not produced by the energy system, both from GHGs released directly and as the principal driver of emissions released through deforestation.⁸¹

Urgent action is needed to build the resilience of the food system, and that of the people who depend on it, to deal with existing climate impacts and further changes to the climate that are forecast. Even at today's level of 0.8°C of warming, food production, prices, and livelihoods are already being hit globally by extreme climate events and other climate impacts. Even if we cut emissions now, some further changes to the climate are unavoidable due to the extent of the greenhouse gases already released into the atmosphere. Building resilience requires urgent action, including to:

- Establish and implement legislative and constitutional provisions in developing countries that guarantee the right to food for all in the face of climate change, including secure access to land and water;
- Address extreme inequalities, both within and between countries, which are a major underlying cause of hunger that will be exacerbated by climate change;⁸²
- Deliver on promises of adaptation support to the poorest people by significantly scaling up climate finance now, to reach at least 50% of total public climate finance, on a path towards the commitment to mobilise \$100bn per year by 2020;
- Secure new commitments at the UNFCCC to address adaptation and loss and damage, including the establishment of a new international mechanism on loss and damage and an agreement that support for adaptation should be linked to the level of global mitigation commitments;
- Reverse decades of under-investment in small-scale, environmentally sustainable, and resilient agriculture to help farmers, especially women, increase the local availability of food and safeguard the resilience of ecosystems on which they rely;

'There is a commitment to climate change of 20 to 30 years into the future as a result of past emissions of greenhouse gases that necessitates immediate adaptation actions to address global food insecurity over the next two to three decades.'

T. Wheeler and J. von Braun (2013)
'Climate change impacts on global food security'

- Scale up disaster risk reduction (DRR) efforts and invest in early warning systems to increase preparedness for when weather shocks strike;
- Scale up humanitarian response to tackle the rising number of weather-related food crises;
- Scale up food reserves and social protection measures to reduce vulnerability and help people cope with recurrent shocks.

REFERENCES

- ¹ FAO (2006) Food Security Policy Brief. ftp://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf
- ² World Food Summit, Rome Declaration on World Food Security (1996). <http://www.fao.org/docrep/003/w3613e/w3613e00.HTM>
- ³ J. Hansen, M. Sato, and R. Ruedy (2012) 'The New Climate Dice: Public Perceptions of Climate Change', NASA, Goddard Institute of Space Studies. http://www.giss.nasa.gov/research/briefs/hansen_17/
- ⁴ IPCC (2007) 'Climate Change 2007: Working Group I: The Physical Science Basis', chapter 6.3.2 'What does the record of the mid-Pliocene show?' http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch6s6-3-2.html
- ⁵ M. Parry et al. (2009) 'Climate Change and Hunger: Responding to the Challenge', World Food Programme.
- ⁶ G. Nelson et al. (2009) 'Climate Change: Impact on Agriculture and Costs of Adaptation', International Food Policy Research Institute (IFPRI); and IFPRI (2009) 'Building Climate Resilience in the Agriculture Sector of Asia and the Pacific', Asian Development Bank.
- ⁷ F.C. Lott, N. Christidis, and P.A. Stott (2013) 'Can the 2011 East African drought be attributed to human-induced climate change?', *Geophysical Research Letters* 40, 1177–1181.
- ⁸ DARA (2012) Climate Vulnerability Monitor 2012, 'Findings and Observations', p.241.
- ⁹ G. Nelson et al. (2009) op. cit.
- ¹⁰ Ibid.
- ¹¹ <http://www.fao.org/docrep/003/w3613e/w3613e00.HTM>
- ¹² D. Lobell et al. (2011) 'Climate trends and global crop production since 1980', *Science*, May 2011.
- ¹³ G. Nelson et al. (2009) op. cit.
- ¹⁴ D. Lobell et al. (2011) op. cit.
- ¹⁵ Many studies have used climate scenario model outcomes in crop growth simulation models to assess potential impacts on yields, including G. Nelson et al. (2010) 'Food Security, Farming, and Climate Change to 2050: Scenarios, Results, Policy Options', *IFPRI*.
- ¹⁶ World Bank (2013) 'Turn Down the Heat: Climate extremes, regional impacts and the case for resilience – Executive Summary'. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/06/14/000333037_20130614104709/Rendered/PDF/784220WP0Engli0D0CONF0to0June019090.pdf
- ¹⁷ W. Cline (2007) 'Global Warming and Agriculture: Impact Estimates by Country', Center for Global Development.
- ¹⁸ M.D. Smith et al, 'Sustainability and Global Seafood', *Science*, 12 February 2010, vol. 327, no 5967, pp 784-786.
- ¹⁹ S.C. Doney (ed) (2012) 'Climate change impacts on marine ecosystems', *Annual Review of Marine Science*, vol. 4: 11-37.
- ²⁰ C. Muller (2010) 'Climate Change Impacts on Agricultural Yields', background note to the 'World Development Report 2010'. The figure shows the projected percentage change in yields of 11 major crops (wheat, rice, maize, millet, field pea, sugar beet, sweet potato, soybean, groundnut, sunflower, and rapeseed) from 2046 to 2055, compared with 1996–2005. The yield-change values are the mean of three emission scenarios across five global climate models, assuming no CO₂ fertilization (a possible boost to plant growth and water-use efficiency from higher ambient CO₂ concentrations). Large negative yield impacts are projected in many areas that are highly dependent on agriculture.
- ²¹ S. Jennings and J. Magrath (2009) 'What Happened to the Seasons?' Oxfam GB.
- ²² The High Level Panel of Experts on Food Security and Nutrition report on 'Food security and Climate Change' (2012) citing P. Ericksen et al. (2011) 'Mapping Hotspots of Climate Change and Food Insecurity in the Global Tropics', CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) Report No. 5.
- ²³ P. Thornton (2010) 'Agriculture and food systems in sub-Saharan Africa in a 4°C+ world', *Philosophical Transactions of the Royal Society*, 29 November 2010.
- ²⁴ IPCC (2012) 'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation', A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change.
- ²⁵ Box 1.1 OECD/FAO Agricultural Outlook 2013 http://www.keepeek.com/Digital-Asset-Management/oecd/agriculture-and-food/oecd-fao-agricultural-outlook-2013_agr_outlook-2013-en

