

**DIRE**  
DRIER  
**HOTTER**  
HUNGRIER

# POVERTY AND A PARCHING PLANET

**CLIMATE  
CHANGE  
SERIES**

**PART I**  
FOOD AND  
WATER SECURITY

“ More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics. ”

—Intergovernmental Panel on Climate Change, Fourth Assessment Report 2007

water  
is  
life

**Sri Lanka:** Child filling water container during tsunami relief operations

Photo: Stefan Trappe

# POVERTY AND A PARCHING PLANET

Turn on a water tap in front of a child in any country of the world, and the same thing happens: The child delightedly reaches out to put his or her hand into the stream and play. Children take pleasure in water! When it is scarce or absent, they are the first to suffer. Over recent decades, water scarcity has become more frequent, and scientists are observing a process of increased parching. Climate change is the dominant driver. The challenges to food and water security in the 21st century are unprecedented. The United Nations Development Programme estimates that unchecked, by 2080 climate change may increase the number of malnourished people by 600 million and increase the number of people facing water scarcity by 1.8 billion. Combine these forecasts with current trends in precipitation patterns, population growth, urbanisation, higher per capita calorie intake, and increasing meat consumption, and it is a recipe for disaster, with enormous potential for conflicts over water resources. With more than half a century of experience working in many of the most food and water insecure countries, World Vision is committed to helping the poorest adapt to a drier and potentially dire future. This publication explores ways and means.

# GRATEFUL ACKNOWLEDGMENT

We wish to thank the following individuals and organisations for their contributions.  
Without your generous help this publication would not have been possible. Thank you!

## Individuals

Jen Orange, Catherine Johnston, Rachel Coghlan, Michael and Sarah Lawrence, Wendy Barrón Pinto, David Mayer, Peter Ampt, Sue Stevens

## Organisations

Monash University  
University of New South Wales, Institute of Environmental Studies

## Production

Printed on recycled paper

## ISBN

978-0-9807094-4-5

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## Poverty and a Parching Planet © 2009 World Vision International

For a list of errors or omissions found subsequent to printing,  
please visit our website at: <http://worldvision.com.au>

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Cover Photo: Composite of NASA and Dale Robins/Stockphoto images

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Around the globe World Vision is witnessing first hand the devastating impact of climate change on poor communities. Governments, non-governmental organisations and communities are grappling to adapt to new threats and their impacts. We have much to learn. In this series of publications, World Vision is seeking to identify concrete responses to climate change both at the programming and policy levels.

# LIST OF ACRONYMS

ACIAR – Australian Centre for International Agricultural Research

CDM – Clean Development Mechanism of the Kyoto Protocol

CGPRT – Coarse Grains, Pulses, Roots and Tubers

FAO – Food and Agricultural Organization of the United Nations

FFS – Farmer Field Schools

FMNR – Farmer Managed Natural Resource

GDP – Gross Domestic Product

GNI – Gross National Income

IFPRI – International Food Policy Research Institute

IFSA – Integrated Farming and Sustainable Agriculture Project

IPCC – Intergovernmental Panel on Climate Change

KIOF – Kenya Institute of Organic Farming

LULUCF – Land Use, Land Use Change and Forestry

NGO – Non-Government Organisation

PNG – Papua New Guinea

PMG – Producer Marketing Group

SSF – Subsistence and Smallholder Farming

UNEP – United Nations Environment Programme

UNFCCC – United Nations Framework Convention on Climate Change

All amounts shown in \$ are U.S. dollars unless otherwise indicated

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# DIRE DRIER

Photo: NASA Terra Satellite, Pixel size: 250m

*“Climate change will make it harder to manage the world’s water. People will feel many of the effects of climate change through water. The entire water cycle will be affected. While the world as a whole will get wetter as warming speeds up the hydrological cycle, increased evaporation will make drought conditions more prevalent. Most places will experience more intense and variable precipitation, often with longer dry periods in between. The effects on human activity and natural systems will be widespread.”*

—World Bank, World Development Report 2010

**Western South Africa:** These images from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite show South Africa's Western Cape province on 21 July 2002 (left) and 21 July 2003 (right).

## Executive Summary

*“The poor do not have the necessary technology and resources, in terms of money and so on, to be able to change and adapt... We can only succeed to adapt to climate change if we fight poverty effectively and generate the resources needed for the purpose.” (Ethiopian Prime Minister Meles Zenawi, speaking at a national climate change conference in Addis Ababa, 16 January 2009) <sup>(1)</sup>*

**Dire And Drier:** Evidence is fast accumulating that the problem of climate change is of a scale not previously encountered by human societies. The scale and scope of climate change challenges to food and water security are unprecedented. World food supply is already facing significant pressures. Even without climate change, ensuring sufficient food for all in the 21st century would be difficult enough. Climate influences food security through many channels. Climate change will increase the severity and frequency of cyclones, flooding and drought. It will intensify rainfall variability, increasing water stress, weeds, pests, and erosion and reducing soil fertility. Above certain temperature ranges, crops develop more rapidly, resulting in lower overall grain production; even moderate increases in temperature can decrease yields in major food crops. Population growth, urbanisation, higher per capita calorie intake, and increasing consumption of meat combine to put more

pressure on existing water resources. Tension and possibly conflict over water would most likely occur even in the absence of climate change. But climate change greatly exacerbates the problem. Without question climate change will challenge almost every aspect of the work of World Vision and other international development NGOs in the years to come. World Vision has half a century of experience working in many of the most food insecure countries in Africa, Asia and Latin America. While not all programmes and interventions have been successful, valuable lessons have been learnt, and World Vision will continue to use its considerable experience to help the poorest adapt to an increasingly food and water insecure future. Meanwhile World Vision recognises that only global agreement on substantial climate change adaptation and mitigation will prevent hundreds of millions of people from being condemned to a future of hunger and extreme poverty.





# HOTTER HUNGRIER

Photo: NASA Terra Satellite, Pixel size: 250m

**Western South Africa:** Most of South Africa's wheat is produced in the Western Cape. The 2003 drought withered and stunted vegetation across this vital crop-producing region. Erratic rainfall often produces wide variations in wheat yields and quality.

## Introduction

***“Observations show that warming of the climate is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases. These emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities.” (Global Change Research Program) <sup>(2)</sup>***

**Food For Thought:** There can be little genuine doubt that the world's climate is changing in ways that will seriously affect life on the Earth. There is widespread acceptance that the troposphere – the lower part of the atmosphere that contains most of the world's weather systems – is becoming warmer. The vast bulk of climate analysis supports the view that warming is due to increased emissions of particularly carbon dioxide and methane resulting mainly from human action. As the U.S. Global Change Research Program's report *Global Climate Change Impacts in the United States* stated in June 2009 (quote above), observations show that warming of the climate is both unequivocal and anthropogenic (caused by humans). The ramifications are of a scale not previously encountered by human societies. Each successive contribution to climate change research typically revises upward the extent, speed or impact of global warming. <sup>(3)</sup> There is also a

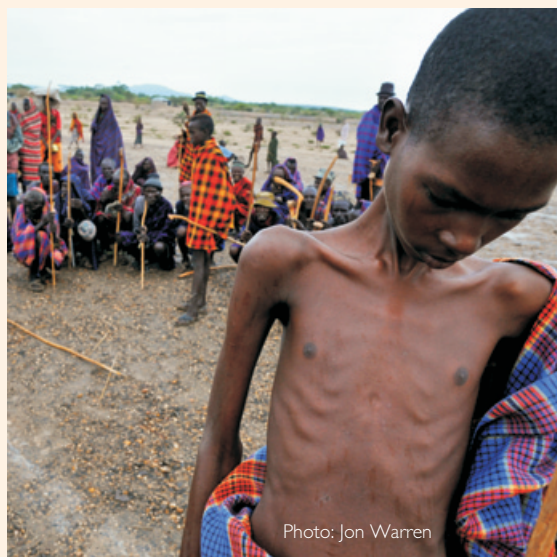
growing understanding of the negative legacy of past greenhouse gas emissions. Even if carbon pollution was stopped today 'the effects of global warming would continue to be felt for at least 50 years into the future'. <sup>(4)</sup> Climate change has significant implications for the food and water security of many of the world's 6.7 billion inhabitants. These implications are especially severe for the 2 billion who are food insecure and/or suffer physical and intellectual limitations due to inadequate nutrition. <sup>(5)</sup> The food crisis of the past two years has shown how fragile the global food system has become, and how a shock to food prices can rapidly undo years of hard-won gains in poverty reduction. The food crisis pushed at least 100 million more people into extreme poverty, and caused civil unrest in more than 60 countries. But in terms of its probable fallout the scale of climate change dwarfs the food crisis. Its cumulative impact, particularly on the world's poorest, will be far

greater. With world population likely to exceed nine billion by 2050, <sup>(6)</sup> ensuring sufficient water, food, and other agricultural products would be a daunting challenge even in the absence of global warming. But climate change makes achieving food and water security, and eliminating extreme poverty, orders of magnitude more difficult.

Consequently, while climate change is undoubtedly a scientific issue, it is primarily a development issue. The poorest people are most exposed: they are concentrated in hotter regions, live in low-lying flood prone areas, have more marginal agricultural land, have little or no influence on global climate change mitigation, and have few resources to adapt to harmful consequences. <sup>(7)</sup> The world's poorest are also the most vulnerable to the spread of tropical diseases, and are more likely to leave their homes in search of water or to escape flooding. Lastly, they will be most vulnerable in looming conflicts over water, food, energy and

displaced people. Climate change is not just an environmental issue. It has become the most critical *developmental* issue facing humanity at the beginning of the 21st century, with the potential to undo decades of development gains. Without question climate change will challenge almost every aspect of World Vision's mission in the years to come.

World Vision is already seeing first hand the impact on the poor of the deterioration in food security in the Horn of Africa, increased natural disasters in Asia, and conflict exacerbated by dwindling food and water supplies. World Vision recognises that to serve the disadvantaged faithfully, humanity must take the challenge of climate change seriously. Moreover World Vision believes that protecting the rights of children today and generations to come is a fundamental human rights issue. The failure of this generation to do all it can to avoid dangerous climate change could become the worst violation of child rights in human history.



■ **Kerkorisogol, Turkana, Kenya:**

Emaciated teen at a World Vision food distribution site.

The complexity and scale of the impact of climate change on food and water security risks creating a mood of resignation or despair: 'climate change is a genuine threat, but the problem is so great that I cannot make a difference.' But this attitude overlooks an important fact: while the impact of man-made climate change is relatively new, the problems of food and water insecurity are not. Government and non-government agencies have a long history of working in developing countries to improve food and water availability, stability, access and utilisation. And while not all programmes and interventions have been successful, much has been learnt that is directly relevant to helping the poorest adapt to the impact of climate change on their food and water, and even to help mitigate some of the longer-term effects. With decades of experience working with the poorest across the globe, World Vision has acquired both experience and a substantial knowledge base that can be used to counter a number of adverse effects of a warming world on communities in developing countries. This publication looks at case studies, lessons learnt, and formulates recommendations for comprehensive action.

***“When we look at projected future climates, we see that much of the continental areas will become barren because of drought. This will have appalling consequences for the already overcrowded nations like China, India, and parts of Africa.”***

*—James Lovelock, scientist and researcher*

**Chad, Africa:** Refugee girl walking through hot desert sand.

Photo: Howard G. Buffett

# FOOD CRISIS

## World Food Supply: Current Situation and Future Trends

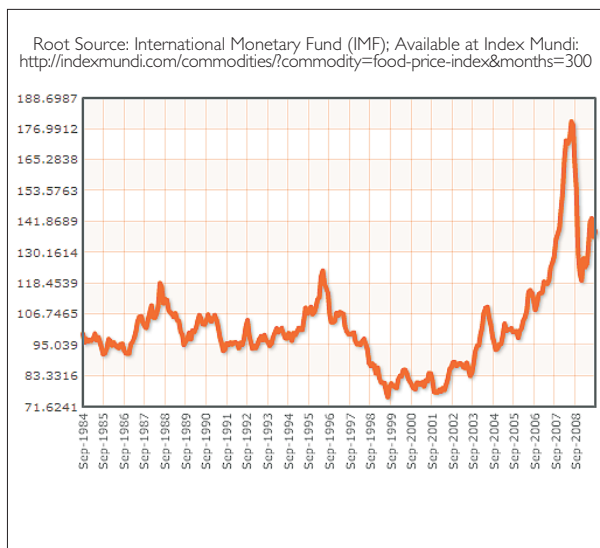
***“By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease ... By mid-century, climate change is expected to reduce water resources in many small islands ... to the point where they become insufficient to meet demand during low-rainfall periods.” (Intergovernmental Panel on Climate Change, Fourth Assessment Report 2007)***

