



Africa – Up in smoke 2

The second report on Africa and global warming from the Working Group on Climate Change and Development



“Africa of course is... seen by experts as particularly vulnerable to climate change. The size of its land mass means that in the middle of the continent, overall rises in temperature will be up to double the global rise, with increased risk of extreme droughts, floods and outbreaks of disease.”¹

Tony Blair, January 2005

Contents

Summary and recommendations	2	El Niño impacts	9
Cut rich country greenhouse gas emissions	2	An interview from Ethiopia	9
Build on Kyoto to toughen up international efforts post-2012	2	Climate change and desertification	9
Support essential adaptation	2	Three case studies from Kenya	10
Empower poor communities to be part of the climate change solution	3	Promoting sustainable agriculture	12
Strengthen disaster risk reduction	3	Conservation farming raises yields ten fold in Zambia	12
Reform emergency responses	3	Climate change and HIV/AIDS: the insidious links	13
Tackle poverty – rural livelihoods for the most vulnerable and boosting small-scale agriculture	3	The threat to health	13
Drought, climatic variability and climate change in Africa	5	Farming food or biofuel?	14
Why is Africa vulnerable to climate change?	6	Urban perspectives on climate change	14
Niger – new approaches to poverty and climate change	6	Better bricks need less fuel	14
Sahelian drought – past, present and future	8	Endnotes	15

Summary and recommendations

Too much or too little rain can be a matter of life or death in Africa. At different times and in different places across the continent, climate change threatens both. This briefing brings up to date the original report from the Working Group on Climate Change and Development, *Africa – Up in smoke?*, released in 2005. Our overarching conclusion then, which is even more pressing now, was that:

*'A new model of development is called for, one in which strategies to increase human resilience in the face of climate change and the stability of ecosystems are central. It calls for a new test for every policy and project, in which the key question will be, "Are you increasing or decreasing people's vulnerability to the climate?" Above all, the challenge calls for a new flexibility and not a one-size-fits-all, neoliberal-driven approach to development. Just as an investment portfolio spreads risk by including a variety of stocks and shares, so an agricultural system geared to manage the risks of changing climate requires a rich diversity of approaches in terms of what is grown, and how it is grown.'*²

Today, new scientific research and evidence from our coalition's work in the field find that the climate change threat to human development in Africa is even greater. To combat the threat, we make these urgent recommendations to the international community:

- **Cut rich-country greenhouse gas emissions**

The first priority must be to cut global greenhouse gas emissions, so that average temperatures do not rise more than 2°C above pre-industrial levels – a goal of the European Union since 1996. Scientists say that the threat of major and irreversible climate change, with potentially enormously damaging impacts, becomes far greater as temperatures increase. Africa's contribution to greenhouse gas emissions is negligible so to address this injustice the onus falls fairly and squarely on the rich nations whose historical and continued profligate use of carbon is to blame for most of the current warming trends. In Britain and Ireland the new environment and development campaigning network Stop Climate Chaos is calling for those governments to do their fair share by setting a legally binding, annual, constantly contracting 'carbon budget', which plots a course, year on year, towards a two-thirds reduction in emissions on 1990 levels by 2050. This would create cuts of between 60 and 80 per cent.³

- **Build on Kyoto to toughen up international efforts post-2012**

Above all, the growing global climate crisis, manifested not only in Africa but also by extraordinary events from droughts in the Amazon to catastrophic floods in the deserts of Rajasthan, shows the absolute urgency for action on a global scale.⁴ To avoid possibly cataclysmic climate change, global greenhouse gas (GHG)

emissions must ultimately be cut by between 60 and 90 per cent. We have less than 10 years before global emissions must start to decline – instead they are rising remorselessly. This means there is not a moment to lose.

The negotiations under way in the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol must deliver a fair, effective and equitable Protocol beyond 2012 that deepens the GHG reduction targets in the industrialised countries and allows greater mitigation contributions from some of the larger developing countries. These negotiations must be completed by 2008 to ensure that there is no gap between the first commitment period of the Kyoto Protocol, which ends in 2012, and the second commitment period. The expanded framework needs to revive the original intent of the UNFCCC for developed countries to take leadership by reducing emissions at home. It must also provide the opportunity for poor countries to escape poverty through massive investments in adaptation and renewable energy and support their sustainable development.

- **Support essential adaptation**

The legacy of higher historical emissions places the onus on industrialised countries to take the lead in significant cuts in greenhouse gases. It also reinforces the need to support adaptation in developing countries, particularly in the poorest countries that have contributed least to causing global warming.

Industrialised countries have committed to providing **financial and technical** resources to developing countries under the UNFCCC, as well as through other political declarations. This support may come in a range of ways, including increased bilateral and multilateral funding related to adaptation, assistance with research and climate monitoring, contributions to the Global Environment Facility, as well as contributions to the various adaptation funds established under the UNFCCC and Kyoto Protocol.

Although spending on adaptation may be difficult to define and calculate precisely, the level of support for adaptation remains limited. Its integration within aid budgets is weak at best. According to the latest report on the status of the two UNFCCC funds (the Least Developed Countries Fund and Special Climate Change Fund), contributions amounted to just \$43 million in 2005–2006 of which the first UK annual contribution was \$12 million (£6.6 million) in total for both funds.⁵

To put all these numbers into perspective, it has been estimated that the overall annual costs to adapt to projected climate change (i.e. climate-proof development)

are likely to be between \$10 billion and \$40 billion per year.⁶ Such sums can be quietly found: following the lethal European heatwave in the summer of 2003, when an estimated 11,435 people died in France, \$748 million in extra funding was announced for hospital emergency services in that country alone. Furthermore, it has been estimated that rich-country subsidies to fossil fuel industries come to \$75 billion per year, and globally fossil fuel industries are subsidised to the tune of over \$235 billion per year.

- **Empower poor communities to be part of the climate change solution**

Recently donor governments have emphasised the role of new technology – in particular, how to improve weather forecasting in Africa. Development groups, however, believe adaptation must be more than this: it has to be about strengthening communities from the bottom up, building on their own coping strategies to live with climate change and empowering them to participate in the development of climate change policies. Identifying what communities are already doing to adapt is an important step towards discovering what people's priorities are and sharing their experiences, obstacles and positive initiatives with other communities and development policy-makers. Giving a voice to people in this way can help to grow confidence, as can valuing their knowledge and placing it alongside science-based knowledge.

- **Strengthen disaster risk reduction**

When dealing with the uncertainties of climate change, reducing vulnerability to today's climate through disaster risk reduction (DRR) is an excellent method of building adaptive capacity for the future. Communities can be protected from disasters relatively cheaply and simply – tools and methodologies are well developed and can be employed immediately in communities. Thousands of lives could be saved and economic losses prevented each year if more emphasis was placed on this. The climate change community therefore needs to recognise that DRR is a vital component of climate change adaptation. It should work with the disaster management community to advance both fields and avoid duplicating activities. Governments must also fulfill their previous commitments to DRR.

