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Up in smoke? Asia and the Pacific

The threat from climate change to human development and the environment

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The fifth report from the Working Group on Climate Change and Development



The human drama of climate change will largely be played out in Asia, where over 60 per cent of the world's population, around four billion people, live. The latest global scientific consensus from the Intergovernmental Panel on Climate Change (IPCC) indicates that all of Asia is very likely to warm during this century. Warming will be accompanied by less predictable and more extreme patterns of rainfall. Tropical cyclones are projected to increase in magnitude and frequency, while monsoons, around which farming systems are designed, are expected to become more temperamental in their strength and time of onset. This report asks, will global warming send Asia and the Pacific 'up in smoke'?

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Foreword

I had the privilege of writing the foreword for the first *Up in smoke* report published in 2004 by a group of NGOs focusing on climate change and development. I am glad that the current volume continues in the same spirit and direction that was evident in the first. It is becoming increasingly clear that development policies and initiatives will have to include explicitly several aspects related to climate change. While going through the foreword that I wrote for the 2004 volume, I find that the concerns and priorities that I had touched on as part of that write-up, if anything, have become stronger, and the uncertainties associated with what I had stated then have been reduced significantly.

Since 2004, we have recently brought out three reports of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report which deal with the physical-science basis of climate change; aspects of impacts, vulnerability and adaptation, as well as mitigation issues. One dominant characteristic of these reports is the significant advance that has taken place in knowledge related to climate change based on recent research that has been carried out in several parts of the globe. Unfortunately, there are still gaps which exist in several countries and regions, which require to be filled up urgently through location-specific research if we are to come up with meaningful plans and priorities for action. The reports of the IPCC Working Groups, which have been completed and released this year, shed new light on observations related to climate change in several parts of Asia as well as on projects for the future. It has become clear that Asia would see some major changes as a result of the impacts of climate change, and several of these are becoming evident already. Even more compelling are the projections of future climate change and associated impacts in Asia, which require an integration of adaptation to climate change with development policies. Required measures would include improvements in the efficiency of water use, upgrading healthcare and medical services, proper formulation and implementation of coastal zoning regulations as well as changes in agriculture, which may be affected by reduced yields of some crops.

It is hoped that this volume will be read carefully by policy-makers, researchers, industry executives and members of civil society in Asia and elsewhere, to gain insights into the challenge of climate change in this region and the steps required to tackle it.

**R K Pachauri, Chairman, Intergovernmental Panel on Climate Change (IPCC)
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Executive summary

Summary and overview

The human drama of climate change will largely be played out in Asia, where over 60 per cent of the world's population, around four billion people, live. Over half of those live near the coast, making them directly vulnerable to sea-level rise. Disruption to the region's water cycle caused by climate change also threatens the security and productivity of the food systems upon which they depend. In acknowledgement, both of the key meetings in 2007 and 2008 to secure a global climate agreement will be in Asia.

The latest global scientific consensus from the Intergovernmental Panel on Climate Change (IPCC) indicates that all of Asia is very likely to warm during this century. Warming will be accompanied by less predictable and more extreme patterns of rainfall, including droughts and more extreme inundations. Tropical cyclones are projected to increase in magnitude and frequency, while monsoons, around which farming systems are designed, are expected to become more temperamental in their strength and time of onset. Ironically, if certain types of industrial pollution are reduced, the temporary cooling effect that results from having blankets of smog, could lead to very rapid warming. But existing projections are already bad enough.

The term 'global warming' is misleading, however. While the greenhouse effect is causing an overall warming of Earth, the effects on the climate and weather are regional. The vast expanse of the Asia-Pacific region means it includes a huge diversity of climatic zones. As a result, the impacts of climate change will be equally diverse. There are cold, densely forested regions in the north (boreal Asia), ranging to deserts in the land-locked regions of the Eurasian continent (arid and semi-arid Asia), temperate regions towards the east of the continent (temperate Asia) and regions rich with fauna and flora in tropical Asia. Among these, the arid and semi-arid regions of Asia are set to suffer further shortages and water stress, while tropical, temperate and boreal Asia are likely to experience an increase in flooding.

The Pacific islands, which are scattered across thousands of square kilometres of ocean, are mainly located in the tropics. Many Pacific countries are clusters of numerous low-lying atolls and islands, with tropical forest cover, mangroves and palm-lined beaches. Rising sea levels due to thermal expansion of ocean water and melting glaciers and polar ice caps mean that some communities living on these islands have already fallen victim to the impacts of climate change.

At the same time several factors contribute to an exponential rise in environmental stress that, in turn, increases the vulnerability of people and ecosystems to a changing

climate. These factors include: air and water pollution, water scarcity, and ever increasing consumption that, coupled with mass production for the global markets, produces growing mountains of waste.

Natural climatic variability is hugely significant to this region, in particular the El Niño-Southern Oscillation (ENSO) and the Asian monsoon phenomena. Both result from connections between the atmosphere and ocean, and have large-scale effects. Although ENSO has global impacts, it is a dominant feature of the climate in the Asia-Pacific region. During El Niño, when the Pacific Ocean warms, drought conditions in the Indonesian Archipelago prevail, increasing the risk of forest fires. An ENSO-driven weakening and equator-ward shift of the Asian monsoon often bring summer drought to northwest and central regions of India and heavy rainfall in the northeast. Climate models predict that the increase in strength and magnitude of the ENSO phenomenon due to global warming is likely to weaken the Asian monsoon. But the outcomes are unpredictable and some studies suggest that the retreat of Eurasian snow cover could have the opposite effect and strengthen the monsoon. But movement in either direction puts more pressure on people to adapt.

There is growing consensus about the current challenges facing Asia and what is needed to tackle them. Many of these are elaborated in this report. There is reason to hope. There is already enough knowledge and understanding to know what the main causes of climate change are, how to reduce future climate change, and how to begin to adapt.

This report looks at positive measures that are being taken – by governments, by civil society and by people themselves – to reduce the causes of climate change and to overcome its effects. It gives examples of emissions reduction; alternative water and energy supply systems; preservation of strategic ecosystems and protected areas; increasing capacity, awareness and skills for risk and disaster management; and the employment of effective regulatory and policy instruments. The challenge is clear and many of the solutions are known: the point is, to act. In October 2004, *Up in smoke?* – the first report from the UK's Working Group on Climate change and Development – created a united call for action from environment and development groups, identifying three overarching challenges:

1. How to stop and reverse further global warming.
2. How to live with the degree of global warming that cannot be stopped.