**Taking Stock:** Before considering the impact of climate change on food security, it is worth assessing the global food position at the end of the first decade of the 21st century. The past few years have seen an unprecedented series of short and longer-term food supply pressures combining with rising demand for food. <sup>(8)</sup> The result has been a large increase in the price of key staple foods, and considerable price volatility. After 30 months of sustained strong rises, the Index Mundi commodity food prices index (Chart 1 on page 10) peaked in June 2008. <sup>(9)</sup> The index rose by 84% between late 2005 and mid 2008. Some individual food commodities rose by much more – wheat by 173%, maize by 199%, and rice by 266%. Helped by record cereal production in the 2008-09 season, prices in the second half of 2008 dropped sharply, with the aggregate index falling by 33%. Again, the prices of some of the index components moved by more – rice for example fell

by 46% from its peak, and wheat by 50%. For 2009-10, the FAO <sup>(10)</sup> has forecast a 3% decline in cereal production, but it will still be the second largest harvest on record. Despite this, in the first half of 2009, food commodity prices resumed their upward trend, with the index up 14% in July compared to its December 2008 low. Moreover, because of poor harvests, civil unrest, weak currencies and other factors, many developing countries have seen little or no decline in global prices. <sup>(11)</sup> Both the rises in food prices and their volatility have had major impacts on food security. The forces behind these dramatic movements in food prices have been well documented. <sup>(12)</sup> They include, to varying degrees, supply side pressures from poor seasonal conditions in some major exporting countries, the rising cost of oil, U.S. dollar weakness, the diversion of crops and agricultural land to the production of subsidised biofuels feedstocks, export restrictions on some major food crops,



**Chart 1: Index Mundi**



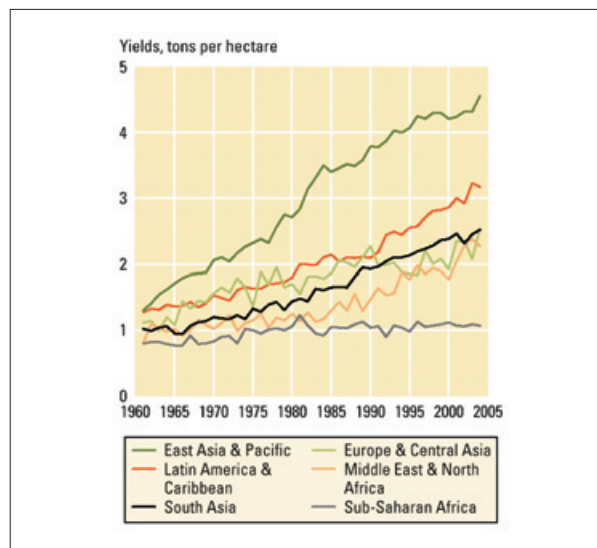
### End of Cheap Food?

Monthly Commodity Food Prices Index (includes Cereal, Vegetable Oils, Meat, Seafood, Sugar, Bananas, and Oranges Price Indices)

(notably rice and wheat), low world grain stocks, and arguably, speculative activity in agricultural markets. On the demand side, rising incomes, particularly in China, and global population growth, have increased demand for cereals for human consumption and animal feed, and for meat. Analysis of the food price crisis has identified three important developments with significant long-term implications for food security that will both affect, and be affected by, climate change. Of particular concern is the slowdown in agricultural productivity growth. <sup>(13)</sup>

**Output Outlook:** The second half of the 20th century witnessed a large and sustained increase in world agricultural productivity. Between 1950 and 2000, grain yields rose from 1.1 tonnes per hectare to 2.7 tonnes. However,

**Chart 2: Agricultural Productivity**



### Growing but Slowing

Agricultural yields in tonnes per hectare

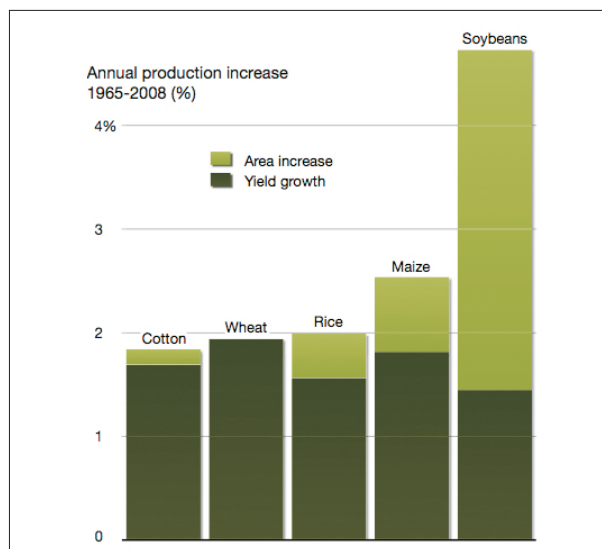
(Source: World Bank World Development Report 2008, p. 51)

Available: <http://go.worldbank.org/LBJZD6HWZ0>

cereal production per hectare declined in recent years, and agricultural production per capita remained stationary from the mid-1980s. As Chart 2 shows, slowing yield growth in most regions, and virtually no growth in sub-Saharan Africa, emerges as a significant long-term contributor to the growth of food supply being unable to keep up with demand. The increase in crop output in the past half century was due to three main factors – increased land used for agriculture (which contributed 15% of the total increase in output 1961-1999); increased yield (78% of the total increase), and greater cropping intensity, including reduced waste and greater food energy efficiency (7% of total) [See Chart 3 on page 11]. Over 70% of the total increase in production in the period came from just two sources – increased use of water (through irrigation), and

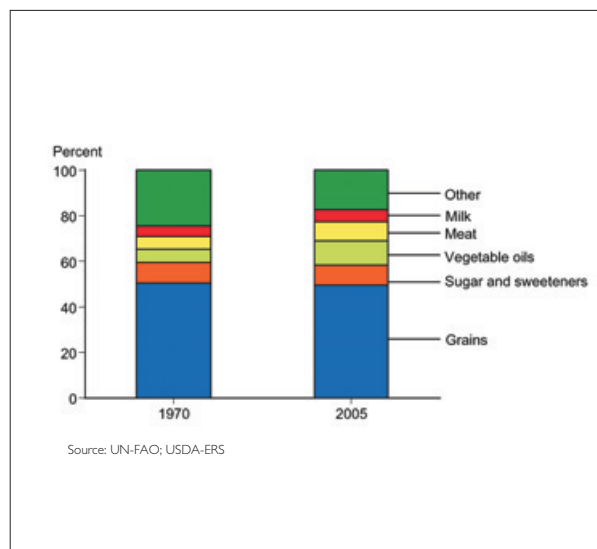


### Chart 3: Agricultural Productivity



**A Yield Story:** Annual Production Increase 1965-2008 (%) Yield increases have generally exceeded areal increases. (Source: World Bank, 2009) Available through UNEP webpage: <http://grida.no/publications/rr/food-crisis/page/3562.aspx>

### Chart 4: More Meat in the Global Diet



**More Meat:** Global Diet Composition (Source: Shapouri, Shahla, 'Global Diet Composition: Factors behind changes and implications of new trends' ERS, U.S. Dept.Agr.) Available: <http://ers.usda.gov/Publications/GFA19/GFA19b.pdf>

increased use of fertiliser. <sup>(14)</sup> Climate change seriously challenges the assumption that these inputs can keep increasing output as before.

**Feed Lots, Feed Less:** The second significant longer-term development influencing food supply is changing global diet. Total per capita calorie consumption (all food available for consumption) increased 17% from 1970-2005. Calorie consumption in industrialised countries rose 9% over the period and by more than 27% in developing countries. The range of foods consumed has become more varied with increased consumption of vegetable oils, meat and dairy products. From 1970-2005, meat demand increased by 80%, accounting for more than 8% of calories consumed by 2005. <sup>(15)</sup> The sustainability of increasing the

proportion of calorie intake from meat is problematic. Around 1/3rd of all arable land is used to produce feed for animals, and rising demand for meat is likely to continue deforestation to expand the land available for livestock grazing. If this trend continues it will contribute to the extreme pressures on entire ecosystems such as the Amazon rainforest. The FAO estimates that 70% of grazing land in dry areas is now degraded as a result of overgrazing, compaction or erosion. Moreover, the livestock sector accounts for an estimated 18% of all greenhouse gas emissions. <sup>(16)</sup> Grain-fed meat is also a heavy user of water – a kilo of beef requires up to 100,000 litres of water to produce. And it diverts food from end consumers – an estimated 800 million people could be fed using the grain fed to animals in the U.S. alone. <sup>(17)</sup>

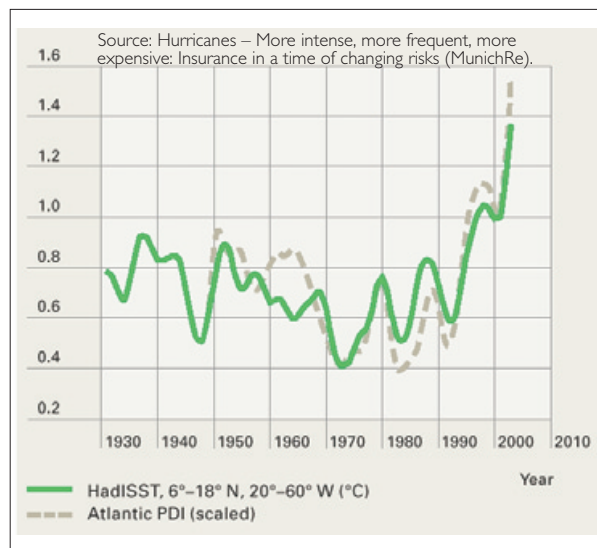
**Food For Fuel?** The third major development significantly affecting current and future world food supply is the rapid rise of biofuels, particularly maize (corn) based ethanol. High oil prices and a desire for greater energy security have prompted a number of countries to sharply increase production of bioethanol and biodiesel from food crops. <sup>(18)</sup> Farmers in many regions now face a choice between selling grain for food or for fuel. Demand for biofuels has been reinforced in numerous countries through blending mandates (e.g. petrol must contain 10% ethanol), subsidies to grain producers to produce for ethanol, favourable tax treatments, and duties on imported biofuels. This has driven a food-for-fuel frenzy: Ethanol alone absorbed 70% of the global increase in maize production from 2004-2007, and the U.S. used around 81 million metric tonnes of maize in ethanol production in the 2007-08 crop year. <sup>(19)</sup> Biofuel production from food crops affects food supply in a number of ways, including

- Increasing the quantity demanded and price of maize
- Diverting land from food to fuel production
- Pushing agricultural land into environmentally sensitive areas such as rainforests
- Increasing prices for other grains as consumers switch out of (more expensive) maize.

A range of simulations have found that biofuel demand has had significant impacts on the price not only of maize, but close substitutes, notably wheat and rice, and on soybean due to the planting of maize on land previously used to grow soybean. <sup>(20, 21)</sup>

**Summary:** World food supply is currently facing significant pressures from a variety of sources. Even without climate change, ensuring sufficient food for all in the 21st century would have been difficult enough. But as shown, climate change, by influencing so many aspects of food production, makes the problem much greater.

**Chart 5: Hotter And Stronger**



#### Sea Surface Temperature\* and Cyclone Intensity \*\*

\* Hadley Centre Dataset (HadISST)

\*\* Atlantic Power Dissipation Index (PDI); Source: Munich Re  
[http://www.munichre.com/publications/302-04891\\_en.pdf](http://www.munichre.com/publications/302-04891_en.pdf)

The longer-term balance between food demand and supply – the ultimate determinate of real food prices – will be far less benign than in the previous century. Using UN population projections and Food and Agriculture Organization (FAO) food supply estimates to calculate global food supply-demand balances for 2025 and 2050, Tweeten and Thompson conclude that 'the historic era of secularly falling real food prices is over'. <sup>(22)</sup> The food crisis in conjunction with the global financial crisis has been a disaster for the poor, pushing world hunger to a record high of 1020 million people in 2009, up from 915 million in 2008. <sup>(23)</sup> But as shown, the worst is yet to come.

**Sinazongwe, Zambia:** What looks like a desert or seashore is a field where crops were planted last season. Floods washed away both crops and soil, leaving only sand and a bleaker outlook on the future.

Photo: Collins Kaumba

# WATER CRISIS

## Climate Change And Food Security

***“Climate shifts, manifested in rising sea levels and more intense droughts and storms, could stimulate large-scale movements of people within, and across, international borders. Individually or collectively, such developments could destabilise nations internally, aggravate tensions between states and endanger human security.”***  
***(Dr. Alan Du Pont and Dr. Graeme Pearman, Lowy Institute for International Policy)***

**Concepts:** Climate change is already affecting human wellbeing, and its impact will increase through reduced food security. Food security is not a settled concept. <sup>(24)</sup> Current thinking emphasises four main elements – *availability, stability, access, and utilisation*. <sup>(25)</sup> *Availability* is about the productive capacity of agriculture and the effectiveness of markets to provide incentives to increase production. *Stability* relates to the ability of people to consume adequate food on a sustained basis. Hence it focuses on income volatility and the adequacy of savings or other reserves to act as buffers against food scarcity. *Access* is concerned with the ability of individuals to have control over resources (legal, social and economic) necessary to ensure a nutritious diet. Finally, *utilisation* relates to the health, safety and quality of food. Assessment of the impact of climate change on food security tends to focus on the first of these elements. Truth is, climate change influences them all.