- **Reform emergency responses**

While conditions vary greatly, across sub-Saharan Africa as a whole, 33 per cent of people are under-nourished, compared with 17 per cent of people in all developing countries. The proportion rises to 55 per cent in Central Africa.⁷ The average number of food emergencies in Africa per year almost tripled since the mid 1980s.⁸ Climate change is a new and unprecedented threat to food security.

These failures stem in part from the fact that for over 40 years emergency aid, and food aid in particular, has remained the chief instrument to address food crises. Food aid does save lives, but it does not offer long-term solutions, and at worst it may exacerbate food insecurity.

The emergency, or 'humanitarian', system must be overhauled, so that it is truly able to deliver prompt, effective assistance on the basis of need. It must support people's livelihoods as well as meeting the immediate needs of the hungry. The stop-start approach must give way to longer-term support to address the underlying causes of food insecurity, including through social protection programmes through governments, backed by reliable funding. Moreover, the type of aid is still often inappropriate. It is not right that 70 per cent of food aid distributed by the UN is still the produce of the developed world: food aid should not be a means of supporting farmers in developed countries. When hunger is caused by lack of access to food as a result of poverty rather than food shortages, providing cash can be a more appropriate, faster, and less expensive option.

- **Tackle poverty – provide rural livelihoods for the most vulnerable and boost small-scale agriculture**

More fundamentally, if food crises are to be averted, much more must be done to tackle the root causes of hunger. That means tackling poverty and the power imbalances that underpin it. The number of people in sub-Saharan Africa who subsist on less than one dollar a day has almost doubled since 1981, to 313 million people in 2001, representing 46 per cent of the population. Even allowing for the extraordinary pace of urbanisation in Africa, the majority of the continent's poorest and most undernourished people live in rural areas – especially smallholders, nomadic pastoralists, and women. The joint effort to eradicate poverty promised by African governments and donor governments must therefore deliver rural policies that involve and prioritise these vulnerable groups. Even small improvements in what they produce and earn, in access to health, education and clean water, will have major impacts in reducing hunger, as well as driving equitable growth. The need to give much more support to small-scale farming comes up again and again from the field experience of development groups, and yet aid for agricultural production in sub-Saharan Africa dropped by 43 per cent between 1990–92 and 2000–02.

As Klaus Toepfer, Director of the UN Environment Programme from 1998 until 2006, said in March 2006:

*'Drought is a natural climatic phenomenon, but what has dramatically changed in recent decades is the ability of nature to supply essential services like water and moisture during hard times... This is because so much of nature's water and rain-supplying services have been damaged, destroyed or cleared. We have got to fight climate change by realising meaningful and ultimately substantial reductions in greenhouse gases, and we must help vulnerable communities adapt to the climate change which is already here and that which is to come.'*⁹

Up in smoke? – the first report from the Working Group on Climate Change and Development – joined the environment and development communities in a united view on the minimum action necessary to deal with the threat of global warming to human development. The proposals we called for in October 2004 are now more pressing than ever before.

Three overarching challenges include:

1. How to stop and reverse further global warming.
2. How to live with the degree of global warming that cannot be stopped.
3. How to design a new model for human progress and development that is *climate proof* and *climate friendly* and gives everyone a fair share of the natural resources on which we all depend.

In that light, our urgent priorities include:

- A global risk assessment of the likely costs of adaptation to climate change in poor countries.
- Commensurate new funds and other resources made available by industrialized countries for poor country adaptation, bearing in mind that rich-country subsidies to their domestic, fossil-fuel industries stood at US\$7 billion per year in the late 1990s.
- Effective and efficient arrangements to respond to the increasing burden of climate-related disaster relief.
- Development models based on risk reduction, incorporating community-driven coping strategies in adaptation and disaster preparedness.
- Disaster awareness campaigns with materials produced at community level and made available in local languages.
- Co-ordinated plans, from local to international levels, for relocating threatened communities with appropriate political, legal and financial resources.

In addition to these, as organisations striving to improve human well-being in the face of enormous challenges, we will:

- Work towards a collective understanding of the threat.
- Share the best of our knowledge about how to build human and ecosystem resilience and live with the degree of global warming that is now unstoppable.
- Do everything in our power to stop dangerous climate change and help bring about a global solution that is fair and rooted in human equality.

Drought, climatic variability and climate change in Africa

The severe drought that hit the Horn and East Africa in 2005–06 was eased by fairly good rains in April–May of 2006 but as this briefing is published, upwards of eight million people across East Africa are still experiencing a food crisis and in need of various forms of assistance. It will take herders years to recover from the deaths of so many of their livestock, their main means of living. Furthermore, the rains were by no means good everywhere. Distribution was uneven and parts of north west Kenya and Somalia, which had only just emerged from a prolonged four-year drought, had patchy and erratic rain. For millions of people, the success or failure of the 'short rains' in October–December are crucial. Will 2007 offer the prospect of recovery, or be another year of desperate struggle to survive?

Africa's climate – especially in the semi-arid regions – has always been very erratic, from year to year and over longer periods. The success or failure of one rainy season, or even several, cannot be attributed to global warming. But, Africa *is* steadily warming, climate *is* changing, and models predict further warming and further changes in rainfall patterns. The continent as a whole is warmer by 0.5°C than it was 100 years ago,¹⁰ putting extra strain on water resources. The six warmest years in Africa have all been since 1987 and globally, 2005 was the hottest year on record. But temperatures have increased more in the interiors, as Tony Blair pointed out. The maximum temperature in Kericho, a highland area in the Rift Valley province where most of Kenya's tea exports are grown, has increased by 3.5°C during the past 20 years. In Lamu, on Kenya's north east coast near Somalia, the maximum temperature has increased by more than 3°C since the 1940s.¹¹ The UK's Hadley Centre says temperature increases over many areas of Africa will be double the global average.

The tendency is also towards greater extremes. Arid or semi-arid areas in northern, western, eastern and parts of southern Africa are becoming steadily drier. Equatorial Africa and other parts of southern Africa are wetter. Although drought is often seen as the problem in African agriculture, in fact it may not be drought *per se* that causes the problems. Farmers are as much or more concerned about confusing changes in the seasons and violent, erratic and unpredictable weather. It becomes ever more difficult to know when and where to invest precious time, energy and inputs into planting and other activities. It is becoming clear that in many places, dangerous climate change is already happening.¹²

Modelling the recent evolution of global drought and projections for the twenty-first century¹³

New research modelling the future global of drought patterns has terrifying implications for human survival. The UK's Hadley Centre for Climate Prediction and Research looked at the share of the Earth's land surface prone to extreme, severe and moderate drought. It's research concludes that the percentage of the Earth's land surface that suffers from extreme drought has trebled from just one per cent to three per cent, in less than a decade at the start of the twenty-first century. But the centre's climate model projects that this trend will continue until extreme drought conditions prevail over some eight per cent of the land surface by 2020 – and then accelerate until extreme drought affects no less than 30 per cent of the globe by 2090. Historically a total of 20 per cent of the Earth's land surface has been in drought at any one time, be it extreme, severe or moderate. This has now risen to 28 per cent and is predicted to be 35 per cent by 2020 and cover 50 per cent – half the Earth's land surface and still rising – by 2090. Droughts will also be much longer in duration.