3. How to design a new model for human progress and development that is climate proof and climate friendly and gives everyone a fair share of the natural resources on which we all depend.

Climate change in China and India

Just two nations, India and China combined, account for well over one-third of the world's population. Across the two over 250 million people saw their incomes rise above US\$1 a day between 1990 and 2001. Yet even at income levels of around US\$1 a day, infant mortality rates as high as one in six are common. And, malnutrition has been less effectively tackled, particularly in South Asia, where around half the population of 0- to 5-year-olds are malnourished. A decrease in food security due to climate change is likely to exacerbate this problem. Widespread droughts in Indian states, such as Maharashtra, in recent years have contributed to soaring suicide rates among heavily indebted farmers.

Increasingly intense rainfall, particularly during summer monsoon, could increase the risk of flooding. Already a large number of floods have occurred in China in the last few years, mainly over the middle and lower basins of the Yangtze (Changjiang), Huaihe and Haihe.

In arid regions of China, temperatures have risen since the 1970s, and will continue to rise. Rainfall is already low in arid regions, and is expected to decline further, although the temporal and spatial variability of predicted changes in rainfall are high. Drought in north China has increased, resulting in severe agricultural losses. Already, some 82 per cent of the glaciers in western China reportedly are retreating due to climate change.

India's climate is dominated by the southwest monsoon, which brings most of the region's life-giving rainfall. Heavier rainfall during the summer monsoon could increase flooding, but, there is a worse prospect of the monsoon potentially failing with the increasing frequency and intensity of the El Niño phenomenon. With over 6,500 kilometres of low-lying, densely populated land, millions of Indians are at significant risk from sea-level rise. In August 2007, British aid agencies, including those in the Working Group, asked the UK public for funds to assist up to 28 million people affected by flooding in South Asia. Most water sources in affected areas of India, Bangladesh and Nepal were said to be contaminated or submerged.

Farming and food

The threat from climate change to food production in Asia is striking in the case of Bangladesh. Over 70 per cent of Bangladeshis rely on farming in one way or another, and it employs seven out of ten people in the labour force. But temperature and rainfall changes have already affected crop production in many parts of the country, and the area of arable land has decreased. A study by the International Rice Research Institute (IRRI) showed that increases of 1°C at night-time during the growing season, well within the predicted range of global warming, would reduce global rice yields by

'The time for words is over... If the human race has not advanced to the point where we can put aside immediate self-gratification for the larger global good and our own futures, then I fear for what the world of the next ten years and thereafter will become.'

**President Leo Falcam, Federated States of Micronesia
World Summit on Sustainable Development, 3 September 2002**

10 per cent while another global study showed that the production of rice and wheat could fall by eight per cent and 32 per cent respectively by the year 2050.¹ In a region whose population is still rising, if the ability to grow food is weakened by climate change, the health and livelihoods of millions of people will be at risk.

The latest climate National Assessment Report published by the Chinese Government,² estimates that climate change is already having a negative impact on China's agricultural production. If no action is taken, it warns, the productivity of Chinese agriculture will fall by five to ten per cent. By the second half of this century, the production of three staple crops – wheat, rice and corn – could fall by up to 37 per cent. In India, less water for rain- and meltwater-fed agriculture could cause a loss of up to 30 per cent of India's agricultural production, including food grains.

Recommendation

Asia is home to 87 per cent of the world's known 400 million small farms. China alone accounts for almost half followed by India with 23 per cent. Many Asian countries like Indonesia, Bangladesh and Vietnam are also home to millions of small-scale farmers. To cope with a changing environment Asian small-scale agriculture will need dramatically increased support, and an approach to farming built on maximum appropriate, locally adapted crop diversification that boosts biodiversity. Highly diverse systems, as opposed to commercial monocultures, are more resilient and overall are often more productive. Although some technological advances will facilitate adaptation to climate change, farming based on expensive and energy-intensive fossil-fuel-based inputs will be both vulnerable to fuel-price rises and will further add to the release of greenhouse gases and environmental vulnerability. Vitally, small-scale farmers need support by a favourable policy environment and research that addresses the problems that they, themselves, have identified. Greater investment in the agricultural sector is needed to increase productivity. Boosting production and improving distribution is crucial, and doing so requires systems that combine new insights and approaches with the wisdom of traditional farming and drought-control techniques. Governments must guard against the dangers associated with clearing forests and putting biofuels ahead of food crops.

Energy

Eighty per cent of the carbon dioxide released into the atmosphere each year that is connected to human activity is due to the burning of fossil fuels mainly used to produce electricity, heat or transport.

While the use of fossil fuels in Asia continues to spiral upwards, per capita greenhouse gas emissions across the continent are still far below European and American levels. At the same time, Asia is a world leader in developing and installing a vast array of clean, efficient, renewable energy technologies. A combination of solar, wind, hydro, geothermal and biomass technologies are bringing power, heating and light to millions who have never benefited from reliable access to energy. From micro-level household systems to small-scale grids supplying whole communities, more and more people are finding that clean renewable energy is the answer.

In 2004, Cyclone Heta struck the Pacific island of Niue, the smallest nation on Earth, and destroyed 70 per cent of its infrastructure. After the population's immediate needs were met, the Government set out to make Niue the first nation on Earth to meet all its energy requirements from renewable sources. Niue had been entirely dependent on imported diesel for all its energy needs. Now, it has signed an agreement with Greenpeace, to make the shift to wind energy. Other small islands in the Sunderbans off the south coast of India have set themselves similar targets.

The amazing flexibility of renewable energy technologies is visible in the remote region of Chalanbeel in Bangladesh. Here, a fleet of boats fitted with photovoltaic systems deliver a combination of services including children's education, libraries, training in sustainable agriculture, health advice, batteries charged to run solar home lighting systems, mobile phones and Internet access, in which the energy for the services comes directly from the sun.³

Biofuels: blessing or curse?

Biofuels are seen by some as a way to combat climate change and provide an alternative source of fuel in the face of decreasing global oil reserves. Indonesia has some six million hectares of land under oil palm and the Government is actively encouraging further expansion. In 2007, the Indonesian Government signed 58 agreements worth US\$12.4 billion in order to produce about 200,000 barrels of oil-equivalent biofuel per day by 2010 and replace 10 per cent of the country's total oil-based fuel needs. This could result in the emission of an additional 300 million tonnes of carbon dioxide to the atmosphere each year. Cumulatively, the contribution to global carbon dioxide emissions could be very significant.