**Main Drivers:** Climate influences food security through a variety of channels. <sup>(26)</sup> Climate change will increase the severity and frequency of tropical cyclones, flooding and drought. It will increase rainfall variability, with consequent adverse impacts on agriculture through water stress, increased weeds and pests, erosion and reduced soil fertility. Above certain temperature ranges, crops develop more rapidly, resulting in lower grain production. Even moderate increases in temperature can decrease yields in corn, wheat, sorghum, beans, rice, cotton and peanuts. <sup>(27)</sup> Higher temperatures affect how plants use water, with greater transpiration through leaves more than offsetting any possible net increase in rainfall. Earlier development of plants may increase their exposure to late-season frosts. Weeds and pests often benefit from higher atmospheric carbon or warmer temperatures, leading to either lower crop yields or increased use of herbicides and pesticides.

Higher carbon levels, while increasing the quantity of forage, often reduce its quality by lowering plant nitrogen and protein concentration. <sup>(28)</sup> Livestock productivity will be adversely affected by higher temperatures and humidity, due to the impact of greater heat stress on milk production, weight gain and reproduction. Sea level rise, resulting in coastal inundation and salinisation, will reduce or degrade available arable land. And sea level rise and higher sea surface temperatures will adversely affect the productivity of fisheries, an important source of nutrition, livelihoods and exports. Evidence of more extreme weather events, and other changes consistent with global warming, is accumulating:

- Since the 1960s, droughts typically occurred in Uganda every 5-10 years. Between 1991 and 2000, there were seven droughts. <sup>(29)</sup>
- The destructive impact of hurricanes in both the Atlantic and the Pacific has increased. Over the past 30 years, the wind speed and duration of tropical cyclones has increased by 70%. <sup>(30)</sup>
- The number of severe tropical cyclones (Saffir-Simpson Categories 4-5) has increased from around 8 per year in the early 1970s to 18 per year for the period 2000-2004. The destructiveness of tropical storms from 1958-2001 has increased by 60%. <sup>(31)</sup>
- As Chart 5 (page 12) suggests, there is a correlation between rising sea surface temperatures and the intensity of cyclones. <sup>(32)</sup>
- Since the late 19th century, surface global temperatures have increased by 0.74°C, and the linear trend for the past 50 years of 0.13°C per decade is almost twice that for the past 100 years. <sup>(33)</sup>

The following table gives examples of ways in which climate change will adversely affect food security. Note that the information in the table is based on the 2007 Fourth Assessment Report of the Intergovernmental Panel on Cli-

mate Change. Since publication, estimates of the scale and pace of climate change have been consistently revised upwards. So the probabilities in the table of particular events occurring should be seen as conservative – chances of them happening will likely be greater.

**Table 1: How Climate Change Affects Food**

Phenomenon and direction of trend in weather and climate events	Possible impacts on agriculture, forestry, fisheries, and ecosystems
Warmer and fewer cold days and nights; warmer and more frequent hot days and nights over most land areas. (Virtually certain)	Increased yields in colder environments; decreased yields in warmer environments; increased insect pest outbreaks.
Warm spells and heatwaves increasing in frequency over most land areas. (Very likely)	Reduced yields in warmer regions due to heat stress; increased danger of wildfire.
Heavy precipitation events increasing in frequency over most land areas. (Very likely)	Damage to crops; soil erosion; inability to cultivate land due to waterlogged soils.
Drought affected areas increase. (Likely)	Land degradation, soil erosion; lower yields from crop damage and failure; higher livestock losses; increased risk of wildfire; loss of arable land.
Intense tropical cyclone activity increases. (Likely)	Damage to crops; uprooting of trees; damage to coral reefs.
Extremely high sea levels (excluding tsunamis) increase in incidence. (Likely)	Salinisation of irrigation water, estuaries and fresh water systems; loss of arable land; increased migration.

(Source: FAO Climate Change Adaptation and Mitigation in the Food and Agricultural Sector – Technical Background Document From Expert Consultation 5-7 March 2008)



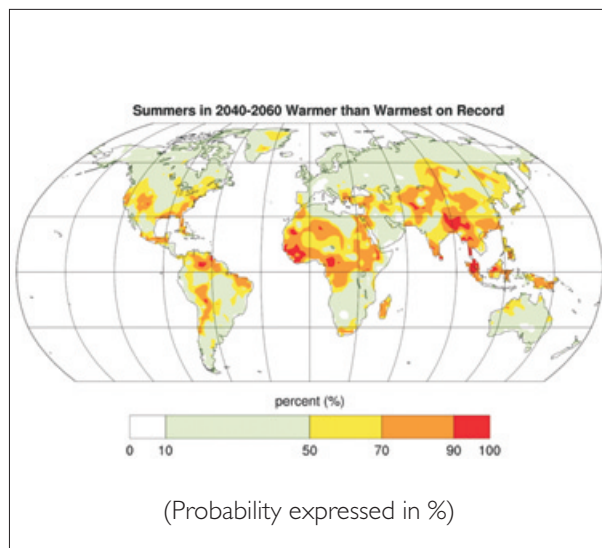
**Intricate Interrelations:** Climate change can also impact food security through triggering complex and subtle changes in animal and plant behaviour. For many animals and plants, temperature and other climatic variables trigger important responses such as migration or growth phases, or determine the areas they can inhabit. <sup>(34)</sup> Species leaving or entering areas earlier or later, or colonising or deserting particular habitats will cause complex and as yet little understood interactions with species already there. These interactions can affect food supply. For example, in the north-eastern coastal waters of the U.S., algae blooms in late winter and early spring in response to increasing sunlight. Rising water temperatures in turn trigger an increase in zooplankton that feed on the algae. Excess algae dies and falls to the ocean floor, providing valuable nutrients to support deeper dwelling fish. The sunlight trigger for the algal bloom is not affected by climate change, but water temperature is. Rising water temperature means the gap between the algae blooming and the zooplankton population expanding is becoming smaller, with the result that less algae is reaching the ocean depths. This process favours fish that live closer to the surface at the expense of deeper dwelling and commercially important species. <sup>(35)</sup> Research continues to uncover unexpected impacts of climate change on the quantity and quality of food. For example, we are discovering that

- **Wheat in Europe** is displaying gluten deficiencies as increased atmospheric CO<sub>2</sub> makes it more difficult for plants to get adequate nitrogen to synthesise the gluten protein. While reduced gluten in wheat affects the texture of bread (making it heavier), lower nitrogen uptake reduces the production of grain crops, including rice <sup>(36)</sup>
- **Extreme weather events** appear to affect the timing of flowering of some plants and the length of the flowering period. Heavy rain was found to shorten important springtime flowering seasons and bring them forward. In both cases

the change was by approximately one month. Following a period of extreme weather events in the Netherlands during the second half of 2006 (record high temperatures in July and September, record rainfall in August and temperatures 3°C plus above average in October, November and the first half of December), more than 240 wild and 200 cultivated plant species were flowering in December. <sup>(37)</sup> Moreover, the sequence of extreme events, for example whether flooding precedes or follows a drought, can also affect how plants respond. <sup>(38)</sup> Such changes can even influence the interaction of plants and animals. For example, earlier and shorter springtime flowering seasons may upset the synchronisation between flowering plants and pollinating insects. <sup>(39)</sup>

- **Higher night temperatures** can affect the yields of some crops (e.g. common green beans) <sup>(40)</sup>
- **Concentrations of atmospheric CO<sub>2</sub>** is increasing ocean acidity, making it more difficult for a range of sea life to build shells and skeletons from calcium carbonate <sup>(41)</sup>
- **Climate change-induced food crises** may contribute to the spread of pests and invasive species. Humanitarian emergency food aid is subject to lower phytosanitary standards, and it is believed, for example, that the parthenium weed was introduced to Ethiopia in ad hoc famine relief grain shipments. <sup>(42)</sup> There is also the likelihood of insect predation on forests and food supplies. <sup>(43)</sup>
- **More variable water supplies** have prompted many small farmers in Tanzania to revert to growing more predictable crops such as sweet potato, despite returns at least 25% down on those achieved from maize. <sup>(44)</sup>

**Chart 6: Onwards And Upwards (2040-2060)**



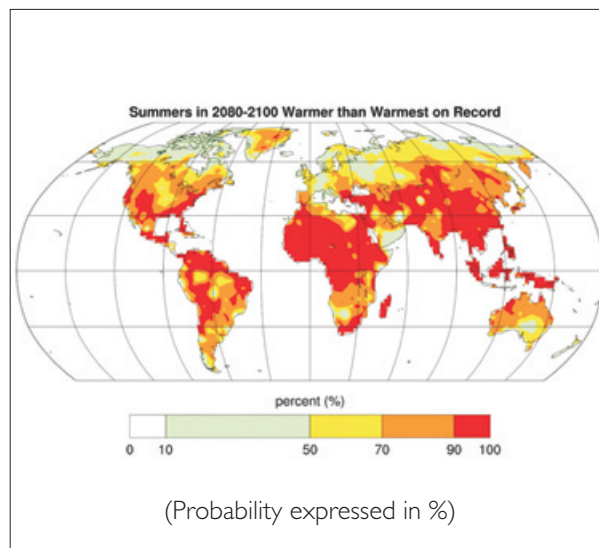
**Hotter Summers in 2040-2060**

Warmer Than Warmest on Record

(Source: Battisti and Naylor, 2009); Available:

<http://sciencemag.org/cgi/content/full/323/5911/240>

**Chart 7: Onwards And Upwards (2060-2100)**



**Hotter Summers in 2060-2100**

Warmer Than Warmest on Record

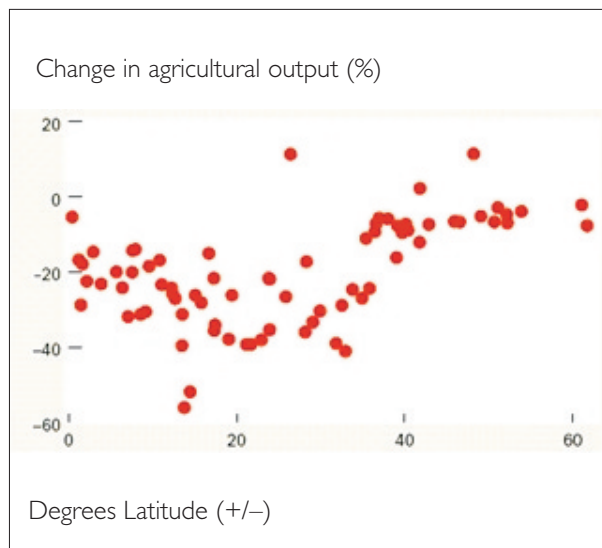
(Source: Battisti and Naylor, 2009); Available:

<http://sciencemag.org/cgi/content/full/323/5911/240>

**Higher And Hotter:** Warmer temperatures and higher atmospheric CO<sub>2</sub> levels are not completely negative – they do suit some crops. Up to a point higher temperatures increase the growing season of melons, okra and sweet potatoes. Higher CO<sub>2</sub> – ‘carbon fertilisation’ – typically causes plants to grow larger (although in some cases this means they are less nutritious) and allows some plants to use water more efficiently. But there is widespread agreement that the negative effects of climate change “fertilisation” clearly outweigh the positive, particularly if warming exceeds 2-3°C above pre-industrial levels. World Vision’s work in Kenya highlights the complex interaction of a changing climate on an agricultural sector that is already under growing pressure. (See case study on page 18.)

**Geographic Impacts:** How climate change affects food security will vary widely across regions. What is clear is that developing countries are generally most exposed to its negative effects. In particular, they are far more vulnerable to higher temperatures. Using the 23 climate models used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), scientists assigned probabilities to increasingly hot summers. <sup>(50)</sup> For substantial parts of Africa and Asia they estimate that, by the middle of this century, average summer temperatures will rise above the highest on record for the previous century (Chart 6). For the end of the 21st century, the outlook for the developing world is even worse (Chart 7). In short, the consequences of global warming will be unevenly suffered.

**Chart 8: Close to the Equator – Close to the Edge**



### Reductions in Crop Yields

Developing Countries: 15-26% Median Loss by 2080  
(Source: Kline, 2008)

**Equator Inequality:** Higher temperatures mean that the agricultural outputs of developing countries are likely to experience the greatest falls. This is often due to geographical location. In some areas, climate change will shorten growing seasons through a combination of higher temperature and reduced rainfall. Using six climate models to estimate temperature and precipitation, and two classes of agronomy models to estimate crop impacts, Kline has estimated the relationship between proximity to the equator and decline in agricultural output if carbon emissions continue unabated. Countries between the Tropics of Cancer and Capricorn ( $\pm 23.5^\circ$  of latitude around the equator) are likely to experience greater reductions in crop yields. These reductions are likely to be substantial if

carbon emissions continue on a business as usual basis, as assumed in Chart 8. Reductions can be offset to some extent by elevation and carbon fertilisation, although as noted, the extent of the beneficial impact of higher carbon levels on plant growth varies between crop types. For developing countries, Kline estimates a median loss by the 2080s (average for 2070-2099) of 15-26% without carbon fertilisation. For some countries losses will be significantly higher: Senegal and Sudan, for example, can expect reductions greater than 50%.