Drought is projected to affect the great grain-growing areas of Europe, North America and Russia, as well as the Middle East and Central Asia, North Africa and Southern Africa, Amazonia/Brazil, and Central America. Yet although the models forecast a severe, overall drying pattern over our surface, certain areas will get much wetter. A wetter future is forecast for Central Africa, the Horn and East Africa and parts of coastal West Africa, China and Eastern Asia, and high Northern latitudes. Although higher rainfall could come equally in the destructive form of heavy inundations as well as beneficial rain, it raises the intriguing possibility of environmental refugees from a dehydrated Europe flooding into Africa by the mid-century.

Why is Africa vulnerable to climate change?

Africa – site of the UN climate change conference in Nairobi in November 2006 (COP 12/MOP 2) – is the continent probably most vulnerable of all to the negative effects of climate change and the one that faces the greatest challenges to adapt. Poverty, conflict, disease, governance problems, an unjust international trading system, and the burden of unpayable debt – these and other factors hinder the ability of communities and nations to handle shocks.

This dual jeopardy was a key theme of *Africa – Up in smoke?*, the second report of a unique coalition of environment and development agencies that came together to express their shared concerns about the threat that climate change poses to human development and to the Earth's ecosystems upon which all life depends.

In this 2006 report, agencies pointed out that in Africa, these natural systems form the foundation of the economy of most countries, from which the majority of the population derives their livelihood.

Africa contains about one-fifth of all known species of plants, mammals, and birds, as well as one-sixth of amphibians and reptiles. Biodiversity in Africa, which principally occurs outside formally conserved areas, is under threat from climate change and other stresses. Savannahs, tropical forests, coral reef marine and freshwater habitats, wetlands and East Africa montane ecosystems are all at risk.

Poor people, especially those living in marginal environments and in areas with low agricultural productivity in Africa, depend directly on genetic, species and ecosystem diversity to support their way of life. As a result of this dependency, any impact that climate change has on natural systems will threaten the livelihoods, food intake and health of the population.

The International Panel on Climate Change (2001) explains that there are six situations, which make Africa particularly vulnerable to climate change:

1. Water resources, especially in international shared basins where there is a potential for conflict and a need for regional co-ordination in water management.
2. Food security at risk from declines in agricultural production.
3. Natural resources productivity and biodiversity at risk.
4. Vector- and water-borne diseases, especially in areas with inadequate health infrastructure.
5. Coastal zones vulnerable to sea-level rise, particularly roads, bridges, buildings, and other infrastructure that is exposed to flooding.
6. Exacerbation of desertification by changes in rainfall and intensified land use.



Paul Mayan Mariao (left). Photo: Jane Beesley, Oxfam.

“The weather is changing. We used to get heavy rains when the winds came from the west and then came back 2–3 days later with rain. Now the wind comes from the east so it brings little or no rain... these are dry winds. I don't know what is causing this. Maybe all this fighting in Iraq and Iran, all this bombing and pollution, bombing the oil fields and all those fumes going into the air... and we're not very far from that.”¹⁴

Paul Mayan Mariao, Chief Kaikor, Turkana

Niger – new approaches to poverty and climate change

Drought hit Niger hard in 2004/2005. Given that it can take decades for livestock herds to recover to previous levels of size and health, many pastoralist communities have never fully recovered from the disasters of the early 1970s and mid-1980s. By December 2005 over 326,000 malnourished children were being given special feeding in Niger, and thousands more in neighbouring countries.

Increasing aridity is a terrible problem, but people's problems in coping with it are due as much or more to social and political factors. Ongoing poverty, low literacy rates, and little access to basic health services combine to weaken people and are reflected in shockingly high child-mortality and malnutrition rates, even in normal times. In the Sahel, one child in five will die before reaching the age of five. Grain markets are unstable and function badly. During the 2005 famine, grain was often available in markets, but few could afford to buy it.

Another factor is the developed world's failure to deliver aid predictably and in accordance with its commitments. Sahelian countries receive far less aid than other African countries affected by food crises. Annual aid to Niger, one of the world's poorest countries, actually fell from \$60 per person in 1984, to \$44.2 per person in 1992, \$28.7 in 1998 and finally to a mere \$12 per person in 2004. The UN has recommended that countries get \$45 per head in order to have a chance of reaching the UN Millennium Goals by 2015.¹⁵



Emergency feeding, Niger, 2005.
Photo: Glenn Edwards, Oxfam.



Vouchers for food in Niger, a new approach to relief. Photo: Glenn Edwards, Oxfam.

Aid agencies, like Oxfam, working in Niger, have pioneered new responses to drought – such as calls for less foreign food aid and more direct transfers of cash vouchers into people’s hands to enable them to buy the local food that is available on the markets. To help in the long term agencies are working with local non-governmental organisations like JEMED, a partner of Tearfund, to trap rainfall and boost agriculture. Simple structures that capture rainwater – stone lines or earthen half-moon crescents, mini-dams and dykes – can give communities an extra three months worth of water per year.

Jeff Woodke of JEMED (Youth with a Mission) said:

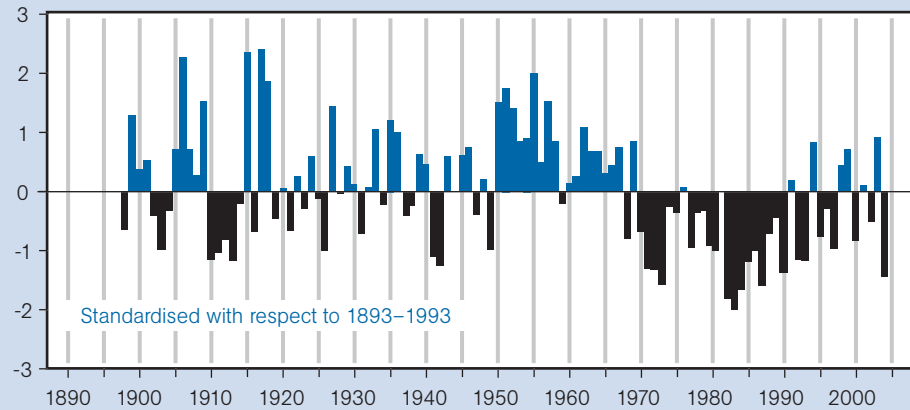
‘The changed rainfall patterns contribute to increased desertification. The decreased production of grass means that it can sustain fewer animals. Drought causes massive loss of livestock. This has a devastating effect on the pastoral people, both Tuareg and Wodaabe, who rely on livestock for their livelihood. It creates chronic food security problems, and great social ones as well.