Deforestation is already the second-largest contributor to rising levels of carbon dioxide in the atmosphere. As a result of deforestation, some of which is for palm oil plantations, Indonesia is the third-largest emitter of carbon dioxide, after the USA and China.⁴ Deforestation to make way for large-scale mono-cropping of energy

crops obliterates the 'green credentials' of the biofuel. In addition, land clearing for large-scale plantations will accelerate the destruction of peatlands, which are vitally important carbon stores – containing nearly 30 per cent of all land carbon stores while covering only three per cent of the land area. But, the rise of the biofuel market is having still wider effects. Its economic attraction is leading to conflict between crops grown for food and those grown for fuel. Increasingly, the result is expected to be both greater competition for land and higher food prices.

Recommendation

Wealthy industrialised countries must act first and fastest to cut greenhouse gas emissions, but emerging Asian countries also need to contribute to climate change mitigation by implementing sustainable development policies that include halting deforestation and developing both energy efficiency and renewable energy.

The exploitation of fossil fuels in Asia brings some short-term economic benefits, but at great current and future risk to the human development and security of its people. Yet, the potential for sustainable and renewable energy across Asia is vast, and the market, especially in poor communities frequently unable to gain power from large grid systems, is huge.

To meet people's need for energy, to 'improve health' at the household level, and to help Asia leapfrog Western style 'dirty development', international donors, financial institutions, energy companies and transnational corporations should phase out investment from fossil fuels. Instead, they should promote access to, while aggressively investing in, renewable and sustainable energy, removing obstacles to the transfer of clean technology, supporting the transition down low-carbon development pathways, and adopting targets and timetables to achieve those objectives. Barriers to accessing state-of-the-art energy technologies by developing countries must be removed and adequate finance must be made available to the developing countries, not as loans, but in the form of non-repayable grants. Abandoning the growth of coal in India and China in favour of decentralised, renewable energy systems would have significant impacts on the trajectory of global emissions growth. Both nations have a large potential for renewable energy. For example, 60 per cent of India's total electricity supply by 2050 could be provided in this way. India and China could choose an efficient and clean development pathway for their energy systems, which would provide them with long-term energy security.

The development of biofuels in Asia places greater pressure on agricultural land and results in the encroachment of plantations into the natural environment, particularly tropical forests. Europe is one of the largest buyers of palm oil grown on former forest areas. The impact on biodiversity is extensive and irreversible, and in many cases benefits accrue only to governments and large corporations rather than local communities. Conflict over rights to use land often occurs, and inevitably the poor lose out.

An urgent assessment is needed of whether there are carbon benefits from different biofuel schemes, as studies indicate that carbon release from forest clearance and soils due to palm-oil plantations can render them far less carbon efficient than conventional fossil fuels. Western governments, investors and biofuel companies should undertake full impact assessments on a case-by-case basis before further expanding plantations for biofuels. These should include assessments of their costs and benefits in terms of social, economic, energy and environmental factors. Social and environmental standards for biofuel plantations must be developed and adhered to.

Health

Global warming will cause multiple impacts on human health and a wide range of diseases – vector-borne, water-borne and respiratory – have demonstrated links to climatic changes. The most vulnerable people will be older age groups and urban poor populations.

Already some regions are suffering the consequences. For example, Bangladesh is already vulnerable to outbreaks of climate-sensitive diseases. Incidences of malaria have dramatically increased in the last 30 years, and malaria is now a major public health problem. Other diseases like diarrhoea, skin diseases, asthma, hypertension, dengue and dysentery are also increasing, especially during the summer months. Climatic factors, such as temperature, rainfall and salinity, are directly connected to incidences of diarrhoea, skin diseases, kala-azar and other illnesses. Climate change is also likely to affect the distribution, lifecycle, and population dynamics of dengue fever. Additional factors, such as dehydration, malnutrition and heat stress, especially among children and the elderly, are closely linked to water supply, sanitation and food production. All will be affected by the fact of global warming. Climate change will mean that there will be less clean water for a country where waterborne diseases are already responsible for 24 per cent of all deaths.

Hurricanes, storms and heavy rainfall have direct life-threatening impacts. Urban and coastal populations are particularly at risk from storm surges, flooding and coastal erosion. Increased incidences of disease also follow floods. Access to safe drinking water is compromised by drought and other factors, such as glacial melt. Health is further threatened when nutrition is undermined by the impact of weather extremes on farming.

Chemical pollution from floodwaters is an additional health risk. Floods may result in the inundation of industrial plants and waste-storage facilities; damage to pipelines, sewage infrastructure and treatment plants; and spreading of existing chemical contamination (such as oil spills or agricultural chemicals). This may cause adverse effects on human health through ingestion of contaminated food and water or by inhalation.

Recommendation

The challenge to the international community is to help map the complex health-related impacts of global warming, and to ensure that resources are available to tackle them. But, more than that, it is important that the development policy framework does not inadvertently make things worse, for example, by prioritising the market-based re-engineering of health systems and access to water above human need. Specific increases of investment are needed in disaster preparedness in the health sector, with particular focus on the high rates of disease that commonly follow floods. Much more research is also needed to assess changing threats and emerging issues, such as the impacts on mental health as climate change induces insecurity, uncertainty and fear for the future.

Migration

From Bangladesh to the communities living by the mega deltas of Asia and the low-lying Pacific islands, climate change stands to greatly increase recourse to the most extreme form of adaptation – migration. In general, people don't want to be forced to leave their homes. Forced migration can have a devastating impact on health and well-being and an individual's sense of identity, culture and security. It can also lead to conflict between resident communities and new arrivals.

Internal relocation of populations due to shoreline erosion and rising sea levels is already happening in Pacific nations like Vanuatu, Kiribati and Tuvalu. The population of the Carteret Islands – six islands off Bougainville – are facing relocation of the entire population to the mainland commencing in 2008.

Where migration forced by climate-related environmental factors is concerned, the international community is in a state of denial. Developing countries already bear most of the burdens created by migration. Overstretched mechanisms designed to deal with smaller flows of political refugees cannot cope.

In the Pacific, both Australia and New Zealand also have international obligations under the United Nations Framework Convention on Climate change (UNFCCC) to help Pacific island countries and other developing nations in meeting the costs of adaptation to climate change and develop regional mitigation and adaptation programmes.⁵

The options for the Pacific islands and others, apart from justifiably berating industrialised nations for their lack of action, include migration, developing renewable energy sources, stabilising foreshores and resettlement to adapt to the impacts of climate and sea-level changes. Pacific nations will need a new international policy framework and new sources of funds to implement these options and move forward.