For countries in sub-Saharan Africa higher temperatures and lower rainfall levels mean reduced output of key crops such as maize. The Climate Systems Analysis Group estimates that within 30 years, the rain season in Zimbabwe and South Africa's Limpopo province will start a month later and that maize yields will be nine percent lower by 2045. <sup>(51)</sup> Additionally, disruption of long established seasonal weather patterns complicates decision making for farmers, increasing the risk of falling outputs. As a farmer in Kenya observed: <sup>(52)</sup>

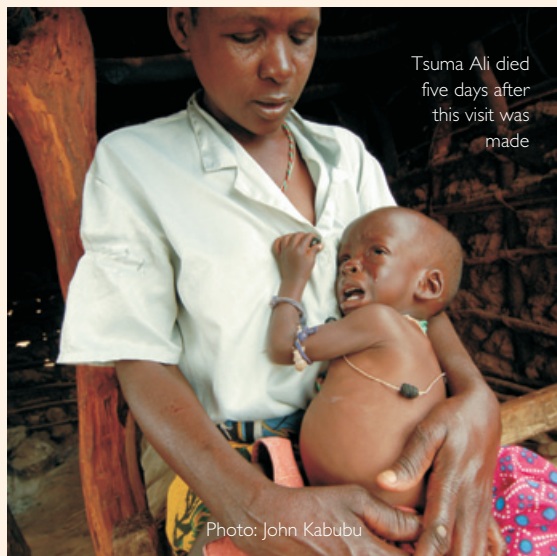
*When I was young, we used to have regular rains, but now it rains any time of the year. The changes started about 20 years ago. Food production in the area has gone down because people are not sure when to plant, and even when they plant, they may not get rains at the right time. Farming in our area is not only for our food, we also depend on it for our income. Some people have had to rely on food donations from the government, something that has not happened since I was born.*

Climate change impacts on food security will be particularly severe for Pacific island countries. The FAO notes: <sup>(53)</sup>

*With increasing global temperatures, rising sea levels and more frequent and intense extreme weather events, Pacific islands countries, especially those in warmer latitudes, are the most vulnerable to the adverse effects of climate change. Their populations are expected to be*

*among the first that will need to adapt to climate change or even abandon their traditional homeland and relocate.*

**Price Hike:** Existing food insecurity in the region will be exacerbated by climate change. Assessments carried out for Fiji, PNG, Tonga and Vanuatu by the UN affiliated CGPRT (Coarse Grains, Pulses, Roots and Tubers) Centre in 2000 found that provincial food security was more fragile than national security because urban populations could resort to imported food. In some cases, monoculture agriculture for export has increased dependence on imported food, and made locally produced food more expensive. The importance of fisheries for food and export earnings increases the region's sensitivity to climate change. <sup>(54)</sup> World Vision has developed strategies for the varied physical and cultural environments encountered in the Pacific and Southeast Asia. (See Case Study 2 on page 21.)



Tsuma Ali died five days after this visit was made

Photo: John Kabubu

■ **Kenya – Severe hunger spreads:** Baby Tsuma Ali was one of 50,000 people dependent on World Vision food aid. Malnutrition can be so severe that food aid cannot save all lives.

## Case Study I: Kenya Increasing Food Security

**Ongoing Drying:** Kenya has already begun to feel the effects of climate change. It lies just south of the Sahel countries and shares many of their climate-related concerns, including dependence of part of the population on rain-fed agriculture and livestock; rainfall variability; land degradation and desertification. <sup>(45)</sup> Kenya has been wracked by drought since 1999. Its long coastal belt, where World Vision's food security project is situated, has traditionally received 900 to 1,100mm of rainfall annually. In the past decade, however, rainfall has dropped to the bottom end of this range or lower. Felling trees for firewood and charcoal, regarded as an alternative livelihood option for struggling farmers, has contributed to erosion, removed nutrients from the soil and compromised the area's capacity to absorb and store atmospheric greenhouse gases. Worryingly, climate models predict 'substantial ongoing drying' over the coming century over most of the continent, with 'the epicentre for drought in Africa effectively moving further south.' <sup>(46)</sup>

**Context:** Kenya also faces other challenges. Traditionally a regional hub for trade and finance in East Africa, and one of the most politically stable countries on the continent, Kenya has received hundreds of thousands of refugees from neighbouring Sudan, Ethiopia, Uganda and Tanzania. But in early 2008, Kenya experienced prolonged ethnic clashes following a hotly contested election. <sup>(47)</sup> Large numbers of Kenyans fled their homes, increasing pressure on aid for refugees and internally displaced people. Additionally, endemic corruption has disrupted flows of aid from the World Bank and the International Monetary Fund, dampening economic growth. <sup>(48)</sup> Even in communities unaffected by political unrest, per capita GDP is now only \$1,600 a year on average. Poor communities have little resilience to economic shocks caused by low rainfall or problems with pests or crop or livestock diseases. <sup>(49)</sup>



**Exposure to Food Prices:** Prior to World Vision commencing work, poor farmers in the area lacked the skills and knowledge to develop and implement innovations in the face of declining annual rainfall. They watched as their land holdings shrank due to subdivision with each generation, and the productivity of their land declined because of insufficient land left in fallow each season. The soil thus became drained of its nutrients and the quality as well as the quantity of crops declined. Small landholders often turned to casual labour on larger farms to gain income. In a survey conducted by World Vision, 56% of householders reported that casual labour was one of their coping mechanisms in times of financial hardship. This has resulted not only in neglected household farms, but also an overall reduction in acreage planted. Farming families now purchase more food from markets, and have become increasingly exposed to the rising food prices of recent years.

**World Vision's Response:** World Vision intervened in Bamba and Vitengeni, two divisions of the Kilifi district in the Coast province of Kenya, to work alongside farmers to improve their food security and ability to cope with drought. An effective response required targeting simultaneously all the main factors contributing to the community's vulnerability. It had to focus both on making household gardens and small farms more productive in an environment less conducive to rain-fed agriculture, and on long-term sustainability, when conditions are likely to be even drier. World Vision partnered with the Kenya Institute of Organic Farming (KIOF) to encourage farmers to reduce reliance on synthetic fertilisers and pesticides (which are expensive and pollute the environment), factory-manufactured livestock feed, and plant and animal growth additives. Instead, farmers learnt how to make green manure and compost, control pests biologically, and rotate crops to maintain soil productivity. The farmers selected for training by KIOF all belonged to Farmer Field Schools, and were expected to use these schools as avenues to disseminate their knowledge to a wider population. The efforts have not been in vain.

**Achievements:** Despite extreme dry weather, World Vision's Food Security and Recovery Project in Bamba and Vitengeni have made significant gains:

- **The Coast Development Authority**, a Project partner, conducted training on soil and water conservation.
- **World Vision trained 50 farmers** in establishing and managing nurseries so they could tend the Project's saplings prior to distributing them to targeted household farms. In total 900 families received fruit tree saplings sourced from the Kenya Agricultural Research Institute.
- **Drought tolerant crops** were sourced and distributed to farmers, encouraging diversification of individual household farm produce (1.408Mt pigeon peas, 1.366Mt green grams, 2.272Mt sorghum, 1.358Mt millet, 2.296Mt cowpeas and 5.43Mt maize, as well as 2,250 cassava cuttings and 9,000 sweet potato plants). Drought-tolerant crops not only mature faster in dry conditions, they also provide good seed bulk for the next planting season, thus reducing the cost of inputs.
- **Selected farmers received livestock inputs** for animal husbandry and were trained in the handling and management of Gala goats – a more drought-resilient breed than the small east African goats in the project area. Some 70 Galas (50 does and 20 bucks) were distributed among 10 farmer groups for cross-breeding with local animals to produce better quality offspring which would generate more income when sent to market. Each group received at least five does and at least one buck. Responsibility for maintaining the goats is shared among group members, who will ultimately all receive a goat once breeding begins.

- **30 Farmer Field Schools (FFS)** in the project area set up a demonstration farm where training and farmer field days occurred. Six field days were held on some of the demonstration farms. They were attended by 1,072 women and 260 men and focused on the importance of introducing improved agronomic practices. Farmer field days not only encourage adoption of new technologies by participants, but farmers who come to see the demonstration plots at FFS also see the innovations at work. FFS provide an arena for farmers, especially women who are traditionally responsible for family nutrition, to discuss their progress, challenges and lessons learnt, encouraging future cooperation.
- **Silos:** A major cause of food insecurity among rural farmers is food loss as a result of poor post harvest management. To reduce losses due to spoilage, insects and rodents, World Vision locally sourced 90 metal grain silos with a capacity of 450kg in order to reduce the crop losses of the most vulnerable farmers.
- **A Producer Marketing Group (PMG)** for Bamba and Vitengeni was established as one of the most important project activities. Through banding together, farmers are better placed to access loans from microfinance institutions, and better able to supply markets. No individual farmer could supply all the produce needed, but by pooling their produce farmers can better supply markets and split the profits accordingly. PMGs in Bamba and Vitengeni are up and running.

**Summary:** Despite adverse weather conditions World Vision's Food Security and Recovery Projects in Bamba and Vitengeni can be considered a success.



■ **Turkana, Kenya:** Logialan Ngiro and her family now rely on World Vision food aid as their only source of nourishment.

## Case Study 2: PNG, Laos, Thailand – Improving Crop Yields

**Comparing Crops:** Since 2000, World Vision has been working in partnership with the Australian Centre for International Agricultural Research (ACIAR) to better understand the impact of climate change on agriculture, and to transfer this knowledge to poor farmers bearing the brunt of a warming environment. Projects in Thailand, Laos, Vietnam and Papua New Guinea (PNG) equip farmers with inputs to compare different crop varieties and choose those most viable for their specific situation.

**Papua New Guinea:** In PNG, 93% of the poor live in rural areas, and the vast majority of them rely on agriculture for survival. Sweet potato accounts for 65% of the population's calorific intake and is PNG's most important food crop. World Vision PNG, partnering with ACIAR and PNG's National Agricultural Research Institute, embarked on a project to trial different varieties of sweet potato in a number of different areas in PNG, with the aim of increasing yields (and therefore food security), and the adaptive capacities of subsistence farmers in the face of a rapidly changing climate. The project, which ran over three years, took place at six sites, chosen specifically because they spanned a range of elevations (0-600m), soil types and rainfall patterns. Some 16 varieties of sweet potato were trialled at each site, first by technicians and then by farmers. By the project's end, there were trials at more than 300 locations – from remote islands to inland valley plains. Trials were repeated in both wet and dry seasons to provide accurate yield predictions. Project success depended on effective interaction between field technicians, consultants, and farmers; all personnel were chosen carefully and lead farmers were invited to volunteer. The project generated particular interest among agricultural workers in Madang where the project was located. By the end of the project,

farmers were approaching World Vision for planting material. Importantly, dissemination of the project's key learning outcomes occurred spontaneously. Several important findings emerged. First, farmers did not select varieties of sweet potato solely on the basis of predicted yield. They also took into account other factors including taste, and the speed with which plants matured. Second, farmers valued not just increase in yields, but the opportunity to make their own choices about what they produced according to personal criteria. And third, actively involving farmers in the trialling process from the outset, rather than conducting controlled experiments and then disseminating cuttings from the most successful sweet potato varieties, encouraged target communities to embrace ongoing trialling, experimenting with, adapting and perfecting their practices. This resulted in a genuine improvement of overall adaptive capacity of target communities.

**Laos:** In 2000, the Laos Department of Agriculture founded the national Agricultural Extension Agency to distribute research and technical support among rural communities. Coverage was limited, however, and many farming communities in Laos continued to struggle to produce enough rice to sustain adequate livelihoods. World Vision, in collaboration with ACIAR and a local partner, established a project to improve local farming capacity through applied research. The objective was to increase food production through low-input, sustainable technology. Activities were simple: groups of 5 or 6 families set up small demonstration plots (3m x 6m for each rice variety tried, with and without fertiliser). Larger plots of around 1,600m<sup>2</sup> were also used with and without fertiliser. Farmers were then encouraged to decide which varieties to plant in the larger plots according to soil types. Farmers experimented, comparing the recommended fertiliser (distributed by the project) with locally available substitutes. Since non-rice crops can improve the nutritional intake of farmers and provide an additional source of income, they were also included in the trials. The project trained hun-

dreds of farmers in three districts of Savannakhet province in how to prepare their land, plant, fertilise, protect crops from pests and diseases, produce organic fertilisers such as compost, and how to reserve seeds after harvesting for the following season. Coriander, lettuce, cucumber, onion, garlic, Chinese greens, tomatoes, eggplant and chillies were all trialled in different locations according to soil type and quality. Results were mixed; villages with a dam nearby experienced high yields of almost everything they trialled, whereas villages reliant on rainfall could not make all their crops viable. The key lesson learnt concerned methodology. Since farmers trialled different seed varieties or crops simultaneously, they were able to compare results and identify which crops flourished in which weather and soil conditions. As global climate becomes increasingly unpredictable, such adaptive capacities are likely to become increasingly significant.