At one site called Abrik, a valley that runs east-west serves as a dividing line between the “dead” land to the north, and the “living” land to the south. The northern land is “dead” because of desertification, which has climatic as well as human causes. The valley itself was dying as well. We were able to reverse this process and help the people to adapt to the changing rainfall patterns, for example through building dykes. But then drought struck. For two years the men had to be away from their families, struggling to keep their animals alive. Some men did not see their families for six months at a time. However in spite of all this, the improvements they made in the valley allowed some grass to grow and they could feed a few animals. The women stayed put, and the children stayed in school. The school was one of the most successful in Niger that year.’



Half-moons, Niger. Photo: Dieudonne Bira.

Figure 1: Standardised JJASO-mean Sahel rainfall 1898-2004.



Source: Joint Institute for the Study of the Atmosphere and Ocean¹⁷

Sahelian drought – past, present and future

There were three major droughts in the Sahel – the semi-arid belt just south of the Sahara Desert – in the twentieth century: 1910–11, 1941–45 and 1983–84. The 1950s were unusually very wet, and then a severe drying trend began in the late 1960s and continued into the 1980s. The big downswing in rainfall in the 1970s struck many Sahelian farmers and pastoralists particularly hard and there were an estimated 100,000 human drought deaths. Then the great drought in the mid-1980s triggered the famine in Ethiopia that shocked the world. From the high of 1950s to the low of 1980s, rainfall declined by 40 per cent – “the most substantial and sustained change for any region of the world within the period of instrumental measurements”.¹⁶ In recent years Sahelian rainfall has been more stable and has recovered to near the century-long mean.

There are many gaps and deficiencies in climate records in Africa. Computer models struggle to account for all the influences on the climate. There have been conflicting scenarios and the models do not go down to local levels. But the understanding of climate change and the models themselves are getting better all the time.

Scientists concur that sea-surface temperatures (SST) control many aspects of Sahel rainfall variability. If the waters of the southern Atlantic warm up, while the northern Atlantic cools, then the rain belt, whose northern limit is the Sahel, is attracted further south and so does not reach the Sahel. Instead, rainfall in parts of equatorial Africa increases, as it did in the twentieth century, by 10 per cent or more in places.

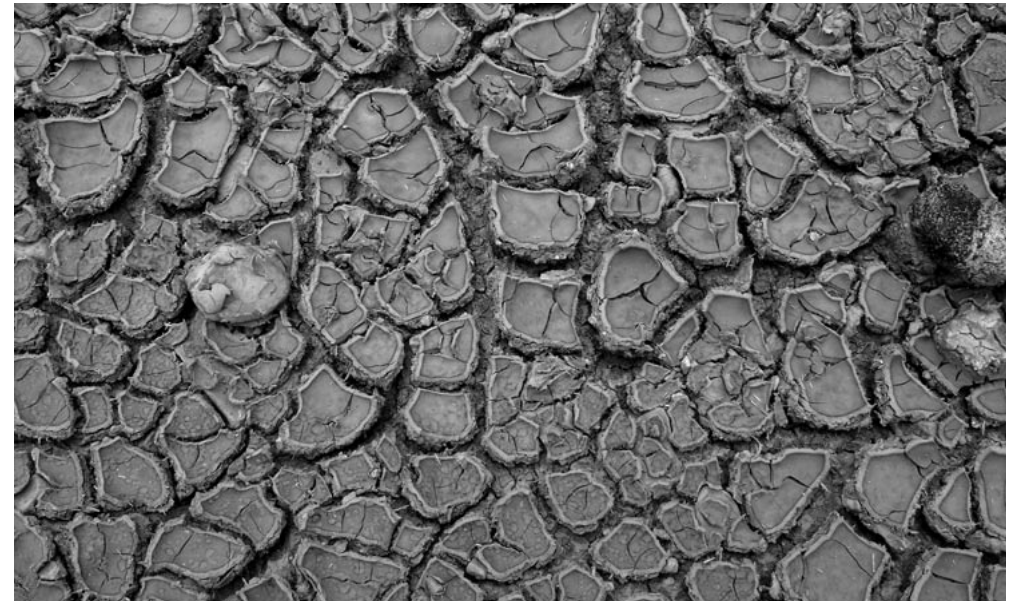


Photo: Jane Beesley, Oxfam

SSTs are rising all over the world. The warming is well beyond the range expected from natural processes, which strengthens the case that greenhouse gases are involved.

Climate models have generally forecast a wetter Sahel in the future, which should be good news. But in October 2005 Dr Isaac Held from the US National Oceanic and Atmospheric Administration (NOAA) and other scientists published dramatic new research findings that challenge this. Their model, which maps the Sahel's actual previous climate changes more closely than others, predicts that the 'more recent ameliorating trend' may continue for the first few decades of this century but will be followed by dramatic drying – a 30 per cent reduction in rainfall from the average for the last century and 'due primarily to increasing greenhouse gases'.^{18,19}

Drought in southern Africa is related more to warming in the Indian Ocean, which has warmed more than 1°C since 1950. Rather than falling over the land, rain develops in the rising air above the warm ocean. Between 1950 and 1999 there was about a 20 per cent decline in summer rainfall.²⁰ It also tended to come in the form of torrential rain.²¹ Even a 10 per cent drop in rainfall can reduce river flows by 50 per cent or more.²² Other studies project a much drier future for southern Africa. According to Dr James W Hurrell: 'In our models, the Indian Ocean shows very clear and dramatic warming into the future, which means more and more drought for southern Africa. It is consistent with what we would expect from an increase in greenhouse gases.' Rural areas, where people rely on streams and small rivers, will be particularly hit; women, the water-carriers, will be far more affected than men.

El Niño impacts

Perhaps the biggest influence on global climate is the SST fluctuation known as *El Niño*, when a large area of the central and eastern equatorial Pacific becomes warmer than normal.

One of the biggest *El Niños* recorded –1982/83 – was linked to the devastating drought in the Horn of Africa. Another *El Niño* caused massive floods in some parts of eastern Africa in 1997/98 (in Kenya alone, damage to roads came to US\$17 billion); its counterpart, *La Niña*, which followed, brought a long drought to the sub-region lasting from 1998 until 2000.

The relationship between greenhouse gas concentrations and *El Niño/La Niña* specifically is little understood but if, as has been suggested, *El Niño* is a 'release valve' for tropical heat then global warming may well intensify it. Recent research indicates that *El Niños* have been more intense since 1900 than at any time in the last 130,000 years.²³ More "Super" *El Niños*²⁴ like 1982/3 and 1997/8 would furthermore come on top of the general warming which, given Africa's vulnerability, is steadily eroding people's capacities to cope. 2005, the hottest year on record and a year of severe drought in both East and West Africa, was not an *El Niño* year.