Recommendation

Before people are forced to move, assistance should be provided, within reason, to enable people to stay within their community. However, when the climate push factors, such as lack of fresh water or sea-level rise, become too extreme the international community must ensure that there are no barriers to their movement. There is an urgent need for coordinated plans, from local to international levels, for relocating threatened communities with appropriate political, legal and financial resources. New problems are emerging. For example, as some nations lose land, a way to deal with threats to Exclusive Economic Zones, and appropriate compensation funding, need to be developed. Resources, too, will need to target the appropriate level of government with whom the responsibility to care for environmental refugees will fall.

Cities

The relationship between urban centres and climate change is complex and two-fold. Urban areas, with their energy consumption and burning of fossil fuels, help cause climate change, but they are also particularly vulnerable to its impacts.

China, the world's most populace nation, is urbanising rapidly. But, as the population migrates increasingly into urban areas, its vulnerability to extreme weather events, such as heavy rainfall, is set to increase. Mumbai, the financial hub of India, is especially vulnerable to sea-level rise, and climate change could result in gigantic financial losses in Mumbai alone.

In Hong Kong, global warming in combination with urbanisation means the city's cool winters could vanish within 50 years. The number of 'cold days,' when temperatures dip below 12°C, might soon be zero. Between 1961 and 1990, there was an average of 21 cold days every winter. The number of summer 'hot-nights' above 28°C, on the other hand, has risen almost four-fold since the 1990s. Heat trapped by the city and its skyscrapers is unable to escape at night, causing multiple health stresses.

The 13 million people of Dhaka, the capital city of Bangladesh, are on the climate front-line and their fate is a foretaste of what other city populations may face. Global warming will affect Dhaka in two primary ways: through floods and overstretched drainage systems, and through heat stress. Increasing rainfall and the melting of glaciers and snow in the Himalayas will lead to more frequent flooding. But, water-logging and drainage problems during the monsoon season already seriously damage the city. In 2004, there was a massive health crisis as sewage mixed with floodwater flowing through Dhaka putting 10 million people at a high risk from water-borne diseases. The United Nations reported sludge gushing from manholes, and diseases such as acute respiratory infections, diarrhoea, dysentery, jaundice, typhoid, and scabies were reported.

Recommendation

With a rising proportion of Asia's people living in urban areas, city authorities will need to assess both the existing and new climate-related vulnerabilities that the growing

urban populations will face. But city governments are often weak and under-resourced. Even when they have progressive policies they often lack the capacity to ensure best practice in urban design and service delivery. This will demand more support to, and capacity at, the appropriate institutional level, whether a town council or the regional government covering, for example, river-basin areas. But there is also great scope to encourage the community-level management of services.

Reducing greenhouse gas emissions in cities is also vital. Projects that promote low-carbon city development, protect water resources and green areas, and reduce greenhouse gas emissions should be a priority. As cities are growing, there is a huge opportunity to intervene now to ensure good urban design in small and medium-sized cities, before they become large and unwieldy. There are also numerous possibilities for alternative energy technologies, such as solar heating and cooling systems, and good water-management practices all especially beneficial to low-income families. Each country's middle class also has an important role to play in raising awareness, encouraging the efficient use of energy and mobilising resources for adaptation.

Lessons relevant to urban areas across Asia can be learned from paradoxical examples like the green city development of Dongtan, near Shanghai, on the third-largest island in China. Dongtan provides insights on how to integrate sustainable transport into business development, road infrastructure development, and local community development. But Dongtan also reveals the limits of green designs as the new city is vulnerable to storm surges, and will become more so with global warming.

Gender and vulnerable groups

Inequality is a major contributing factor to vulnerability. As women in Asia have often traditionally been excluded from assuming active roles in community and social functions, women-headed households are likely to be the group most challenged to cope with climate change. Many Indian women already trek vast distances each day in search of fuel, fodder and water, and climate change will likely add to this burden. Women also have less access to mobility than men. When a cyclone and floods hit Bangladesh in 1991, the death rate for women was almost five times higher than for men. Men were able to warn each other as they met in public spaces, but they communicated information to the rest of the family only sporadically. Many women, too, are not allowed to leave their homes without a male relative. They waited, tragically, for their relatives to return home and take them to a safe place. Moreover, as in many Asian countries, most Bengali women have never learned to swim.

The issue of gender has been neglected in the UN negotiations on climate change. But, at a practical level, gender considerations are increasingly recognised as vital in planning and implementing responses to climate change. On the ground, responses to climate change focus on sectors primarily managed by women, such as agriculture, water and energy. But, while women may be the primary labourers, they are rarely the decision-makers. Therefore, by increasing the control of women over resources and decision-making through improved access to knowledge and information, there

are opportunities to increase both women's empowerment and the effectiveness of measures for climate change adaptation and mitigation, particularly at the community level through support and self-help groups.

Recommendation

Special attention needs to be given in all policy areas to the different impacts that climate change-related factors will have on women. Greater equity and social justice could save as many, if not more lives, than large infrastructure construction projects. At the same time it is important to map the multiple vulnerabilities of various groups across the population from children to the elderly and people with disabilities. The gender dimension needs to become a central focus of discussions to increase our understanding of the impacts on resilience and adaptive capacity to climate change.

Water and drought

The impacts of global warming are centred on the water cycle. And, for large parts of Asia, that means changes to the glacial cycle in the Himalayas. Over the past decade, the retreat of glaciers and the thawing of permafrost in the Himalayan highlands in north Asia have accelerated. Supplying seven of Asia's great rivers – the Ganges, Indus, Brahmaputra, Salween, Mekong, Yangtze and Huang He – the glaciers on the Tibetan Plateau, including Himalayan glaciers, ensure a year-round supply of water to billions of people.⁶ The impacts of glacial retreat range from increased risk of flooding in Himalayan catchment areas in the short-term, to reduced river flow in the long-term. Initially, accelerated Himalayan glacial runoff will increase the risk of lethal glacier lake outburst floods, flooding, avalanches and mud flows.

Central Asia already experiences a high degree of water stress. Agricultural systems and ecosystems in some areas may be able to cope with some decrease in rainfall, but other semi-arid areas could be amongst the first to show the effects of climate change. The prospect of declining rainfall in places with arid climates like Iran means a bleak outlook for sustainable fresh-water supplies. Currently, 94 per cent of water use in Iran is accounted for by irrigation for farming, and over half of that, around 55 per cent, comes from ground sources.