Photo: World Vision Thailand

**Thailand – World Vision-sponsored Aquaculture:** Breeding fish is a promising climate change adaptation measure.

**Thailand:** Aquaculture is integral to many Thai communities. It is an important complement to rice production in terms of income generation, and provides producers with valuable protein. With fish feed accounting for 30-40% of production costs, however, and some fish species dying at an early stage, improving survival rates of fingerlings became a key success factor of viable aquaculture practice. Several activities were pursued simultaneously. First, low-cost fish feeds were developed in partnership with ACIAR that were less susceptible to growing mould. Second, training centres were set up in the Surin and Udon Thani provinces and run as co-operatives, selling low-cost fish feed and fingerlings cheaper than other manufacturers. Third, new methods of nursing Tilapia and catfish fingerlings were developed with increased survival rates. During the life of the project, hundreds of farmers were trained. Fingerlings were nursed in floating baskets with increased levels of oxygen in the water before being transferred to ponds. For participants with more than 2 acres of available land, the project dug dirt ponds measuring 20m by 10m by 2.5m (deep), which could accommodate up to 5,000 catfish. For those with smaller plots of land, plastic ponds measuring 2m by 4m were used, which could hold up to 500 catfish. In these plastic ponds, catfish grew quickly. It took only 2 months before participants could either consume or sell their fish. The fish farming project not only increased individual incomes – World Vision estimates that a Thai family could boost their income by up to \$500 a year through the quarterly production of 800 fish. It also improved community organisation and management as farmers took ownership of the project. The training centres in Surin and Udon Thani became the destination of field trips by World Vision staff, leading other Thai World Vision Area Development Programmes to copy the Low Cost Fish Feed Project. Changing precipitation patterns, sea level rise, salt water inundation and erosion are serious concerns for Thai farmers. World Vision and ACIAR's investment has bolstered the resilience of communities in Surin and Udon Thani, preparing farmers to respond more readily to the challenges of climate change.





# PARCHING PLANET

***“The greatest harms global heating causes are ... from prolonged and unrelenting drought. According to the forecasts (IPCC report from Working Group II, 2007) many parts of the world will experience such a lack of water by 2030. Saharan conditions will extend into southern Europe, as they are experienced in Australia and Africa.”***

*—James Lovelock, scientist and researcher*

**Namibia, Africa:** Parched lake

Photo: ra\_photos

## Water Security

***“Impacts will require adaptive responses such as investments in storm protection and water supply infrastructure, as well as community health services. ... The global community needs to coordinate a far more proactive effort towards implementing adaptation measures in the most vulnerable communities and systems in the world.” (R. K. Pachauri, Chairman of the Intergovernmental Panel on Climate Change, Nobel Lecture)***

**Water Woes:** Even without climate change, water security would still be a serious issue facing many developing countries. <sup>(55)</sup> The combined impact of population growth, urbanisation, higher per capita calorie intake, and increased consumption of meat, with its heavy requirements for water, are placing more and more pressure on water resources. Tension and possibly conflict over water between competing users – farmers and pastoralists, rural and urban, states, humans and the environment – would most likely occur even in the absence of climate change. But climate change greatly exacerbates the problem. Global warming increases the amount of evaporation of water from the land and sea, and increases the amount of water vapour held in the atmosphere. Changes in atmospheric moisture influence weather patterns and hence water availability in a variety of ways, including the amount, location, timing, and type of precipitation. Rising average winter

temperatures will see more rain and less snow, bringing forward spring peak runoffs and increasing the risk of winter flooding and reduced late summer river flows. <sup>(56)</sup> As the Global Humanitarian Forum's Forum 2008 Water Stress Roundtable noted: <sup>(57)</sup>

*Climate change is shifting the availability of water worldwide, with severe drought, dwindling ground water sources, decreasing glacial and snow melt and changing rain patterns rendering land uninhabitable in a number of regions. Africa is the worst hit, where river basins have shrunk by up to 40-60% since the 1970s. Minor additional rises in sea levels could also lead to the salination of further clean water sources. These changes are taking place against a backdrop of fast accelerating population increases.*



Over recent decades, a range of developments consistent with climate change have been observed, including <sup>(58)</sup>

- increasing evaporation
- increasing atmospheric water vapour
- changes in precipitation patterns and intensity
- changes in the incidence of drought
- widespread melting of snow and ice
- increasing water temperatures
- reductions in lake and river ice
- changes in soil moisture and runoff

These changes are intensifying normal wet and dry periods, making wet areas wetter, and dry areas more arid. In the U.S., for example, averaged over the whole country,

- **total precipitation** has increased by about 7%, while the heaviest 1% of rain events have increased by almost 20% in the past century
- **drought duration** has decreased in intensity and severity in the Northeast and Midwest, but increased in the Southwest in the past 50 years
- **proportion of precipitation** falling as rain has increased in most areas relative to snow over the past half century
- **extended dry periods** have become more common in the Southwest over the past few decades

**Water Pollution:** heavy rainfall can increase water pollution (from sediment, herbicides and pesticides), and disease levels, and rising water temperatures reduce oxygen essential for many aquatic organisms. <sup>(59)</sup> Water security is essential to food security. As Fred Pearce, author of *When the Rivers Run Dry* has observed <sup>(60)</sup>

*We are using [many of the world's major] rivers to death. And we are also pumping out underground water reserves*

*almost everywhere in the world. With two-thirds of the water abstracted from nature going to irrigate crops – a figure that rises above 90 percent in many arid countries – water shortages equal food shortages.*

**Water Overuse:** Agriculture (i.e. food and agricultural products) accounts for 70% of freshwater withdrawals from rivers and groundwater reservoirs. Approximately 80% of agricultural evapotranspiration – the process of crops using water and returning it to the atmosphere as vapour – comes directly from rainfall, the rest comes from irrigation. Rainfall is essential to food security in developing countries; reduced and more variable rainfall directly influences food availability, stability and utilisation. But food production is coming up against water imposed limits in a range of countries. <sup>(61)</sup> In large parts of Africa, more than 75% of agriculture is rainfed, <sup>(62)</sup> but rainfall in West Africa has been declining by an average 4% per decade since the 1970s, and annual water supply in Morocco has decreased by 15% from 1971-2000. <sup>(63)</sup> Agriculture in northern China uses vast amounts of water from the Yellow River, which now rarely reaches the sea except during the monsoon season. The Nile River is in a similar situation. Indian agriculture is also running up against decreasing water availability, and groundwater supplies are increasingly extracted at unsustainable rates.

**Water Management:** Water security, or the lack of it, directly affects poverty reduction. More than 800 million impoverished men, women and children who live in rural areas, often on marginal land, depend directly on rainfed agriculture. These people are extremely vulnerable to spatial or temporal variation in rainfall. Improved water management in agriculture is central to continued reduction of rural poverty. World Vision's work in Sri Lanka has shown how low-income farmers can cope with less water supply through adopting better farming methods and more efficient water management techniques.

## Case Study 3: Sri Lanka Permaculture Project

### Climate Change Challenge

Sri Lanka shares the climate change challenges of most Small Island States: sea level rise and resultant saltwater inundation, loss of productive land, destruction of mangroves, and loss of biodiversity. What needs to be added to this list are climate change adaptation challenges arising specifically from human activity.

First, Sri Lanka has a history of sophisticated irrigation going back centuries. The system included more than 25,000 dams, ranging from small catchments high in the hills to huge reservoirs in the valleys. These dams provided water security and management to a culture then dependent on rice production. World Vision and others are interested in understanding the potential to rehabilitate and reintegrate these age-old dams into the agricultural system in Sri Lanka today as an adaptive response to climate change.

Second, deforestation has wiped out some of Sri Lanka's natural 'carbon sinks' <sup>(64)</sup> and reduced biodiversity. In upland areas in particular, firewood collecting and timber harvesting have diminished soil quality, causing erosion and degrading water supplies.

Third, farmers in Sri Lanka's upland hills have been practicing chenna (slash-and-burn) farming for decades. Traditionally, this method of farming was seemed suited to the environment: the land was planted, crops were harvested then the soil was left to lie fallow to regenerate for several seasons while farmers farmed other land. Today agricultural land is typically planted and harvested continuously, making chenna farming a poorly adapted environmental farming practice: it is labour-intensive, causes erosion and degradation of water supplies, and it is not particularly productive.

The impacts of climate change cannot be predicted with great accuracy, but some studies estimate a decline in agricultural productivity in Sri Lanka of up to 15-20% over the next 20 years. Weather records from the past 50 years indicate that temperatures in Sri Lanka are steadily rising; projections for coming decades indicate that the temperature increase will be 2-4°C. Additionally, Sri Lanka is experiencing considerable variation in precipitation patterns – in some regions droughts and floods are now an almost annual experience. And Sri Lanka is already identified as a 'hotspot' in terms of food insecurity; any increase in climate variability or monsoon patterns is likely to reduce Sri Lanka's ability to meet its own food requirements. <sup>(65)</sup> Farmers dependent on one particular crop are likely to be particularly vulnerable.



Photo: World Vision Sri Lanka

■ **Sri Lanka:** Household garden crop diversification

## World Vision's Response

From 2003-2008, World Vision Sri Lanka, in partnership with the United States Department of Agriculture, implemented a major Integrated Farming and Sustainable Agriculture Project (IFSA) with the aim of helping 2,695 small-scale farmers move from slash-and-burn agriculture to a system of permanent cultivation. The IFSA project promoted mixed annual and perennial cropping and low-cost water capture and management techniques. Taking inspiration from the success of the IFSA project, WV Lanka established a Permaculture, Livelihoods and Nutrition project (PLN) in 2008. The PLN project has been incorporated into four Area Development Programmes sponsored by WV Australia. The PLN project has individual household kitchen gardens as its primary targets (rather than commercial farms).



■ **Galenbindunuwewa, Sri Lanka:** Agriculture suffered much in this area due to frequent dry spells. World Vision has been able to restore the land from brown to green through irrigation projects and renovation of agriculture tanks.

The term 'permaculture' – permanent agriculture – is the conscious design and maintenance of agriculturally productive ecosystems with the same diversity, stability and resilience of natural ecosystems. To this end, the PLN project encourages thoughtful planting of a variety of crops in each household garden to optimise the use of available soil nutrients and rainfall. Diverse food crops allow for a more varied and nutritious diet, as well as reducing the risk of food insecurity (if any individual crop fails, others will likely survive). Initiatives piloted in the PLN project include seed-saving groups, nurseries for local species, livestock banks, bee-keeping and aquaculture. Seed-saving groups and nurseries will build up reserves of seeds. Successful seeds can be planted in pilot kitchen gardens, while livestock banks, bee-keeping and aquaculture provide potential alternative income sources.

Water management is promoted in a variety of ways, from incorporating organic matter back into the soil to increase its capacity to retain moisture, to building small drains along natural contours and slopes to direct runoff into ponds and dams to be reused for irrigation or aquaculture. Improved water use and management makes better use of available rainfall, while drainage systems and gardens planned with the changing climate in mind are more likely to provide natural drainage systems in the event of extreme rainfall or flooding. The PLN project is transferring skills, knowledge and technologies to 400 low-income rural households in 60 communities across Sri Lanka, enabling beneficiaries to set up and maintain their own permaculture plantations. After this, 100 of the best-practice farmers will be supported by WV Lanka to turn their gardens into models to encourage further learning within targeted communities and beyond. Nutrition standards are improving. Some households are now self-sufficient in vegetables, 400 women, especially pregnant and lactating mothers, are being targeted for nutrition education, and 40 community workers are being trained in basic nutrition. Every seasonal crop-production planning workshop now includes protein- and vitamin-rich crops.