An interview from Ethiopia



Mrs Suufee Mulata, Sire Baabo Village, Ethiopia²⁵

Mrs Suufee, aged 62, is a widow living with her 31-year-old son who has five children in Sire Baabo village, Ethiopia. Her husband died recently. Her elder son also lives nearby and has eleven children. The family cultivates three hectares on which they grow sorghum, maize, teff, and wheat.

Mrs Suufee has noticed definite changes in the local climate. The amount of rainfall has been reduced and it tends to be erratic. In particular, the sorghum-growing season has been getting shorter and shorter. Ideally, sorghum does best when rainfall starts in early February and continues until October. Nowadays, the earliest rain may not start until April. In her experience, they get two or three good years followed by one or two bad years. For the most part the rainfall is adequate for the vegetative growth stage but stops early at the heading and flowering stages in September. During those years, yields are

almost halved. Hailstorms also damage crops sporadically. Villagers report increased malaria, typhus and *Trypanosomiasis*, which claimed the lives of six oxen and several cows belonging to Mrs Suufee. In her view, the weather has not got back to normal since the severe drought of 1984/85.

Climate change and desertification

There has been debate around the relative contributions of human mismanagement of natural resources and that of global climate change as causes of drought. The pendulum of scientific opinion now seems to have swung towards the view that external and global factors are relatively more important influences on African climates, especially via SSTs.

According to Held: 'An externally forced drying trend... attributable to anthropogenic [i.e. man-made] forcing' has been superimposed onto internal variability. But the two are related. Klaus Toepfer points out that 62 per cent of precipitation occurs over land as a result of evapotranspiration from lakes, wetlands and dense vegetation, in particular forests. **Drying causes people to adopt more desperate strategies to survive.** Deforestation, causing land degradation and desertification, leads to a spiral: less moisture in soils and in greenery means less rainfall, which means less vegetation and so on. It has been argued that the effects are not simply local, and that tree felling as far afield as the Congo affects rainfall in the Sahel, hundreds of miles to the north. Deforestation accounts for between 20 and 30 per cent of all greenhouse gas emissions worldwide and has devastating effects on both biodiversity and local communities.²⁶

Habiba Hassan, from central Somalia, says:

'No-one is going to survive out here, unless they bring water. I am 70 years old now, and the temperatures are getting hotter and hotter as the years pass by. We cut down trees so we can make some money from charcoal, but those areas that we cut are turning to desert.'

The Boston Globe reports that everyone in her village knew the reason for the drought. 'It's global warming' she said, adding that villagers had learned much about the potential effects from climate change from radio programmes aired on the BBC's daily Somali Service. 'In the past, this season was very hot during the day and cold at night. Now the temperature seems to be equal day and night. At night, we have to sleep outside, it's so hot.'²⁷



People bringing their weakened animals to an Oxfam destocking programme. Photo: Jane Beesley, Oxfam.

Three case studies from Kenya

Turkana: new approaches to relief

In 2005/06 some 25 million people faced a serious food crisis across sub-Saharan Africa, 11 million of them in East Africa. Cows and goats, even camels, died in vast numbers. In East Africa, Oxfam alone provided food and water to over 700,000 people in one of its biggest humanitarian operations. The crisis in Turkana district in north west Kenya, and the stories of some of the people involved, appeared in the first *Up in smoke?* report in 2004 and in *Africa – Up in smoke?* in 2005.

The Turkana have names for the increasingly frequent droughts. The latest has been called *Atiaktiak ng'awiyei* or 'the one that divided homes' because so many families split up to survive, migrating in all directions to the borders, towns and relief camps. They say that there has been, in effect, an almost continuous drought problem since 1999 when the *Kichutanak* drought. *Kichutanak* means 'it has swept away everything, even animals'. Hassan Mahmood, one pastoralist, said: '

This drought has no comparison. No other drought has been like this. It's all encompassing. All regions are affected; there is no place to escape, everywhere is dried out.'

Previous droughts happened in 1992–95 (*Longuensil* or 'when the man with no legs from Oxfam came', a reference to an Oxfam member of staff with a disability), 1979–80 (*Lopiar* or 'sweeping everything away'), 1970 (*Kimududu* or 'the plague that killed humans and livestock') and 1960 (*Namotor* or 'bones exposed').

To survive the droughts, people have had to resort to practices that damage their dignity and security, their long-term livelihoods, and their environment, including

large-scale charcoal production that intensifies deforestation, fighting over water and pastures, selling livestock, and dropping out of school.

And yet, even though droughts are becoming more intense and more frequent, it is primarily politics that explains the increasing inability of many pastoralists to cope with what the climate throws at them.

The arid and semi-arid lands of Kenya make up more than 80 per cent of the country and are home to over 30 per cent of its population and more than half of its livestock. Yet nomadic pastoralists are some of the most under-provided-for and politically under-represented people in East Africa. Lacking education and health care for themselves and their children, water provision and veterinary care for their animals, or help in marketing skins and animal products, means that they lack alternative income opportunities and place increased pressure on the environment.

Oxfam and others argue that if the Kenyan Government makes good on its promises to promote sustainable development in the arid and semi-arid lands, and also creates a national drought contingency fund, pastoralism could still, despite climate change, be not only a viable way of life, but a profitable one, too.²⁸

Aid agencies like Oxfam and Practical Action are also calling for new, creative and dignified approaches to emergency relief, including less food aid from abroad. One new approach used by both agencies is a 'meat aid safety net' or 'off-take'. In this, people sell their weakest animals – usually goats that would die in the drought – to the agency for a fair, fixed price. The animals are slaughtered and the sellers receive both the meat and the hide, which they can sell on. These schemes have been very successful. People receive a good price for what would otherwise be an almost worthless animal, money they can use to buy food, to pay off debts or to restock. The money stays in the local economy. Women often use the money to buy school uniforms, which means their children can then go to school, not only enabling them to resume their education, but providing them with school meals. People's main diet is meat, so the system ensures people receive their preferred food, rather than maize and beans that require lengthy cooking using a lot of fuel wood. Finally, destocking reduces grazing pressure on the dry land. Other interventions include cash for work, direct cash relief to the most vulnerable, provision of veterinary services, and seed distributions.

Sesophio, a Maasai pastoralist from Ololosokwan village, Ngorongoro, Tanzania (pictured), said:

*"It is this development, like cars, that is bringing stress to the land, and plastics are being burnt and are filling the air. We think there is a lot of connection between that and what is happening now with the droughts. If you bring oil and petrol and throw it onto the grass it doesn't grow, so what are all these cars and new innovations doing to a bigger area? Every day diseases are increasing... diseases we haven't seen before."*²⁹



Sesophio, youth chief, Ololosokwan, Ngorongoro, Tanzania. Photo: Jane Beesley, Oxfam.