In some places, people are responding to environmental change by rediscovering traditional, more drought-resistant livelihoods. Locals in the Thal region of the Punjab in Pakistan are facing living with longer summers and shorter winters. Gram has been grown in the region as a cash crop. It provided Thali farmers with an important new source of income. But the four-month gram crop depends on sufficient and timely rains. These are becoming increasingly uncertain with climate change. Gram cultivation is now seen locally as a gamble. No crop can match gram if the rains come on time, because it grows without fertilisers or pesticides. But when rains fail, everything is lost. From 1998 to 2002, Pakistan faced one of the worst droughts in its history. As a result, many Thal residents reverted to traditional livelihood patterns based on the natural vegetation, indigenous trees and livestock. They are an example of the ability

to adapt by using drought-resistant livelihood patterns often abandoned or neglected decades ago.

Recommendation

Low-cost, effective approaches to drought resilience and flood management should build first on the traditional knowledge and crop biodiversity of indigenous communities, with new techniques and crops introduced as appropriate. Communities need more support to help them adapt and learn together. Working with nature is more effective than the use of hard engineering, especially for poor communities with scarce financial resources. Investment in early warning systems for droughts, floods and water-related disasters, such as glacial lake outbursts, is also needed.

Changing hydrological systems will alter regional patterns of vulnerability. The impacts of Himalayan glacial melt will change river flows and threaten water supplies for people, industry, agriculture, and nature. Disputes over access to water resources are certain to increase as a consequence of climate change. Changes in hydrology will also exacerbate the effects of pollution. All these factors point to the need to scale-up water conservation and river-basin management strategies. Understanding the impact of different types of infrastructure and the governance of water – whether privately, publicly or communally owned and managed – is as important as focusing on scarcity and access. Across Asia, countless civil society groups are campaigning for more people- and environment-friendly water management.⁷

In supporting different approaches to farming, donors and financial institutions need to take account of the different 'thirstiness for water' of crop types. Cotton, for example, is an attractive cash crop, but very thirsty, and governments must monitor and regulate the growing of such inappropriate crops in areas that are not suited for them.

Seas and coasts

Environmental change associated with global warming has already affected China. Its coastal economy and environment were hit particularly in 2004 and 2006 by the effects of rising sea levels, coupled with storm surges, coastal erosion, and saline water intrusion. Huge losses resulted. In 2006, saline water intrusion and coastal erosion intensified in Yangtze Delta region. Shanghai City's water supply was affected, reducing the quality of groundwater supplies and soils, with even broader impacts on local ecosystems. Coastal areas provide an important habitat for many species and support countless peasant livelihoods. Both will suffer from high tides, coastal erosion and saline water intrusion as the sea levels rise. But impacts will also stretch inland affecting the reproduction and behaviour of fish living in river estuaries. The fishing industry, already suffering from over-fishing, will be further hit.

Vietnam will encounter some of the worst impacts due to rising sea levels.⁸ Should climate change result in a one-metre sea-level rise, Vietnam could incur losses totalling US\$17 billion per year and lose more than 12 per cent of its most fertile land.⁹

The best agricultural land, together with 50 per cent of the population, is on the low-lying Red River and the Mekong Delta regions. Over 17 million people could lose their homes, 14 million of whom live in the Mekong Delta region.

Cambodia's long, 435-kilometre coastline is particularly vulnerable to climate change and coastal development has already caused widespread erosion. Climate change demands rethink of many current economic activities. For example, mangroves that act as a buffer against storm and tidal surges and provide essential spawning grounds for marine fish have been cut on a large scale for the production of charcoal, for aquaculture and for housing. This has increased the vulnerability of the coastal region.

Pacific islands are also extremely vulnerable to rising sea levels and coastal erosion as a result of damage to coral reefs from coral bleaching and storm surges.

Recommendation

Asia is home to several 'mega deltas' where governments will be faced with a choice between expensive and unpredictable engineering-led solutions to sea-level rise and extreme weather, and assisting coastal communities to adapt by working more with nature using approaches such as 'managed retreat'. But, much more research is needed to understand coastal dynamics in a warming world. For example, the movement and collapse of fisheries will present a major threat to livelihoods but is insufficiently understood. At the same time, known risks are worsened, such as the destruction of mangroves that provide protection from flooding and storm surges. More attention should be given to reversing policies likely to exacerbate future risks, such as mangrove destruction for the promotion of aquaculture. More than anywhere else, all development in coastal areas and river basins should be assessed for whether it promotes climate resilience and is reasonably climate proofed.

Biodiversity and the environment

Globally, both climate change and human economic activity threaten biodiversity, especially through impacts on marine coastal and forest environments. Asia is no exception. For example, deforestation and pollution of water resources have already devastated much of Vietnam's rich biodiversity. With rising sea levels, Mangrove and cajuput forests – important ecosystems in low-lying areas – may die back or be entirely lost.¹⁰ One estimate suggests that a 90-centimetre rise in sea levels could cause the loss of one-third of all Vietnam's reserves and over one-quarter of known biodiversity contained in them.¹¹

In Thailand, the Lower Mekong region is known as a 'biological hotspot' because of its rich biodiversity. And yet, one in six of the country's 197 national parks and wildlife sanctuaries are situated in 'climate change hotspots', where they will be severely affected by changes in average temperatures and rainfall. A forest area of 10 square kilometres in Thailand could contain up to 750 species of trees and 1,500 species

of higher plants, more than the total tree and plant diversity of North America.^{12,13} Tropical rainforests contain many species which are valued by indigenous people for their properties, such as for use as medicines. In many cases, these have made a wide contribution to human health and have even greater potential in the future. But increasing aridity resulting from global warming stands to damage these forests before such values can be realised.

Damage to coral reefs is occurring throughout Asia and the Pacific, and rising sea temperatures leading to bleaching of coral reefs might be one stressor too many for many coral reef systems. This will affect local resources, such as fisheries, on which many poor coastal communities depend, and reduce the value of other destinations for tourism.