## Food, Water And Conflict

***“In the event of mitigation efforts failing, climate-induced security risks will begin to manifest themselves in various regions of the world from around 2025-2040. The key challenge is to take resolute climate policy action within the next 10-15 years, in order to avert the socioeconomic distortions and implications for international security that will otherwise intensify in subsequent decades.” (German Advisory Council on Global Change)***

**Water Wars?** The ways in which climate change influences food and water security gives rise to multiple possible causes for conflict. However, central to them will be competition over scarcer resources. Most often, climate change will not be the sole cause of increased conflict. But through extreme weather events and deteriorating long-term food and water security, it is likely to play an increasingly central role in creating new tensions or exacerbating existing ones. The food price crisis may have given us a glimpse of the future. The dramatic rises in food prices in 2007 triggered a wave of civil unrest in many countries in Africa and Asia in the first months of 2008. Chart 10 (page 28) indicates the correlation between civil unrest in more than 60 countries and high (or rapidly rising) prices for staple foods. Most unrest occurred in poor countries, but about 1/3rd occurred in middle and high income countries (although it was typically less violent). While unrest de-

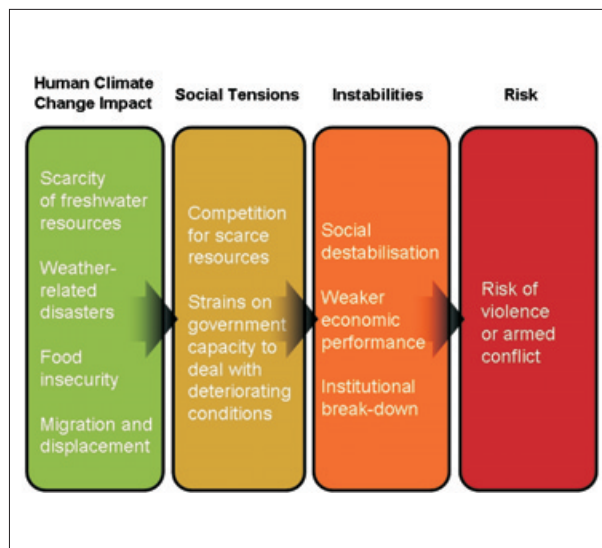
clined quickly as prices began to fall, it should not be overlooked that

- lower prices were in part due to either undesirable or unsustainable policies such as price subsidies and export restrictions
- despite the fall in world food prices in the second half of 2008, the FAO and the World Bank have shown that the prices actually paid by the poor in local currencies have not always fallen by as much, suggesting that unrest could return with any new pressure on food supply or demand

The sharp rise in food prices 2006-08 highlights how quickly deteriorating food security can trigger friction between states. Whether as an attempt to improve food security or because of civil unrest over high food prices, a



**Chart 9: More Heat, More Friction**

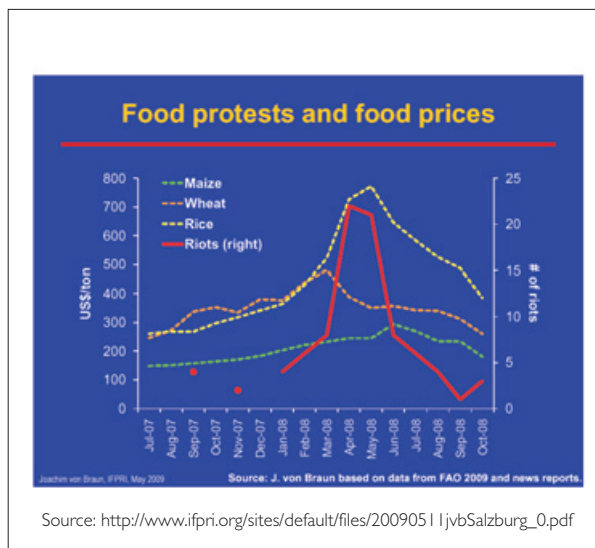


### Climate Change Conflicts

(Source: Global Humanitarian Forum, 2009, p.54)

range of countries restricted food exports. Argentina, Bolivia, Cambodia, China, Egypt, Ethiopia, India, Kazakhstan, Malaysia, Pakistan, Russia, Tanzania, Vietnam, Indonesia, Nigeria, Malawi, Zambia, Ukraine and Cambodia imposed bans for varying lengths of time. Most have been lifted, but while operative, they made the global market for some major food staples more volatile. In some cases – for example in India, Bangladesh, Pakistan, Afghanistan, Vietnam, the Philippines, Nigeria and Niger – the bans had an adverse impact on import dependent trading partners. <sup>(66)</sup> But the food crisis also highlights how important control of resources has become. The rapid rise in the prices of food and energy encouraged numerous countries to secure access to land, including in developing countries. <sup>(67)</sup> Table 2 (Appendix) gives examples of this trend. A dramatic ex-

**Chart 10: Higher Prices, Higher Tensions**



Source: [http://www.ifpri.org/sites/default/files/20090511jvbSalzburg\\_0.pdf](http://www.ifpri.org/sites/default/files/20090511jvbSalzburg_0.pdf)

### Food Security And Friction

(Source: Von Braun, Joachim: 'Food security under stress from price volatility, agricultural neglect, climate change and recession' – IPC Spring Seminar, 11 May 2009)

ample is Daewoo Logistics' lease of 1.3 million hectares of land in Madagascar (half of Madagascar's arable land) to grow corn and palm oil for biofuels. Such investments have potentially large negative impacts on food security, particularly when land is taken from producing food available for domestic consumption to producing plantation crops for export or biofuels. Climate change is likely to exacerbate this rush for resources. But conflict over resources is not inevitable. Scarce resources can be utilised peacefully, as evidenced by the more than 200 water treaties negotiated in the past 50 years. But the number of people who will be affected by climate change, and the poverty and political instability often prevalent in the regions that will be hardest hit by climate change, significantly increase the propensity for conflict in coming years.



Hoglabunia, Bangladesh: Babul Bepari (42) shows paddy produced on his field.

Photo: Amio Ascension

# FOOD SECURITY

## Effective Responses

*“The climate change that the world is already locked into has the potential to result in large-scale development setbacks, first slowing, then stalling and reversing progress in poverty reduction, nutrition, health, education and other areas ... Hoping – and working – for the best while preparing for the worst, serves as a useful first principle for adaptation planning.” (2007/2008 UN Human Development Report)*

**Smallholder Farming:** The scale and complexity of climate change as it affects the food and water security of the poorest makes effective assistance strategies and actions a major undertaking. Some idea of this complexity is evident from John F. Morton's examination of the impact of climate change on subsistence or smallholder farmers. <sup>(68)</sup> Morton finds that the impact of climate change on these people is difficult to assess. The terms subsistence and smallholder farming (SSF) cover a diverse range of farming systems with varying characteristics, including the amounts of purchased inputs used, the extent of family labour employed, and the degree of market involvement enjoyed. Beyond these, there are variations in land tenure, farming methods, soil-related limitations, types of risks, extent of off-farm income, access to food from gathering and hunting, and other variables. Characteristics such as the use of family labour or off-farm income are sources of resilience.

**Combined Approach:** Assessment of the impact of climate change on SSF has typically taken one of two main approaches – quantitative projections at various geographical levels, or a more qualitative approach focusing on adaptation. Morton claims that to date there has been little integration of these two approaches. He argues for an approach that combines the biological impacts of climate change on crops and livestock with specific features of livelihoods. Such an approach would acknowledge the complexity of SSF agricultural systems, the fact that they are highly location specific, and that they are also subject to non-climate related stresses. Moreover, it would recognise that there are three main channels of climate change impact – biological at a small-scale level (fields and individual animals), environmental and physical (landscape or community level), and impacts on health and non-agricultural livelihoods.

**Raising Resilience:** The complexity of the interaction of climate change with SSF agriculture and food and water security gives rise to numerous types of assistance. The global food crisis has drawn attention to several strategies that can improve climate change adaptation (and to some extent mitigation) in developing countries. The importance of SSF in the agriculture sectors of the poorest countries means that greater food security and climate change resilience is simply not possible without increased productivity in this sector. How this is achieved will vary from region to region and between countries. The Global Humanitarian Forum's *Forum 2008* identified 'Increased support to small-scale farmers, including through resources, meteorological and agricultural information, cooperative organizations and equitable land tenure regulations.' It also emphasised improved seed quality, market knowledge and stronger farmers' organisations. <sup>(69)</sup>



Photo: Andrew Goodwin

■ **Northern Bangladesh:** Dried rice paddy. Climate change adaptation strategies must be underpinned by action on mitigation.

**Cultivating A Culture Of Learning:** The Global Humanitarian Forum also drew attention to the need to sensitively introduce new information and techniques to counter the impact of rapid climate change on traditional agricultural knowledge. Traditional knowledge is likely to be the distillation of decades of farming experience. Rapid climate change will most likely mean that that the explanatory power of this knowledge is reduced – it becomes less able to guide farmers in important areas such as what to grow when and where. 'Consequently, it is important to create an effective partnership between traditional knowledge and new developments and technologies, along with appropriate education.' <sup>(70)</sup> (Of course, some traditional knowledge and skills gained from farming in harsh environments may become more important as the effects of climate change are increasingly felt.) In particular situations, improving water harvesting and soil quality, reducing land degradation or reforming land tenure may be critical. Recognising the importance of women in agriculture and helping them achieve a greater role in decision making is likely to be a central strategy in improving food security. As reduced agricultural R&D by government and other institutions <sup>(71)</sup> has been a significant cause of the slowdown in agricultural productivity, increased R&D spending, particularly in developing countries, is key to increasing yields. And consistent with World Bank thinking, stronger social safety nets for small-scale farmers will be important to help people stay on the land rather than drift to cities. Perhaps more than is the case with food security, the technology exists to considerably improve water security. Available strategies include improved rainwater harvesting, greater use of less water-intensive crops, and more efficient (e.g. drip) irrigation systems. For the poorest, the hurdle is typically cost, even for the most basic rainwater collection equipment. 'Sensible pricing of water, avoiding wastage while ensuring a basic supply for all should be priorities for all countries.' <sup>(72)</sup> Finally, World Vision's Humbo project in Ethiopia shows how it is possible for an extremely poor region to develop responses to benefit from the emerging international carbon reduction institutions.

## Case Study 4: Ethiopia Humbo Forestry Project

### Context

Ethiopia is one of the poorest nations in the world, with per capita GDP of just \$177 per annum. It is prone to periodic droughts and flooding, and natural resources are scarce. The agricultural sector dominates the economy, accounting for nearly half of GDP and employing the vast majority of the population. <sup>(73)</sup> Over-exploitation of forest resources has left less than 3% of Ethiopia's native forests untouched. Severe erosion reduces the capacity of the land to absorb water, and has resulted in increasingly severe cycles of drought and flood. With 90 percent of Ethiopians dependent on agriculture for their livelihood, recurrent droughts and floods create poverty traps for many households, constantly thwarting efforts to accumulate assets and invest for a better future.

Chronic food insecurity has left many of Ethiopia's children particularly vulnerable – malnutrition is responsible for more than half of all deaths among children under age five. <sup>(74)</sup> Droughts and floods intensify the pressures on poor households to take children out of school and engage them in income generating activities. <sup>(75)</sup> Climate change, which intensifies natural climatic variability and exacerbates erosion, already evidences a direct and adverse effect on health and education levels. By exacerbating the natural challenges faced by Ethiopian agriculturalists, climate change threatens to unwind recent development gains and further entrench chronic poverty and food insecurity.

### Humbo

The Humbo district is located about 420 km southeast of the Ethiopian capital, Addis Ababa. Of the nearly 50,000 people in Humbo, an estimated 85% live in poverty. High population density, variable rainfall, environmental degra-

dation and an over-reliance on maize have caused chronic food shortages. Poverty, hunger, and increasing demand for agricultural land have driven local communities to over-exploit once plentiful forest resources. This deforestation threatens groundwater reserves that provide 65,000 people with potable water. Soil erosion is also a severe problem in Humbo. Heavy rain events regularly cause lowland areas to flood, and in extreme events, mudslides kill people and livestock and damage crops, roads, bridges and other infrastructure.

### Climate Change Challenge

Climate change will compound Ethiopia's vulnerability. The diversity of Ethiopia's landscape – from temperate mountain plateaus to hot, humid lowlands – means that the impacts of climate change will vary across the country. The highlands are becoming warmer and wetter, and based on regional climate change predictions, tropical storms are likely to become more intense. Ethiopia's lowlands are already experiencing higher temperatures, prolonged droughts and less rainfall, but also significant flooding from increased rainfall in the highlands, and increased cyclonic conditions. <sup>(76)</sup> In Humbo, increased cyclone activity and highland rainfall will lead to soil erosion, flooding and mudslides, while prolonged drought conditions will be exacerbated in lowland areas. Patterns of disease outbreaks are changing in response to the changing climate. Warmer and wetter highland conditions are creating breeding sites for malaria-carrying mosquitoes in areas once reasonably free of the disease. Climate change is likely to increase malaria infection by 16-28%. <sup>(77)</sup> And following the extreme floods of 2006, Ethiopia experienced a cholera epidemic and widespread loss of life.

### World Vision's Response

World Vision has a long history of community development work in Ethiopia, and has been in the Humbo region ever since a severe famine occurred there in 1984. Over





Photos: World Vision Ethiopia



#### ■ Humbo mountain, Ethiopia:

In 2007, only one year into the programme, rapid revegetation is occurring (bottom) in an area previously plagued by erosion (top).

time, it became increasingly apparent that important development work in natural resource management had the potential to provide poor communities in Humbo with a sustained source of income. In particular, under the Kyoto Protocol's Clean Development Mechanism (CDM) there was an opportunity to pilot an innovative forestry project that would also meet the community's developmental needs. The CDM allows industrialised countries with emissions reduction targets to invest in (cheaper) projects that reduce emissions in developing countries as a supplement to their domestic efforts. To be approved, CDM projects must show that those particular emissions would not have been reduced without the additional incentive of the carbon credits produced. Recognising the links between forest preservation, climate change mitigation, and the protection of livelihoods, World Vision began groundbreaking work, establishing Africa's first carbon trading forestry project.

After two years of consultation, planning and negotiations, the Humbo Community-based Natural Regeneration Project was born, becoming Ethiopia's first *Land Use, Land Use Change and Forestry (LULUCF)* carbon trading initiative. The project involves the regeneration of degraded forests with indigenous, bio-diverse species. These forests act as a 'carbon sink,' absorbing and storing greenhouse gases from the atmosphere to mitigate climate change while at the same time building environmental, social and economic resilience. While conventional approaches to reforestation require costly replanting of trees from nursery stock, over 90 percent of the Humbo project area is being reforested using Farmer Managed Natural Resource (FMNR) forest regeneration. When farmers fell trees for wood, a series of live tree stumps are left, each of which sprout multiple shoots. The farmers decide which of these shoots to keep and cut away the excess, giving the selected shoots room to grow. To supplement the FMNR reforestation, newly established tree nurseries are also raising over 450,000 seedlings each year to restore the forest where no living tree stumps remain.