Isiolo: Conflict over water

In Kenya's Isiolo District, Sambarwawa is a place where groups of pastoralists congregate in times of drought. Each group is allocated a space on the dry riverbed to dig a shallow well for water. They are allowed to bring their animals to drink here once every four days. 'It's a sort of cafeteria system to ensure everybody has a chance to get water for their animals,' says local leader Wako Liba. But the system has been under extraordinary strain because of almost a decade of drought. By December 2005, some 10,000 herders with 200,000 animals had descended on tiny Sambarwawa, many trekking 400km from the epicentre of the drought in the east

in Turkana and Wajir. Although the village had not seen rain for a year, they knew they could still find water under the riverbed. But then the shallow wells began to dry up.

'As the water level dropped, I foresaw conflict,' says Liba. 'Some herders started encroaching on boreholes owned by different communities. As one group pushed to water its livestock, another moved to restrict access to the few boreholes that had enough water.' As the drought intensified, the pressure finally led to killings.

'Gunshots reverberated the whole night,' Liba recalls. 'By the time I came down, seven people had died. There were dozens of injuries. Animal carcasses littered almost a kilometer stretch of the valley.' David Kheyle, 37, was queuing for water when fighting broke out. 'There was grumbling that evening. A good number of boreholes didn't have water so the queues were relentless,' he says. 'People were becoming impatient. Suddenly there was a scramble at the northern end of the valley... it was a free-for-all. But it later took on an ethnic dimension when people aligned with their kind to defend themselves.'

Edwin Rutto of the Africa Peace Forum, says that there is an 'established correlation between drought and violent conflict'. With recurring droughts associated with climate change, poor pastoralists are stuck in an ever-tightening poverty-trap. 'After people go through a period of relative recovery, then another drought hits. People are living in a state of perpetual suffering,' says Rutto.³⁰

Tharaka: The canal that ran dry

Joshua Musyoki-Mutua has every right to be worried about his future. Out of 300 farmers who grew crops around him a decade ago, he is now one of only two who remain – a fact he blames on global warming.



Dry waterhole, Turkana. Photo: Jane Beesley, Oxfam.

The 36-year-old, who grows chilli, egg plants, green peppers and other crops for the local and export market, remembers when the land around his plot in Mitoandei in Tharaka District in central-south Kenya was an oasis of green. Now that has changed.

The farms were irrigated from a nearby canal, which in 1982 flowed for 7km. But now the levels of rainfall have dropped and the water only travels half a kilometre, forcing hundreds of farmers to abandon their farms and livelihoods.

'I would estimate we now get 40 per cent less rain than we used to,' says Joshua. 'Many farmers have left, mainly because the water no longer runs along the canal like it used to. These people now have nothing. They are destitute. Therefore, climate change is increasing poverty.'

However Joshua says the government and international community could help him and other farmers get back on their feet with irrigation systems and advice on water management. But, he adds, basic work on the current canal could also be a lifeline for fellow farmers.

'In the past there was enough water to compensate for what leaked out of the canal,' he explains. 'That is no longer so, now every drop is very important. Making the canal watertight and improving the dam which serves it could dramatically improve the distance the water flows. With water people could work to get themselves on their feet again. Without it, they can do nothing.'³¹

Promoting sustainable agriculture

While some agricultural areas may benefit from increased rainfall and carbon dioxide fertilisation, estimates suggest climate change will reduce crop yields by 10 per cent over the whole of Africa and even more in localised regions: a 33 per cent reduction in maize in Tanzania; millet down between 20 and 76 per cent and sorghum down between 13 and 82 per cent in Sudan.³² In Africa, 70 per cent of the working population relies on agriculture to make a living, the majority of them women farmers and cultivators. Due to their efforts, agriculture contributes 40 per cent of the continent's collective Gross Domestic Product. At the same time, external development aid to agricultural production in sub-Saharan Africa declined by 43 per cent between 1990–92 and 2000–02, from an average of \$1.7 billion to an average of \$975 billion, although it has shown a slight recovery since.³³

Conservation farming raises yields ten-fold in Zambia

The Evangelical Fellowship of Zambia (EFZ) a Tearfund partner, is training people to use a technique known as 'conservation farming', which has helped communities in the Monze East area deal with changing rainfall patterns and boost self-sufficiency in the face of drought. This is vital in an area that has recorded the lowest river water levels in 12 years and in a country where 17 per cent of the population is HIV+ (and thus often forced to spend what scant resources they possess on medicines, or are too ill to work) and which has more than 1.5 million orphans.

Conservation farming is a minimum-tillage method that traps moisture, improves the quality of the soil, minimises soil erosion and creates growing conditions that exhibit a high drought tolerance. There is typically a ten-fold yield increase associated with this method. Conservation farming lessens the farmers' reliance on rain as crops can utilise the moisture trapped in the soil.

It is different from traditional farming patterns because it requires sustained periods of moderate activity on the farmers' part rather than short periods of intense activity. This has enabled many to continue to farm (and so feed their families), many who would otherwise be too frail to cope with the traditional ways of working the land. This is particularly beneficial for women who are increasingly responsible for agriculture.

By encouraging farmers to diversify, EFZ helps to ensure that yields remain high even in times of low rainfall. In some years, Conservation farming of maize alone isn't enough to ensure adequate food for people. When this happens, diversification acts as a vital coping mechanism. For example, cash crops can be grown and then sold to purchase food. Herb cultivation is also being actively encouraged as herbs can be used to make home remedies to boost sufferers' immune systems. The yield increases

have been sufficiently large that farmers are creating community grain stores to provide for the most vulnerable members of communities.

Reversing desertification in Senegal

Another impressive project with big implications for African agriculture has been taking place in the Sebikotane area of Senegal. Since the 1970s Senegal has suffered successive droughts, a progressive southwards shift and reduction in rainfall (by 30–40 per cent), falling groundwater tables, and soil degradation. In addition, the Sebikotane area is near the coast and exposed to strong winds that blow away the soil.

A pilot farm there has shown, however, that it is possible to 'produce the environment' – to create a new environment, even reversing desertification, and to increase production and earnings as a result. One way in which the farm does this is through agroforestry. Trees planted in dense perennial hedges act as windbreaks, protecting soils and creating microclimates suitable for a variety of crops. Drip-irrigation-based commercial crops have replaced traditional predominantly rain-fed forms of agriculture earning growers more money. The windbreaks also provide valuable fuel wood for cooking, lessening the burden on girls and women to collect wood. Many farmers who have passed through the Sebikotane pilot farm have gone home to replicate the techniques learned on their own land.