- ²⁶ Box 1.1, OECD/FAO Agricultural Outlook, *ibid*.
- ²⁷ Box 1.1, OECD/FAO Agricultural Outlook 2013, *ibid*.
- ²⁸ See e.g. FAO consolidated appeal, 2012: http://www.fao.org/fileadmin/user_upload/emergencies/docs/CAP_2012_Yemen.pdf
- ²⁹ J.M.Lu et al. (2012) 'The influence of the Madden-Julian Oscillation activity anomalies on Yunnan's extreme drought of 2009–2010', *Science China Earth Sciences*, January 2012, vol. 55 No.1. The drought also affected over 25 million people.
- ³⁰ ROSSTAT (Russian Federation Federal State Statistics Service), cited in 'After the Drought: Russian farmers speak about the struggle they faced in 2012 and the challenges of adapting to extreme weather events', Oxfam (2013, forthcoming). Wheat prices fell by 19% (OECD/FAO Agricultural Outlook, *op.cit*).
- ³¹ 'After the Drought', *op. cit*.
- ³² *Ibid*.
- ³³ UK Met Office. <http://www.metoffice.gov.uk/news/releases/archive/2013/2012-weather-statistics>
- ³⁴ See National Farmers' Union survey of arable members published in October 2012. <http://www.nfuonline.com>
- ³⁵ Peter Kendall, UK National Farmers' Union President, warned that extreme weather "is getting much more difficult to manage" and is the greatest threat to the UK's agriculture and food supplies. See UK newspaper *The Guardian*, 28 July 2013. <http://www.theguardian.com/environment/2013/jul/28/weather-heatwaves-climate-change-uk-farming> Although recent climate change attribution studies have not found that anthropogenic forcers made the extreme wet weather in the UK in 2012 more likely, the extent of the crop damage demonstrates the vulnerability of agriculture in developed countries to extreme weather.
- ³⁶ World Bank (2013) Turn Down the Heat: Climate extremes, regional impacts and the case for resilience – Executive Summary, p. 7 http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/06/14/000333037_20130614104709/Rendered/PDF/784220WP0Engli0D0CONF0to0June019090.pdf
- ³⁷ From the monthly press bulletin of the Colombian national agricultural price information service (CCI), December 2010. www.cci.org.co/cci/cci_x/datos/Canasta/2010/CanastaDic2010.pdf
- ³⁸ From an article in *América Economía*, 28 April 2011. www.americaeconomia.com/politica-sociedad/mundo/colombia-gobierno-no-preve-desabastecimiento-de-alimentos-por-ola-invernal
- ³⁹ S.J. Vermuelen, B.Campbell, and J. Ingram (2012) 'Climate change and food systems', *Annual Review of Environment and Resources* 37:195-222. <http://www.fcrrn.org.uk/research-library/agriculture/climate-change-and-food-systems>
- ⁴⁰ M. Ivanic and W. Martin (2008) 'The Implications of Higher Global Food Prices for Poverty in Low-Income Countries', World Bank Policy Research Working Paper.
- ⁴¹ A. de Janvry and E. Sadoulet (2011) 'Subsistence farming as a safety net for food-price shocks', *Development in Practice*, 21:4-5, 472-480.
- ⁴² Statistical analysis by the IMF found that increases in international food prices lead to increasing risk of riots and civil conflict in low-income countries. <http://www.imf.org/external/pubs/ft/wp/2011/wp1162.pdf>.
- See also analysis of international food prices and political instability, which indicates a food price threshold above which protests become more likely. <http://arxiv.org/abs/1108.2455>
- ⁴³ D. Willenbockel (2011) 'Exploring Food Price Scenarios Towards 2030 with a Global Multi-Region Model', Oxfam research report.
- ⁴⁴ G. Nelson et al. (2010) 'Food Security, Farming, and Climate Change to 2050', *op. cit*.
- ⁴⁵ D. Willenbockel (2012) 'Extreme Weather Events and Crop Price Spikes in a Changing Climate: Illustrative Global Simulation Scenarios', Oxfam research report.
- ⁴⁶ *Ibid*.
- ⁴⁷ *Ibid*.; and see T. Carty (2012) 'Extreme Weather, Extreme Prices: The costs of feeding a warming world', Oxfam.
- ⁴⁸ Reported by Thomson Reuters Foundation, 4 June 2013. <http://www.trust.org/item/20130604105605-6fcrq>
- ⁴⁹ See, for example, J. Magrath (2008) 'Turning Up The Heat: Climate change and poverty in Uganda', Oxfam.
- ⁵⁰ S. Jennings and J. Magrath (2009), *op. cit*.; and A. Renton (2009) 'Suffering the Science: Climate change, people and poverty', Oxfam.
- ⁵¹ L. Jassogne et al. (2013) 'The Impacts of Climate Change on Coffee in Uganda: Lessons from a