Responsible for the management and protection of the re-generated forest are seven village-level cooperatives. World Vision staff are providing technical training and building the capacity of cooperative members. Much effort has also been invested in community consultation, education and awareness raising about carbon trading. The sale of carbon credits will eventually provide an additional income stream to facilitate further development.

The Humbo project is the first large-scale CDM project for World Vision, as well as for Africa, and is due to be registered by the World Bank. Considerable negotiation has been required at national, state, local government and community levels. Partnership arrangements were made between WV Australia, WV Ethiopia, the World Bank, the Ethiopian Environment Protection Agency, as well as local and regional governments and the community. This process, while time-consuming and requiring skills beyond the capacity of poor communities, laid a strong foundation for the project and for establishing future carbon projects in a more timely and cost effective manner.

### **Achievements**

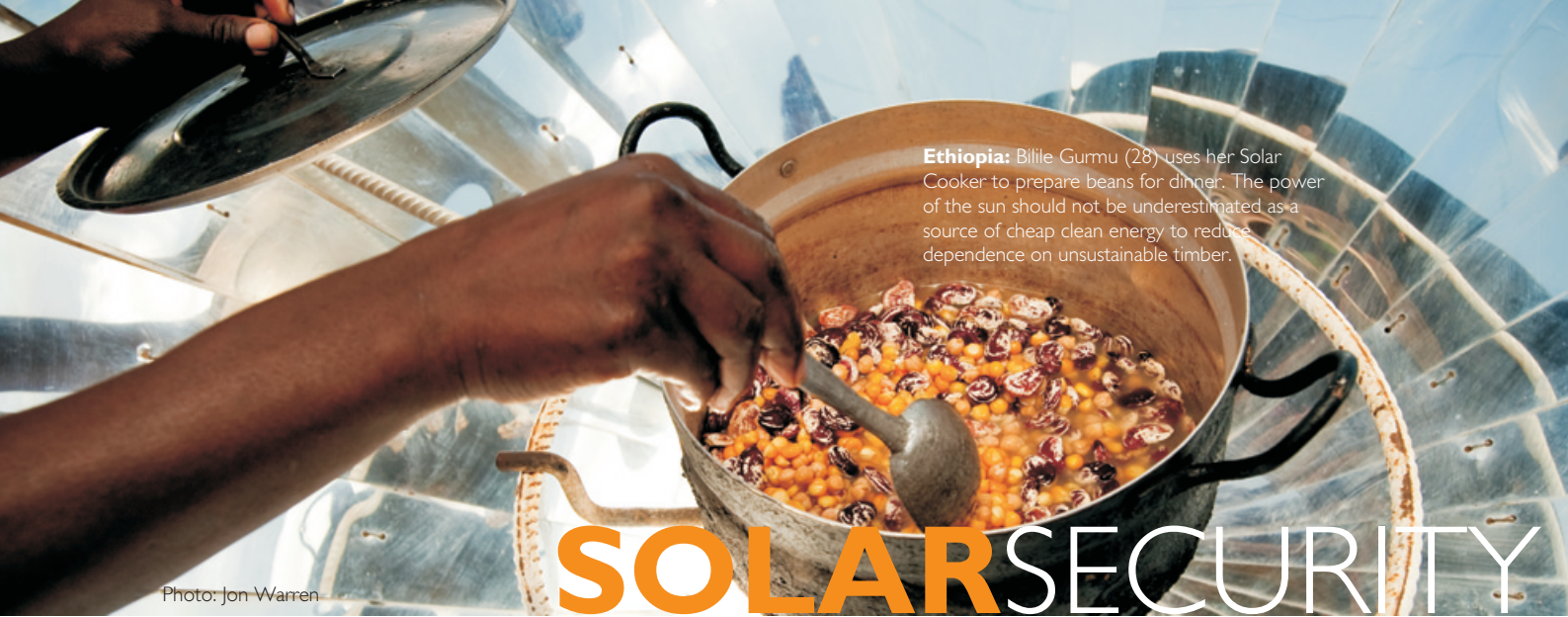
The Humbo project is a highly successful example of reforestation that alleviates poverty while addressing climate change through improved natural resource management. To date, 2,728 hectares of degraded forest that were being continually exploited for wood, charcoal and fodder have been protected, and are now being restored and sustainably managed. Over the 30 year crediting period, it is estimated that over 870,000 tonnes <sup>(78)</sup> of carbon dioxide equivalent will be removed from the atmosphere, making a significant contribution to mitigating climate change. While many carbon trade deals have been stifled by the high cost of reforestation, the Humbo project has overcome this barrier through the use of the cost-effective FMNR approach. Eventually it is hoped that carbon credits will provide a supplementary income stream for the community.

Reforestation has resulted in increased production of tree products, including honey, medicine, fibre, fruit and wildlife that contribute to household economies. Improved land management has stimulated grass that provides fodder for livestock and can be cut and sold as an additional source of income. At one site, Bola, 300 bundles of grass were harvested and sold in 12 months – an excellent outcome given the project was in its first year.

Reforestation is also reducing land degradation and soil erosion. Water infiltration is improving, resulting in the re-charging of ground water and a reduction of flash flooding. (Because the rainfall is seasonal, the rivers are also seasonal and do not flow for much of the year, hence the risk of flash floods). With the likelihood that climate change will cause increased rainfall in Ethiopia's highlands, stabilising soil is essential for reducing vulnerability to flash flooding and increasing agricultural production. Crops surrounding reforested areas also benefit from modification of the microclimate, which comes about through a combination of reduced wind speed, lower temperatures, higher humidity and greater infiltration of water into the soil. The resulting healthier crops and livestock are essential to community members' nutritional status, health and livelihoods.

The Humbo project shows that community-based restoration of forests can contribute to climate change mitigation while building environmental and social resilience to the impacts of climate change. Importantly, the regeneration of the Humbo forest is also producing tangible benefits for the wellbeing of local communities. When a preliminary review of forestry activities was conducted in July 2008, a common sentiment expressed by community members was:

*We are too much happy. We never expected to see so much grass growing from these rocky, barren slopes, to see trees growing so quickly or to harvest firewood so early in the programme.*



**Ethiopia:** Bilile Gurmu (28) uses her Solar Cooker to prepare beans for dinner. The power of the sun should not be underestimated as a source of cheap clean energy to reduce dependence on unsustainable timber.

Photo: Jon Warren

# SOLARSECURITY

## Global Opportunities

***“The starting point for action and political leadership is recognition on the part of governments that they are confronted by what may be the gravest threat ever to have faced humanity ... The starting point is political leadership ... Government leaders need to send a clear signal that the battle against climate change has been joined – and that the future will look different to the past.” (2007/2008 UN Human Development Report)***

**Food Security Programmes:** Climate change undoubtedly throws out challenges that are novel in human history. But not all effective responses will be new. Climate change will often manifest as more extreme versions of problems encountered for many decades, if not centuries. World Vision's half a century of working with the world's poorest people has provided programming experience that is directly relevant to the climate-induced challenges of the 21st century. <sup>(79)</sup> In addition to the four case studies discussed in this report, World Vision has other programmes that are contributing to improving community adaptation and resilience to climate change. All these programmes show how well-developed interventions to improve food and water security are relevant to helping the poor adapt to and mitigate current and future impacts of climate change. A selection of these World Vision programmes with climate change implications are discussed next.

**Angola:** Angola has suffered from a sustained period of civil war. Since 1989, with public, private and non-government partners, World Vision has been working to build agricultural capacity in the central highlands through a variety of measures. These include maize and bean seed distribution and local seed production; training in improved farming practices; broadcasting twice-weekly the 'Farm Talk' programmes in two languages; and the distribution of battery-free radios to hear the programme on. In World Vision's Menongue in the Okavango River Basin Natural Resources Management project, seed banks and nurseries have been established to ensure a sustainable supply of seeds, and farmer field days have been organised to demonstrate improved post-harvest techniques. And in Huambo province in Angola's central highlands, World Vision has developed seed production enterprises to produce higher output seeds that are better suited to local conditions.



**Chad:** In the Mandoul region of southern Chad, World Vision has increased potato production through improved seeds, building potato storage units and improving access to markets to sell potatoes; worked to improve food stability by establishing and providing credit to food banks (for cassava, peanuts, sorghum and yams); provided training in storage management; and improved food utilisation by planting moringa trees (the leaves of which are a valuable source of vitamins C and A, calcium and protein).

**Democratic Republic of Congo:** In Kirotshe, World Vision (through the Food Security Rehabilitation Project) has distributed goats and their offspring to families in the region; distributed improved cassava cuttings better able to resist mosaic virus; and provided training in land management to help offset declining soil fertility and increasing erosion.



Photo: Jon Warren

■ **Ethiopia:** Climate change and a heating planet mean that the power of the sun should be harnessed as much as we can.

**Dominican Republic:** In the Tiroli region on the Dominican Republic-Haiti border, World Vision has constructed a greenhouse to produce fruit tree and forest tree seedlings to increase incomes and offset deforestation from tree clearing to expand land for agriculture. Reforestation will also improve the quantity and quality of water entering the catchment area.

**Haiti:** In response to irregular rainfall and low incomes in the Bassin Diamin area, World Vision has introduced micro-drip irrigation systems and dug wells; trained farmers (mostly women) in small-scale vegetable production for personal consumption and sale; provided training in crop marketing; and supplied low-interest credit for the purchase of seed, fertiliser, and other inputs.

**Honduras:** To increase agricultural productivity in Intibucá, World Vision has installed drip irrigation systems, trained farmers on their maintenance, and organised the provision of finance to farmers. In the Los Pirineos-La Pozona micro-watershed project, to help ensure a more stable food and water supply during the five month dry season, World Vision has built community water reservoirs and family rainwater storage systems; constructed irrigation dams and a piped irrigation system; trained farmers and cattle ranchers in more sustainable techniques; and restored forest near primary water resources.

**Liberia:** In the Todee district, World Vision has worked to support sustainable agriculture including training in irrigation and water control activities, and has established 67 farming groups in 30 communities.

**Mozambique:** Poor soil fertility, low rainfall and unsustainable firewood production have jeopardised food security in the southern Mozambique region of Manjacaze. In its Thlango food security project, World Vision has promoted the utilisation of pedal pump irrigation using water from coastal lakes to produce vegetables and other crops; increased rice production by rehabilitating small-scale irriga-



tion projects; and improved poultry production through immunisation of chickens. In the Sabe community in central Mozambique, World Vision has worked to offset poverty, malnutrition and weather-related disasters on food security by introducing cattle to reduce time spent tilling and weeding fields; established seed multiplication fields; and introduced bee keeping to discourage uncontrolled burning (because beehives need forest habitats).

**Senegal:** In northwestern Senegal, deforestation and periodic droughts and locust plagues put considerable pressure on food security. World Vision has used tree growing projects to generate income from firewood, timber or charcoal, improved soil through fixing nitrogen, and reduced dust storms, desertification and other soil degradation. In the Kolda region, heavy rainfall restricts agricultural production to four months of the year. To increase farmer incomes, World Vision has implemented drip irrigation; extracted greater value for farmers by removing middlemen from the production chain; and encouraged production of less perishable crops for consumption and sale.

**Sierra Leone:** Bagbo in southern Sierra Leone has suffered from poor soil and a lack of access to markets, credit and new technologies in the wake of the civil war that ended in 2003. World Vision has worked with government departments, local authorities and community organisations through the SEED (Sustainable Livelihood and Effective Economic Development) project to reduce food insecurity by increasing food supply and improving access to markets. World Vision also provides education for literacy and HIV and AIDS prevention.

**Sri Lanka:** The Hambantota district of southern Sri Lanka suffers from inadequate rainfall, lack of irrigation and farming knowledge, low nutrition food crops, insufficient income to purchase quality farming inputs, and pest and crop diseases. World Vision has trained local farmers in improved crop production, including better seed and plant variety choices, and livestock production.

**Swaziland:** The Maphalaleni community in northwest Swaziland has experienced prolonged dry periods and high temperatures that destroyed the 2006 corn crop and resulted in 2006-07 corn production being the lowest on record. To increase food output, World Vision has provided farm inputs, including seeds to vulnerable households; helped with the construction of water harvesters; supplied livestock and pest control chemicals to farmers; and provided training on crop and animal production and crop diversification.

**Tanzania:** To help farmers in the Hai district cope with scarce and variable rainfall, World Vision has provided animals (cows, pigs and chickens) on a loan basis to improve food security directly and through higher incomes; trained women household heads in livestock management; and trained 150 people in the use of biogas.



■ **Adama, Ethiopia:** Rainwater catchment systems are useful in arid regions with irregular rainfalls or erratic downpours.