Recommendation

Asia's forests provide vital livelihoods and are a vast sink of carbon. Much stronger measures are needed to protect them from unsustainable logging and environmentally destructive development, including agricultural and biofuel expansion. Much of the consumer demand driving negative developments comes from European and North American shoppers. Deforestation has negative impacts on biodiversity, air quality, local communities and indigenous peoples. Reducing deforestation is key to reducing overall global greenhouse gas emissions. Stronger local governance and greater economic incentives for sustainable forest management are needed, in addition to developing and effectively implementing protected areas. Wildlife corridors to link increasingly fragmented habitats are needed, if biodiversity, like humans, is to be able to adapt to changing conditions. The international community must support Asian nations in this effort with appropriate technology, resources and regulations. In addition, industrialised nations should put policies in place to regulate consumer demand for wood products. Community-based forestry has great potential to preserve biodiversity whilst providing livelihoods and promoting greater resilience through a focus on non-timber forest products. The special role played by forest-dwelling indigenous people as traditional custodians of forests, needs to be recognised by the implementation of laws which ensure their rights to continue this role. Conservation efforts also need to allow for and enable the necessary movement of species that will occur as a result of climate change.

The Johannesburg Plan of Implementation agreed at the World Summit on Sustainable Development contains many commitments to 'protecting and managing the natural resource base of economic and social development', relating to water, disaster management, agriculture, desertification and drought, mountain ecosystems, biodiversity, and forestry. The problem is that too few have been implemented. Now is the time to do so. Immediate challenges include, for example, the need to 'reduce the risks of flooding and drought in vulnerable countries by, inter alia, promoting wetland and watershed protection and restoration, improved land-use planning, improving and applying more widely techniques and methodologies for assessing the potential

adverse effects of climate change on wetlands, and, as appropriate, assisting countries that are particularly vulnerable to those effects'.¹⁴

Disasters

Natural hazards are common in Asia and many are not directly related to climate change, such as the Indian Ocean tsunami, which struck in 2004 and the devastating earthquake that hit Pakistan in 2005. Vitally, regions that are already vulnerable to natural hazards like this will have a weakened capacity to adapt to the impacts of climate change. Bangladesh, for example, has limited capacity to adapt, in part because it faced at least 174 disasters between 1974 and 2003.

Now Asia faces observed and projected increases in the intensity and sometimes frequency of extreme weather events, heatwaves, tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms, severe erosion, and dust storms, to name a few. The devastating South and East Asian floods in 2007 are a prime example.

In Bangladesh the increase in flooding is due to more intense rainfall in the monsoon season. This also causes widespread water-logging, erosion, flash floods, and mudslides in the hilly regions. Damaging floods in 2004 affected 38 per cent of the country destroying more than three-quarters of crops and leaving 10 million people homeless. Diseases, such as dysentery and diarrhoea, increased in their wake.

In 2006, China suffered from climate disasters to an extent not seen since the 1998 floods. Typhoons Kaemi, Saomai and Pearl landed in Chinese coastal areas, along with the tropical storm Bilis. Bilis affected nearly 32 million people from six different provinces and autonomous regions. Around 3.4 million people were relocated. Over 1.3 million hectares of crops were damaged, and 263,000 hectares went unharvested. Some 391,000 houses collapsed and 471,000 houses were damaged. Chongqing City and Sichuan Province also suffered a summer heatwave whose strength was almost unprecedented.

Recommendation

A global plan to minimise the impact of disasters was drawn up as the Hyogo Framework for Action and agreed at the World Conference on Disaster Reduction in Kobe, Japan, in 2005. Along with recommendations from the Johannesburg Plan of Implementation, these agreements call for affected countries to encourage the dissemination and use of traditional and indigenous knowledge to mitigate the impact of disasters. They also call for promotion of community-based disaster-management planning by local authorities, through training activities and raising public awareness. These recommendations still need implementation.

Disaster risk reduction needs mainstreaming into development programmes and policies, and links between adaptation to climate change and disaster risk reduction need to be made more explicit. More resources should be channelled into reducing

disaster risk, and stop-start approaches must give way to longer-term support to address the underlying causes of food insecurity.

The emergency, or 'humanitarian', response system also needs reforming so that it is truly able to deliver prompt, effective assistance on the basis of need. It must support people's livelihoods as well as meeting the immediate needs of the hungry. This includes social protection programmes through governments, backed by reliable funding. Moreover, the type of aid is still often inappropriate. It is not right that 70 per cent of food aid distributed by the UN is still the produce of the developed world: food aid should not be a means to support developed country farmers. When hunger is caused by lack of access to food as a result of poverty rather than food shortages, providing cash can be a more appropriate, faster and cheaper option.

Adaptation is about more than just better forecasting technology – the focus of many aid donors recently – it is about strengthening communities from the bottom up, building on their own coping strategies to live with climate change and empowering them to participate in the development of climate change policies. This is particularly important for reducing risks from disasters. Identifying what communities are already doing to adapt is an important step towards discovering what people's real priorities are. Giving a voice to people in this way can help to increase confidence, as can valuing their knowledge and placing it alongside science-based knowledge.

A global climate framework post-2012

The first priority is to cut global greenhouse gas emissions so that average temperatures do not rise more than 2°C above pre-industrial levels – a goal of the European Union since 1996. The likelihood of major and irreversible climate change becomes far greater above this level, but efforts are needed to keep temperatures as far below 2°C as possible, because increases below 2°C will already doom many of the Pacific island nations. Environmental and development organisations in countries like the UK are supporting calls for the Government to do its fair share by setting a legally binding, annual, constantly contracting 'carbon budget', which plots a course, year on year, towards an emissions cut of at least 80 per cent on 1990 levels by 2050. There are less than 10 years before global emissions must start to decline – instead emissions from the UK and other wealthy industrialised countries are still rising remorselessly.

There is not a moment to lose. Wealthy industrialised countries must act first and fastest to cut greenhouse gas emissions. Much of the historical responsibility for climate change lies with these industrialised nations and their use of fossil fuels over the last 150 years. The negotiations underway in the UNFCCC and the Kyoto Protocol must deliver a fair, effective and equitable agreement beyond 2012 that deepens reduction targets in industrialised countries, allows greater mitigation contributions from some of the larger developing countries, and ensures a strong focus on adaptation. These negotiations must be completed by 2009 to ensure that there is no gap between the first commitment period of the Kyoto Protocol, which ends in 2012, and the second



Trees planted in the Wuwei district of Gansu Province, China, to dissipate sand storms have already died from dry conditions. Low annual rainfall and high evaporation rates make this one of the driest places on earth. The desert, which already occupies more than 30% of Gansu, is expanding. An ever-growing population is converting land for agriculture, destroying trees and other natural vegetation, overusing groundwater, and building reservoirs to supply water for towns and irrigated agriculture. Compounding the problems are overgrazing, the use of wood as domestic fuel, and cultivation of crops that consume a lot of water. Water levels in the area have dropped from 8 to 12 meters below ground level in the 1950s to as much as 100 meters now. Photo: Greenpeace/John Novis.

commitment period. The expanded framework needs to revive the original intent of the UNFCCC for developed countries to take leadership by reducing emissions at home. It must also provide the opportunity for poor countries to escape poverty through massive investments in adaptation and renewable energy and by supporting their sustainable development through greater flexibility in the rules governing the global economy on issues like trade, finance and intellectual property. Technology transfer, especially energy

technology, is also important. Adaptation funds under the UNFCCC and Kyoto Protocol need to increase in size by several orders of magnitude.