- case study in the Rwenzori Mountains', Oxfam.
- ⁵² 'The threatening march of coffee rust', Burlington Free Press, 22 June 2013. http://www.burlingtonfreepress.com/article/20130623/GREEN01/306230013/The-threatening-march-coffee-rust?nclick_check=1
- ⁵³ International Coffee Organization (2013) 'Report on the outbreak of coffee leaf rust in Central America and action plan to combat the pest', 13 May 2013. <http://dev.ico.org/documents/cy2012-13/ed-2157e-report-clr.pdf>
- ⁵⁴ See, for example, Mary Robinson Foundation Climate Justice (2012) 'The Gender Dimensions of Food and Nutrition Security in the Context of Climate Change in Uganda', policy brief.
- ⁵⁵ Oxfam (2009) 'Even the Himalayas Have Stopped Smiling: Climate change, poverty and adaptation in Nepal', Oxfam research report.
- ⁵⁶ Ibid.
- ⁵⁷ S. Chant (ed.) (2010) *The International Handbook of Gender and Poverty: Concepts, research, policy*, quoted in C. Tacoli, B. Bukhari, and S. Fisher (2013) 'Urban Poverty, Food Security and Climate Change', *IIED Human Settlements Working Paper* 37.
- ⁵⁸ UNFPA/HelpAge International (2012) 'Ageing in the Twenty-First Century: A celebration and a challenge'.
- ⁵⁹ World Bank (2008) 'World Development Report 2008', Washington DC.
- ⁶⁰ World Health Organization, Ministry of Health, and John Hopkins Bloomberg School of Public Health (2011) 'Pakistan Floods 2010: Impact Assessment'.
- ⁶¹ T.D. Kirsch, C. Wadhvani, L. Sauer, S. Doocy, and C. Catlett (2012) 'Impact of the 2010 Pakistan Floods on Rural and Urban Populations at Six Months', *PLOS Currents: Disasters*, August 2012. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3441151/>
- ⁶² EM-DAT/CRED cited in WMO, 'The Global Climate 2001–2010, a decade of climate extremes' http://library.wmo.int/opac/index.php?lvl=notice_display&id=15110 and Pakistan newspaper *Daily Asia* report, 24 June 2013 (no website).
- ⁶³ R. Bailey (2013) 'Managing Famine Risk: Linking early warning to early action', Chatham House.
- ⁶⁴ UN News Centre (2013) 'Somalia famine killed nearly 260,000 people, half of them children – reports UN', 2 May 2013. www.un.org/apps/news/story.asp?NewsID=44811#.Uf0it9Kmh-o
- ⁶⁵ The drought affected 13 million people, as set out in D. Hillier and B. Dempsey (2012) 'A Dangerous Delay', Oxfam and Save the Children; Climate attribution study: F.C. Lott, C.N. Christidis, and P.A. Stott (2013) op. cit.
- ⁶⁶ F.C.Lott, C.N. Christidis, and P.A. Stott (2013) op. cit.
- ⁶⁷ C. Tacoli et al. (2013) op. cit.
- ⁶⁸ R. Bullard and B. Wright (2012) *The Wrong Complexion for Protection: How the government response to disaster endangers African American communities*, NYU Press; and Oxfam America (2006) 'Forgotten Communities, Unmet Promises'.
- ⁶⁹ CCI and *America Economica* articles, op. cit.
- ⁷⁰ C Tacoli et al. (2013) op. cit.
- ⁷¹ S.M. Gourджи, A.M. Sibley, and D.B. Lobell (2013) 'Global crop exposure to critical high temperatures in the reproductive period: historical trends and future projections', *Environmental Research Letters*, vol. 8, no. 2.
- ⁷² J.M. McGrath and D. Lobell (2013), 'Regional disparities in the CO2 fertilization effect and implications for crop yields', *Environmental Research Letters* 8 014054, <http://iopscience.iop.org/1748-9326/8/1/014054/article>
- ⁷³ T. Wheeler and J. von Braun (2013) 'Climate change impacts on global food security', *Science* 341, 508. <http://www.sciencemag.org/content/341/6145/508.abstract>
- ⁷⁴ D.R. Taub, B. Miller, and H. Allen (2008) 'Effects of elevated CO2 on the protein concentration of food crops: a meta-analysis', *Global Change Biology* 14:565–75.
- ⁷⁵ S. Vermuelen et al., op. cit.
- ⁷⁶ T. Wheeler and J. von Braun, op. cit.
- ⁷⁷ Recent Oxfam-led research for DFID has identified urban sanitation as the biggest challenge in the global water, sanitation, and hygiene (WASH) sector. See Humanitarian Innovation Fund (2013) 'Gap Analysis in Emergency WASH', July 2013, <http://policy-practice.oxfam.org.uk/publications/gap-analysis-in-emergency-water-sanitation-and-hygiene-promotion-300094>.
- ⁷⁸ UNICEF UK (2013) 'Climate Change, Food Systems and Children: A case for greater action'.
- ⁷⁹ S. Jennings and J. Magrath, (2009) op. cit.; and A. Renton (2009) 'Suffering the Science', op. cit.