**Table 2: Summary: World Vision Development Programming And Climate Change**

Country Region	Main Aspects of Food / Water Security Affected					Climate Change Adaptation / Mitigation
	Availability	Stability	Access	Utilisation	Water	
Angola, Huambo	x	x	x			Agricultural practices
Angola, Menongue	x	x				Deforestation alternatives
Chad, Mandoul	x	x	x	x		Intro nutritious crops
DRC, Kirothse	x					Intro better species
Dom. Rep. / Haiti, Tirolé	x		x		x	Reforestation
Haiti, Bassin Diamin	x	x	x		x	More efficient water use
Honduras, Intibucá	x		x		x	More efficient water use
Honduras, Pirineos-La					x	Watershed management
Liberia, Todee	x	x			x	More efficient agriculture
Mozambique, Manjacaze	x	x		x	x	Small-scale irrigation
Senegal, Northwest	x	x	x			Tree regeneration
Senegal, Kolda	x	x	x		x	Small-scale irrigation
Sierra Leone, Bagbo	x	x	x			Microfinance
Sri Lanka, Hambantota	x	x		x		Improved plant/seed choice
Swaziland, Maphalaleni	x	x		x	x	Indigenous vegetables
Tanzania, Hai	x	x	x		x	Biogas alternative energy

**Tillaberi, Niger:** At the river, women and children gather water, do laundry, wash dishes, and bathe.



Photo: Andrea Peer

## Meeting Food And Water Challenges

***“I have spent decades listening to people talk about Africa’s problems, making promises to help. It’s an experience that has left me thirsty for concrete action ... The final point I wish to make is this: no country or region of significant size has been able to lift itself out of poverty without raising productivity in its agricultural sector. This is our challenge.” (Kofi Annan, former Secretary-General of the United Nations, launch of AGRA)***

**Fair’s Fair:** The scale and scope of climate change challenges to food and water security are unprecedented. The United Nations Development Programme has estimated that unchecked, by 2080 climate change could increase the number of malnourished people by 600 million and increase the number of people facing water scarcity by 1.8 billion. <sup>(80)</sup> Responses must occur at the global, national, regional and local levels if such a catastrophic outcome is to be avoided. At the global level, one major challenge is to ensure that the funding from the developed world is sufficient to produce a large and durable improvement in food and water security in the most exposed developing countries. In practice, this means ensuring sufficient aggregate funding for both global climate change mitigation (impact reduction) and adaptation (impact management) to climate change in the poorest countries. As has been shown in this report, both food and water security are extremely

susceptible to climate change, and will require a significant share of the total available funding. If total mitigation and adaptation funding is insufficient, then it is unlikely there will be adequate funding to make the needed improvements in food and water security, trapping many millions of people in a vicious circle of poverty, malnutrition, and hunger. A commitment to new financial support for mitigation and adaptation in developing countries is one of the four building blocks of the Bali Action Plan, which set out the framework for the two years of negotiations which conclude in Copenhagen this December. <sup>(81)</sup> Developed countries need to be held to this commitment. Estimates of the total amount of funding needed vary. The amounts are large, but are undoubtedly achievable, particularly given that funding was rapidly found for assistance and stimulus packages during the recent financial crisis. (See Appendix for estimated funding requirements.)

**Agricultural Research:** World Vision calls for a substantial increase in funds to be directed to adaptation and mitigation efforts in developing countries. Funding directed to adaptation and mitigation needs to be additional to the 0.7% of Gross National Income (GNI) already pledged by donor countries before climate change emerged as a unique global challenge. Over time it will become increasingly difficult to separate official development assistance into climate and non-climate related aid, so consideration should be given to raising the ODA contribution from rich countries to above the pledged 0.7% of GNI. A second global challenge is how to raise the necessary finance. Voluntary pledges from countries will not be enough to meet the scale of funding required. There have been a number of innovative proposals for new finance mechanisms such as auctioning developed country emission allowances (proposed by Norway), a levy on international shipping and aviation emissions (proposed by Tuvalu), and a 'Green Fund' (proposed by Mexico). It is likely that a number of these proposals will need to be considered. Whichever mechanism is chosen, the funds should be predictable, reliable and administered by institutions in which developing countries are well represented. An important response to both the current food crisis and the ongoing pressure of climate change on developing country food production is to make increased spending on agricultural research and development a priority. In development programming, increasing agricultural productivity must also have a higher priority. As previously discussed, this may mean that other, sometimes novel, strategies be given a greater role. For example, increasing access to information – not only market information but also weather-related information, even down to the state of roads and other infrastructure after extreme weather events – is likely to become important in increasing resilience and maintaining or improving access to more lucrative market opportunities. Facilitating the spread of mobile telephony will play a part here. And helping women achieve a greater role in decision making will be important, given the knowledge and experience of food production women have in many developing countries.

**Overcoming Obstacles:** Climate change will affect the world's poorest, particularly children. At the global level, working with others to ensure the developed world meets its moral responsibility to guarantee sufficient funding to the poorest and most vulnerable communities is an important advocacy task. At the field level, a wide range of challenges face communities and NGOs, including:

- Educating farmers to change practices, such as burning stubble, that release CO<sub>2</sub> into the atmosphere
- Determining how best to work with people in parts of southern Africa who have a strong cultural attachment to maize, given the higher water requirements of maize compared to alternatives such as sorghum and millet
- Increasing environment-enhancing activities that strengthen food and water security, including reforestation, agro-forestry, and organic and sustainable farming in Area Development and other field programmes
- Dealing with an increasing number of climate-related humanitarian and emergency situations without losing sight of the need to help improve the lives of the poorest long-term

World Vision's experience gained through the Humbo project highlights the need for improved carbon trading and extensive community engagement, including:

- Streamlined and simplified compliance requirements more suited to a developing country context need to be developed. This may be easier to achieve in the voluntary carbon market
- A higher price for carbon is required in order to cover both project costs and provide adequate remuneration to participating communities to help them meet the challenges climate change presents, including to food and water security





Photo: Howard G. Buffett / World Vision

■ **Chad, Africa:** A refugee carries a battered suitcase on her head over the parched desert sands.

**Old And New Ways:** World Vision Ethiopia is looking to launch several carbon offset reforestation programmes in the near future. Public financing raised through new and innovative mechanisms should be used to support the commencement of mitigation projects such as this in the future to those countries with limited resources or technical capacity. Of course, NGOs are not starting from scratch. As noted in this report, World Vision has half a century of experience working in many of the most food insecure countries. Further, as subsistence and smallholder farmers are frequently based in marginal, drought-prone areas, they have often already developed, over many years, adaptation and coping strategies relevant to climate change. But both the work of development agencies and the strategies of farmers may be stretched to the limit in coming years.

**Summary:** In short, there is much to do. The bottom line remains this: failure to achieve substantial climate change adaptation and mitigation in the communities and countries where World Vision works means that food and water insecurity will rise, dragging hundreds of millions more into extreme poverty and misery. For children in particular, this will mean rising malnutrition, sickness, stunting and inadequate education which will guarantee the most vulnerable will remain exposed to increasingly frequent and debilitating environmental and social shocks. For World Vision this simply cannot be an option.

***“You can’t grow a crop because the water’s all gone  
Starin’ at a desert where there once was a farm  
People doing nothing while they’re crippled by fears  
Cos you can’t grow a crop when it’s watered by tears.”***

*From the song Give the Water Back, Doug Kerr, 2009*

## World Vision's Recommendations

*As an international child-focused development agency, World Vision believes a range of actions are essential both to improve the food and water security of the most vulnerable communities, and where possible, to mitigate the impact of climate change on food and water availability over the longer-term.*

### National Level:

- **Build** partnerships between government, non-government agencies and the private sector to
  - improve the productivity of subsistence farmers and smallholders
  - increase the capacity of the agriculture sector to adapt to climate change
  - increase the volume and effectiveness of agricultural R&D to achieve greater food and water security, and economic development more broadly
- **Develop** improved carbon trading mechanisms. This will require, among other elements
  - Streamlined and simplified compliance requirements more suited to a developing country context. This may be easier to achieve in the voluntary carbon market.
  - A higher price for carbon that better reflects its true social and economic cost to cover both project expenses and ensure adequate funds reach participating communities to help them meet the challenges climate change presents, including those to food and water security
  - Incorporate extensive community engagement to build long term commitment
- **Help** women achieve a greater role in decision making so that the knowledge and experience of food production that women have in many developing countries is better utilised.
- **Improve** social safety nets for small farmers to help them stay on the land producing food

### Global Level:

- **Ensure** funding from the developed world is sufficient to produce a large and durable improvement in food and water security, especially in the most exposed developing countries. In practice, this means ensuring sufficient aggregate funding for both global climate change mitigation (impact reduction) and adaptation (impact management) in the poorest countries. Food and water security is extremely susceptible to climate change, and will require a significant share of the total available funding.
- **Ensure** developed countries provide additional public financing for adaptation and mitigation efforts in developing countries. Funding directed to adaptation and mitigation needs to be additional to the 0.7% of Gross National Income (GNI) already pledged by donor countries before climate change emerged as a unique global challenge. A commitment to new financial support for mitigation and adaptation in developing countries is one of the four building blocks of the Bali Action Plan, which set out the framework for the two years of negotiations which conclude in Copenhagen this December. Developed countries need to be held to this commitment.
- **Investigate** the use of financial risk sharing mechanisms, such as disaster insurance, catastrophe bonds, weather or index-based derivatives, and micro-insurance, to help reduce the climate-induced uncertainty facing farmers in developing countries

## Appendix

### I. Examples of Land Investments to Ensure Food And Energy Security (Table 3)

Country investor	Country target	Plot size (hectares)	Current status	Source
Bahrain	Philippines	10,000	Deal signed	<i>Bahrain News Agency</i> , February 2009
China (with private entities)	Philippines	1,240,000	Deal blocked	<i>The Inquirer</i> , January 2009
Jordan	Sudan	25,000	Deal signed	<i>Jordan Times</i> , November 2008
Libya	Ukraine	250,000	Deal signed	<i>The Guardian</i> , November 2008
Qatar	Kenya	40,000	Deal signed	<i>Daily Nation</i> , January 2009
Saudi Arabia	Tanzania	500,000	Requested	<i>Reuters Africa</i> , April 2009
South Korea (with private entities)	Sudan	690,000	Deal signed	<i>Korea Times</i> , June 2008
United Arab Emirates (with private entities)	Pakistan	324,000	Under implementation	<i>The Economist</i> , May 2008

Source: IFPRI has compiled this table from media reports. The responsibility for the accuracy of the information presented here, however, lies with the reporting media.

Note: A more extensive listing of media reports on overseas land investments is available on IFPRI's website at <http://www.ifpri.org/pubs/bp/bp013Table01.pdf>. Well-documented examples are scarce, details on the deals are often murky, and some reports are contradictory. IFPRI invites observers to share evidence-based information on the listed and on new land deals by posting a contribution on IFPRI's blog at <http://ifpriblog.org/2009/04/24/landgrab.aspx>.

**II. Potential Funding Requirements:** Estimates of funding needed for climate change mitigation and adaptation vary considerably. For example: <sup>(82)</sup>

- Estimation of annual adaptation costs in developing countries - at least \$50 billion (Oxfam), \$86 billion by 2015 (UNDP), \$28-67 billion by 2030 (UNFCCC) <sup>(i)</sup>
- Tackling deforestation - Stern estimates that to halve deforestation will cost \$3-33 billion per year. <sup>(ii)</sup> The Eliasch review estimated that to halve emissions from the forest sector by 2030 would cost between \$17-33 billion per year. <sup>(iii)</sup>
- Potential costs of mitigation – The UNFCCC's 2007 report on investment and financial flows estimates that by 2030 \$200-210 billion will be required to reduce emissions with roughly 46% of these funds needed for developing countries. <sup>(iv)</sup> However, this report is based on a scenario which would lead to more than 2 degrees centigrade global warming, the tipping point for dangerous climate change. Mitigation costs to

stay below 2 degrees would therefore likely be significantly higher.

- In addition the report from the Oxford Institute for Energy Studies <sup>(v)</sup> states "To reach the minimum adequacy levels expressed in submissions by China, India, and the G77, the assessed contributions of EU Annex II Parties ... would have to be \$53 billion per annum."

The recent report by Parry et al. however, concludes that the UNFCCC has probably substantially underestimated costs for adaptation in developing countries. To date, global adaptation cost estimates refer to the annual cost of adapting to 'median' climate change over the next 20 years, and do not necessarily cover estimates of the social costs of climate change (including adaptation costs plus damages after adaptation) over the atmospheric lifetime of greenhouse gases.

## Endnotes

***“The only near certain conclusion we can draw from the changing climate and people’s response to it is that there is little time left in which to act. Therefore my plea is that adaptation is made at least equal in importance to policy-driven attempts to reduce emissions.” (James Lovelock, independent scientist, researcher and environmentalist) <sup>(84)</sup>***

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- (10) FAO Food Outlook: Global Market Summaries <http://www.fao.org/docrep/011/ai482e/ai482e01.htm>
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- (14) UNEP Rapid Response Assessments: The Environmental Food Crisis <http://www.grida.no/publications/rr/food-crisis/page/3562.aspx>
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