Individuals globally must also take action to reduce their emissions. The growing numbers of demonstrations against airport and motorway expansion in many countries are evidence of rising public action to tackle carbon emissions.

On-going Up in smoke challenges and commitments

Up in Smoke? – the first report from the Working Group on Climate change and Development – joined the UK's environment and development communities in a united view on the minimum action necessary to deal with the threat of global warming to human development. The proposals it called for in October 2004 are much more urgent now that the science is suggesting that we may be further down the path to major, irreversible warming than was thought at the time.

Three overarching challenges include:

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

In view of the above, our urgent priorities include:

- A global risk assessment of the likely costs of adaptation to climate change in poor countries.
- Commensurate new funds and other resources made available by industrialised countries for poor country adaptation, bearing in mind that rich-country (OECD) subsidies to their domestic, fossil-fuel industries stood at US\$73 billion per year in the late 1990s.
- Effective and efficient arrangements to respond to the increasing burden of climate-related disaster relief.
- Development models based on risk reduction, incorporating community-driven coping strategies in adaptation and disaster preparedness.
- Disaster awareness campaigns with materials produced at community level and made available in local languages.
- Coordinated plans, from local to international levels, for relocating threatened communities with appropriate political, legal and financial resources.
- Removing barriers to developing countries accessing appropriate technologies.

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

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

Bangladesh is located in a vulnerable geographical region. It has a high population density, weak institutions, low levels of development and poor economic strength. These factors conspire to make Bangladesh very vulnerable to present climate variability and any future change in climate. Poor and disadvantaged groups are particularly vulnerable. The sectors discussed below are directly affected by climate change. The changes ahead could be extremely detrimental to the economy, to the environment, to the national development and to the people of this nation.

Unlike many poorer nations, the Bangladesh Government is well aware of the importance of climate change, and is integrating it into sectoral plans and national policies such as the Poverty Reduction Strategy Paper and National Adaptation Programme of Action. It hopes that funding from the UNFCCC will enable it to do more climate change relevant programme work.

Bangladesh also has a wealth of experience in community-based adaptation and disaster risk reduction strategies and practices, much of which is supported by civil society organisations. Whilst local knowledge on 'climate change' is low, an adaptation workshop conducted by the UNFCCC in 2004 revealed that local people have great experience and knowledge about global climate change and vulnerability when specific impacts such as floods, cyclones, saltwater intrusion, waterlogging, and water scarcity are discussed.

Agricultural production

The economy of Bangladesh is based on agriculture but is slowly moving towards industrialisation. But even though more and more people are entering the non-agricultural labour market, agriculture remains the main source of livelihood for most of the population. More than 62 per cent of Bangladeshis directly or indirectly rely on outputs from the agriculture sector, which also employs 52 per cent of the labour force.¹⁶

Climate change is a major threat to agricultural production and food security. The main climate change impacts include rising temperatures, changes in rainfall and more extreme events like floods and droughts. Temperature and rainfall changes have already affected crop production in many parts of Bangladesh, and the area of arable land has already decreased. This is common to many communities throughout Asia as this report shows. A shrinking winter season is resulting in decreases in production of winter crops, particularly potatoes. Coastal areas of Bangladesh are also very fertile and used for growing rice. The intrusion of saltwater from storm surges or sea-level rise will have serious implications for the quality of the soil and, therefore, for agricultural systems in these coastal regions.

The climate in Bangladesh – now and in the future

Temperatures in Bangladesh increased about 1°C in May and 0.5°C in November from 1985 to 1998.¹⁷ Further temperature increases are expected. Anomalies have also been observed in rainfall patterns, with a shorter monsoon season, but more intense rainfall when it comes. This has simultaneously created droughts and floods in different parts of the country. Droughts in the northern region are exacerbated by higher temperatures and drier winters.

Changes in temperature and rainfall have increased water stress. This has affected production of major crops like rice. A study by the IRRI showed that night-time increases of 1°C during the growing season reduced global rice yields by 10 per cent.¹⁸ Another study showed that the production of rice and wheat could fall by eight per cent and 32 per cent respectively by the year 2050.¹⁹ Further temperature increases will lower crop production, putting stress on national food security.

Whilst farmers and local people may not understand the science of climate change, they have observed changes in seasons and rainfall patterns. They have noticed that planting seasons have shifted and that seasons are shorter than before. These changes have major implications for agriculture. They also commented that heatwaves are damaging crops, livestock and fisheries.

'Due to changes in rainfall, planting times come earlier or sometimes are delayed. The farmers are meeting their planting needs through collecting deep tube well water. Even in the rainy season the farmers face the same problem. Due to a shortage of rainfall the paddy or other crops are not growing properly, as a result crop production is reducing. Due to heavy rainfall or flooding the farmers are losing crops or facing large damage... If planting and harvesting is delayed due to floods it reduces crop yield for summer varieties of seed and delays winter crop planting.'

Source: The Salvation Army²⁰

'This climate and weather change, like almost all changes, affects and impacts the lives of the poor. The droughts lead to crop failure, because the poor farmers are fully dependent on nature for watering their fields and meeting irrigational needs. If there is a variation in the timing of rains, the crop fails – no water causing drought or too much causing floods... [S]ubsistence farmers... are going to be hit hard. If the crops fail then eventually they are forced to sell their land and move to the cities.'

Source: Health, Education and Economic Development²¹

According to projections, national food-grain requirements will be 41.6 million tonnes in the year 2030. To become self-sufficient in food-grain production by 2030, an additional 14.64 million tonnes is therefore required. But the affects of climate change on crop production mean that farmers are unlikely to be able to provide food grain for their fellow citizens. Unless appropriate adaptation measures are considered now, food-grain self-sufficiency will remain a distant dream for Bangladesh.

Water – too much or too little

Bangladesh is blessed with extensive water resources. It has numerous rivers and wetlands on its surface and vast quantities of groundwater, too. Bangladeshis depend on the surface water for fish cultivation, navigation, industrial and other uses and the groundwater is used for drinking, other domestic uses and irrigation.