According to Moussa Seck of the Senegalese NGO *Environnement et Développement du Tiers-Monde* (ENDA-TM), it is vital to think longer-term. Current cycles of adaptation programmes, typically three to five years, are not long enough. Learning to use the Sebikotane system takes a long time and similar adaptation programmes must be given long-term commitments.³⁴

Climate change and HIV/AIDS: the insidious links

The association between climate change and HIV/AIDS is by no means direct, but it is insidiously real. AIDS has led to lowered productivity as more and more farmers are infected and affected. Many survivors have to spend time attending funerals, looking after orphans, or managing the estates of the deceased. Absenteeism from school and work is common. At the same time, unreliable rain patterns, which are becoming a permanent feature in many parts of the country, have led to massive crop failures of such magnitude as to lead to severe malnutrition, which accelerates the negative effects of the disease and poverty. Girls suffer disproportionately; to survive girls may be forced into early marriage or prostitution. Many rural folk migrate to towns where they are more likely to get infected. In Monze District of Zambia a new research project aims to better understand the links between climate change, drought, and HIV/AIDS. Energy and Environmental Concerns for Zambia is conducting the research with Dutch funding, in collaboration with the World Bank Development Economics Research Group.³⁵

The threat to health

The strong association between climate change and increased disease was outlined in a seminal paper in the magazine *Nature* (November 2005). American academic Professor Jonathan Patz and others showed how diseases associated with climate change hit poor people, with sub-Saharan Africa being the worst affected.

Christian Aid has taken this work further to project how many people might die from disease associated with climate change by the end of the century in sub-Saharan Africa – an estimated 182 million people.³⁶

Table 1: Burden of climate change attributable disease in sub-Saharan Africa

<i>Cause of climate change attributable disease</i>	<i>Disease burden (measured in disability-adjusted life years attributable to climate change in 2000)</i>
Diarrhoea	260,000
Malaria	682,000
Floods	3,000
Malnutrition	323,000
All causes	1,267,000

Farming food or biofuel?

As regional instabilities and dwindling oil supplies send fuel prices higher, political leaders and businesses are scrambling to secure energy supplies. Attention is turning to biological sources, such as crops and trees, and climate change is adding extra impetus. Plants absorb carbon dioxide through photosynthesis. When burnt they simply emit what they have already absorbed and – in theory – no additional carbon dioxide enters the atmosphere.

For developing countries, shifting towards large-scale export-led biofuel crop production will have big impacts. Some could be positive – increased earnings for farmers, farm labourers and exporters. But who benefits depends, like any commodity, on who has power in the markets. Malawi is cultivating *Jatropha* trees for biodiesel, often in areas previously under tobacco cultivation. It is early days yet; too early to see whether the new trees will maintain similar employment levels; many poor people depend on tobacco picking for wage labour.

South Africa has a string of biofuel initiatives, and other countries are rapidly getting involved, too. Nigeria, Africa's largest crude-oil producer, has projects with the Renewable Energy Efficiency Partnership to cultivate cassava and sugarcane for biodiesel and Ghana has a biodiesel refinery for its 20,000 hectares of biodiesel plantation.

One big problem is that, in practice, many sources of biofuels offer negligible or negative carbon savings because the growing and conversion process from crop to fuel is itself energy-intensive and cancels out the carbon gains of plant growth.

But a bigger issue is that a proponent of biodiesel like Jeff Schafer estimates that even if high-yield biofuel crops replaced food crops entirely and were grown on all the farmland on Earth, they would only meet 20 per cent of current crude-oil energy demands. Car ownership is soaring and now contributes about 20 per cent of global carbon dioxide emissions. It seems the world has a choice: reduce car use or dramatically expand the area cultivated for biofuels – mainly to grow fuel for affluent countries – with all that could imply for food production.³⁷

Urban perspectives on climate change

The population of Lagos, Nigeria, is likely to grow to 16 million by 2015, making it the world's eleventh-largest urban system. One of the first sights that greet the visitor arriving after dark is the fumes and smoke swirling around the headlights of gridlocked traffic on the miles-long Third Mainland Bridge. The acrid smell of exhaust fumes stings the nose and mingles with the overpowering smells from the city's largest slum,

consisting of rudimentary shacks built on stilts above the water. Massive influxes of new residents are largely uncontrolled and completely exceed the capacity of existing infrastructures. Seventy-two per cent of the citizens in the cities of sub-Saharan Africa live in slums.³⁸

The major danger to people in cities like Lagos will probably be from extreme events, such as increased storm surges (related to increasing average sea-levels) and temperature extremes (related to increasing average temperatures). Increasing temperatures will also compound the problems associated with local air pollution and increase the risk of heat-stress related deaths. Water supplies – precarious in urban slums at the best of times – may be disrupted. The impacts of climate change on rural areas may further increase the pressures already causing the rural poor to migrate to the cities.

Ultimately, the process of tackling climate change for a city such as Lagos cannot be viewed as a separate issue in itself; there are simply too many other priorities. Climate change will need to be framed in the context of achieving a sustainable development pathway that includes poverty reduction and environmental protection. A transition to a low-carbon economy is desirable – developing new industries supplying renewable energy technologies or low-carbon transport systems.³⁹

Better bricks need less fuel

One example of the many innovative, home-grown technologies that are being employed by Africans to solve environmental problems comes from Uganda. There the Appropriate Technology Centre in Mbale, in conjunction with Makerere University, Kampala, has been disseminating the use of interlocking stabilised soil blocks across the country and further afield.

The bricks are made primarily from ordinary soil with a small portion of cement and compressed in a manually operated pressing machine. The bricks are then dried in the sun before use. This totally removes the need to fire them, which uses great quantities of wood.

Furthermore, the bricks interlock so that structures can be built using only a small amount of cement to hold them firmly and safely together. The pressing machines can make bricks that are straight or curved; straight for construction of houses and other buildings and curved for the construction of cheap, easy-to-build water-storage containers.⁴⁰