⁸⁰ Approximate breakdown of global greenhouse gas emissions is 65% energy-related and 35% non-energy related. See for example: Stern Review breakdown using data drawn from World Resource Institute Climate Analysis Indicators Tool (Figure 1) http://webarchive.nationalarchives.gov.uk/http://www.hm-treasury.gov.uk/media/4/3/Executive_Summary.pdf

⁸¹ Ibid. for breakdown of energy and non-energy related ghg emissions.

See S.J. Vermeulen et al. (2012) op.cit. for an analysis of agriculture and the food sectors share of global emissions.

⁸² Providing the additional calories needed by the 13 per cent of the world's population facing hunger would require just 3 per cent of the current global food supply. Calculation by Oxfam, arrived at by dividing the depth of the food deficit (per capita kcal deficit x global population) by the total food supply (per capita global food supply x global population). Sources: <http://www.fao.org/economic/ess/ess-fs/fs-data/ess-fadata/en/> (accessed 20 August) and <http://faostat3.fao.org/home/index.html#DOWNLOAD>

© Oxfam International September 2013

This paper was written by Tracy Carty and John Magrath. Oxfam acknowledges the assistance of many people in its production with particular thanks to Ricardo Fuentes-Nieva, Tim Gore, Antonio Hill, Duncan Green, Richard King, Martin Walsh, Eric Hazard, Heather Coleman and Chris Funk (Research Geographer, U.S. Geological Survey) in its production. It is part of a series of papers written to inform public debate on development and humanitarian policy issues.

For further information on the issues raised in this paper please e-mail advocacy@oxfaminternational.org

This publication is copyright but the text may be used free of charge for the purposes of advocacy, campaigning, education, and research, provided that the source is acknowledged in full. The copyright holder requests that all such use be registered with them for impact assessment purposes. For copying in any other circumstances, or for re-use in other publications, or for translation or adaptation, permission must be secured and a fee may be charged. E-mail policyandpractice@oxfam.org.uk.

The information in this publication is correct at the time of going to press.

Published by Oxfam GB for Oxfam International under ISBN 978-1-78077-432-9 in September 2013.

Oxfam GB, Oxfam House, John Smith Drive, Cowley, Oxford, OX4 2JY, UK.

OXFAM

Oxfam is an international confederation of 17 organizations networked together in 94 countries, as part of a global movement for change, to build a future free from the injustice of poverty. Please write to any of the agencies for further information, or visit www.oxfam.org.