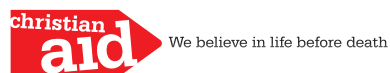
Endnotes

- 1 *The Economist* 1 January 2005.
- 2 Simms A (2005) *Africa – Up in smoke?* (London: nef and IIED) www.neweconomics.org or www.iied.org [4 October 2006].
- 3 Stop Climate Chaos www.stopclimatechaos.org
- 4 Simms A (2006) *Up in smoke? – Latin America and the Caribbean* (London: nef and IIED).
- 5 Global Environment Facility (GEF) Council, (June 6-9, 2006), Agenda Item 13, Status Report on the Climate Change Funds.
- 6 *Clean energy and development: towards an investment framework*, April 5, 2006 draft, p. 33. World Bank/IMF: New York.
- 7 Mayne R (2006) *Causing Hunger: an overview of the food crisis in Africa*, Oxfam Briefing Paper 91, July 2006. (Oxford: Oxfam International). http://www.oxfam.org.uk/what_we_do/issues/conflict_disasters/bp91_hunger.htm [4 October 2006].
- 8 *Ibid.*
- 9 www.irinnews.org interview with Klaus Toepfer, Nairobi, 14 March 2006.
- 10 IPCC, 2001.
- 11 Christian Aid (2006) *The climate of poverty: facts, fears and hope*. (London: Christian Aid). www.christian-aid.org.uk/indepth/605caweek/index.htm [4 October 2006].
- 12 See for example the findings of the ADAPTIVE project featured in *Africa – Up in smoke? op. cit.*
- 13 Source: Modelling the recent evolution of global drought and projections for the twenty-first century with the Hadley Centre climate model. Burke, Brown and Christidis, Hadley Centre for Climate Prediction and Research. Contact eleanor.burke@metoffice.gov.uk
- 14 Source: Oxfam.
- 15 Berton H 'Food security interventions in West African Sahel', Presentation to Oxfam (Niger: Oxfam).
- 16 Kelly M and Hulme M (1993) 'Desertification and climate change' *Tiempo* Issue 9. www.tiempocyberclimate.org/floor0/archive/issue09/t9art1.htm [4 October 2006].
- 17 Source: <http://jisao.washington.edu/data/sahel/> [4 October 2006].
- 18 Held IM, Delworth TM, Lu J, Findell KL and Knutson TR (2005) 'Simulation of Sahel drought in the twentieth and twenty-first centuries' *Proceedings of the National Academy of Sciences* (PNAS), 13 December 2005, 102: 50. www.pnas.org/cgi/doi/10.1073/pnas.0509057102 [4 October 2006].
- 19 Black R (2005) 'Climate change will dry Africa' BBC News (Science/Nature), 29 November 2005.
- 20 NCAR (2005) 'A continent split by climate change: new study projects stronger drought in southern Africa, more rain in Sahel', 24 May 2005, citing Hurrell and Hoerling, National Center for Atmospheric Research. www.ucar.edu/news/releases/2005/hurrell.shtml [4 October 2006].
- 21 Ambenje PG (2001) 'Climate change and extreme weather/climate events: data needs for monitoring of land and atmospheric extremes'. GCOS Regional Workshop 3–5 October 2001, Kisumu, Kenya.
- 22 de Wit M and Stankiewicz J (2006) University of Cape Town, *Science Express*, March 2006, cited in IRIN News, 14 March 2006, 'Environmental Health key to decreasing incidence of drought'. http://www.irinnews.org/report.asp?ReportID=52190&SelectRegion=East_Africa,%20Horn_of_Africa [4 October 2006].
- 23 Kirby A (2001) 'Coral shows El Niño's rise' BBC News (Science/Technology), 25 January 2001, citing research by Dr Sandy Tudhope and Prof. David Lea.
- 24 Hansen, Sato, Runedy, Lo, Lea, Medina-Elizade, *Proceedings of the National Academy of Sciences of the USA*, September 26, 2006.
- 25 Source: Tearfund.

- 26 The immense ability of humans to influence the climate is illustrated by the reasons for the cooling of the North Atlantic. SSTs were altered partly by greenhouse gases and partly by pollutants – particularly sulphate particles – in the atmosphere in Northern latitudes that reflected sunlight. These cooled the Northern hemisphere, and rains were drawn southwards away from the Sahel. Since clean air legislation the North Atlantic has warmed up and rainfall has moved in response and recovered somewhat. If greenhouse gases warm the Northern hemisphere more in the future, it might be expected that this wetting will continue, but Held's model predicts that increasing greenhouse gases will cause a general heating that overrides this and leads to dramatic drying in the twenty-first century.
- 27 *The Boston Globe* 20 February 2006.
- 28 Kirkbride M (2006) *Delivering the agenda: addressing chronic under-development in Kenya's arid lands* Oxfam Briefing Paper 88 (Oxford: Oxfam International). http://www.oxfam.org.uk/what_we_do/issues/livelihoods/downloads/bp88_kenya.pdf [4 October 2006].
- Huser K and Kirkbride M (2006) *Making the case: a national drought contingency fund for Kenya, 2006* Oxfam briefing paper 89. http://www.oxfam.org.uk/what_we_do/issues/conflict_disasters/downloads/bp89_kenya.pdf [4 October 2006].
- 29 Source: Oxfam.
- 30 Christian Aid, *ibid*.
- 31 Source: Practical Action.
- 32 Tanzanian submission to the IPCC quoted in: Murray L and Orindi V (2005) *Adapting to climate change in East Africa: a strategic approach*. Gatekeeper Series 117 (London: IIED).
- 33 Source: OECD, quoted in Mayne (2006) *op. cit*.
- 34 Seck M, Mamouda MNA and Wade S (2005) 'Adaptation and Mitigation through produced environments: the case for agricultural intensification in Senegal' in Yamin F and Huq S eds (2005) *Vulnerability, adaptation and climate disasters*, p71–86, IDS Bulletin, 36(4) (Brighton: Institute for Development Studies) <http://www.ids.ac.uk/ids/bookshop/bulletin/bull364.html>
- See also id21News Number 210, 'Changing farming systems to adapt to climate change in Senegal', September 2006: www.id21.org/society/s3ms1g1.html [4 October 2006].
- 35 Pablo Suarez, Department of Geography, Boston University, suarez@bu.edu
- 36 Patz *et al.* 2005, cited by Christian Aid, *ibid*.
- 37 Source: Panos.
- 38 www.kutokanet.org
- 39 Source: Columban Faith and Justice.
- 40 Ashden Awards, www.ashdenawards.org



Supporting organisations (The Working Group on Climate Change and Development)



Written and compiled by: John Magrath, Programme Researcher, Oxfam, with the assistance of Andrew Simms, policy director of **nef** (the new economics foundation) and the support of and material supplied by fellow members of the Working Group on Climate Change and Development.

Thanks are also due to: all the active members of the Working Group on Climate Change and Development, Saleemul Huq, Beth Hughes, Petra Kjell, Ruth Potts and the Ashden Trust for ongoing support and encouragement.

Cover photo: Crispin Hughes, Oxfam

Edited by: Mary Murphy **Design by:** the Argument by Design – www.tabd.co.uk

new economics foundation, 3 Jonathan Street, London SE11 5NH, United Kingdom
Telephone: +44 (0)20 7820 6300 Facsimile: +44 (0)20 7820 6301
E-mail: info@neweconomics.org Website: www.neweconomics.org

International Institute for Environment and Development
3 Endsleigh Street, London WC1H 0DD, United Kingdom
Tel: +44 (0)20 7388 2117 Fax: +44 (0)20 7388 2826
E-mail: info@iied.org Website: www.iied.org

Published by **nef**, October 2006
Registered charity number 1055254 ISBN 1 904882 17 X