Surface water and groundwater resources throughout the world are directly affected by climate change. In some countries these affects will be positive but in others they will be negative. In the case of Bangladesh, the affect is entirely negative.²² Climate change will alter seasonal water flow in the rivers. Increased intensity of floods and droughts, brought on by changes in rainfall and temperature, has already put tremendous stress on the availability of fresh water for both domestic and agricultural use during the dry season. This is coupled to poor land and water management, both nationally and trans-boundary, which will exacerbate the impact of climate change on water resources.

Bangladesh faces extreme water shortages during the dry months, adversely affecting both ecosystems and agricultural production. On the other hand, floods during the monsoon season inundate 20.5 per cent of the country on average and can flood as much as 70 per cent of the country.²³ More intense rainfall during the monsoon season will increase sudden floods and problems of water logging, especially in urban areas.

'Frequency of droughts is increasing. Canals, ponds and rivers are drying due to low rainfall... as a result water level is going down and people are not getting water from shallow tube wells. Winters tended to have some rainstorms during the period from November to February. In recent years winter drought has been extended from the end of the monsoon in October to April.'

Source: The Salvation Army²⁴

The contribution of snow to the runoff of major rivers in the Himalayas varies from 10 per cent (in eastern rivers) to more than 60 per cent (in western rivers). The season in which most snow melts coincides with the summer monsoon season, which intensifies the risk of floods. Studies have shown that accelerated melting of glaciers in the Himalayas will increase flooding in Bangladesh. At the same time, the decrease in the size of the glaciers will also lead to more drought in the northern regions of the country as river flows will decrease even further.

Changes in the tide and sea level along with less water flow in rivers has already increased saltwater intrusion in the coastal areas and caused flooding of marshland. The salinity of groundwater resources in the coastal regions has increased. Climate change, low dry-season river flows and sea-level rise in particular will increase saltwater intrusion in the coastal area water resources. This will be a major problem for coastal communities.

Coping with disasters

At least 174 disasters affected Bangladesh from 1974 to 2003. Extreme events, such as floods and flash floods, droughts, severe erosion and cyclones, are commonly linked to climate change. Studies have shown that the frequency, and in some cases the intensity, of these events are directly related to climate change.

In recent years there have been serious floods in Bangladesh almost annually. The increase in floods is due to more intense rainfall in the monsoon season. Waterlogging, erosion, flash floods and mudslides in the hilly regions also result. Floods in 2004 were the most damaging. They affected 38 per cent of the country destroying more than three-quarters of crops and leaving 10 million people homeless. Diseases such as dysentery and diarrhoea increased in their wake. Bangladeshis have developed strategies to cope with floods, but with climate change, the temporary flooding during the wet season is becoming permanent.

'Frequency of flooding is increasing due to heavy rainfall or water coming from surrounding countries and creating waterlogging. Before 1988, we did not see flood in the Jessore area because Jessore is comparatively high land. But in 1988, 1998 and 2004 Jessore area flooded...The poor rush towards safest places during the flood, towards cities in search of jobs or even for alms. The flood waters damage their crops, houses, local infrastructures that put them into starvation, isolated, shelterless.'

Source: The Salvation Army²⁵

Whilst southern regions may suffer flooding, northern districts are facing drought because of higher temperatures, less rainfall and reduced flow of river water because less rain is falling in the upstream region. Each year the drought causes loss of crops and livestock, malnutrition, and disease. But as the problem is localised it gets little international attention.

Md Liakat – a Bangladeshi farmer with hope²⁶

Md Liakat, a 52-year-old farmer from the village of Gidari in Gaibandha District started his farm with 19.8 acres of land, eight cows, a variety of crops and a pond with fish, but now he is completely landless. He has witnessed many changes over the last few decades such as fewer crop varieties, more floods and erosion and many farmers becoming landless. Md Liakat feels that temperatures are steadily increasing in summer and decreasing in winter. Heavy rain and frequent floods have meant he has lost land, crops and other assets. He has shifted his homestead five times due to erosion and floods.

Md Liakat has experienced many climate change-related disasters. The first was the 1978 flood in August/September. He said that the flood came back with a vengeance in 1984 from June to September. There were also heavy hailstorms that damaged most of his crops in February 1985. In 1988, fierce floods hit Md Liakat's village again from June to September. These washed away all of his crops, livestock and other assets. The flood was followed by severe river erosion. Md Liakat also mentioned the cold wave of 1994 and river erosion in 1996.

A study by Practical Action Bangladesh has confirmed these observed changes. Meteorological data prove that temperature has been increasing over the last 30 years. Winters are becoming warmer than they were 30 years ago, which affects winter crops, particularly potatoes. The study showed that the number of days without rainfall is increasing although total annual rainfall varies little. This indicates the occurrence of heavy rain over short time periods and also more droughts.

Worried about his income, Md Liakat desperately wanted to know how to adapt to the changing climatic conditions. He received training and technological support from Practical Action and explored various activities to increase his income. After training he established a nursery in his backyard to grow vegetables. He rears ducklings and grows vegetables on floating beds during the monsoon. He has sold 3,000 tree seedlings earning himself Taka 12,000. He has reinvested some of this money to grow more saplings in his nursery. He now meets his family's needs and is confident that soon he will be able to buy some agricultural land and livestock, making him a rich farmer in a few years like his father was before him.



Md Liakat plants tree seedlings in his nursery. Photo: Practical Action



Md Liakat grows vegetables during the monsoon in his floating vegetable garden. Photo: Practical Action

Reducing risk from disasters²⁷

The Christian Commission for Development in Bangladesh (CCDB) has considerable experience of managing disasters from its different projects spread across Bangladesh. The northern districts of Dinajpur and Rangpur are experiencing a drop in groundwater levels due to reduced annual rainfall. The dry soil is less capable of supporting rice cultivation; many farmers now grow maize. This could reduce food security as corn is not considered a dietary staple.

In the district of Manikganj, many people have migrated because each year homesteads are lost due to erosion from floods. People from the Maloti Padma Women's Forum at Harirampur Union say the frequency of major floods in Manikganj has increased from one in seven or eight years, to one in two or three years. This has caused hundreds of families to relocate to neighbouring villages or other districts.

On the island of Moheshkhali, where CCDB constructed several cyclone shelters, inhabitants of Thakurtala Village report an increase in the occurrence of cyclones. CCDB's Disaster Preparedness Programme has been working to minimise the vulnerability of the community by building awareness, raising public places, planting trees, constructing shelters and providing relief. The Programme has also trained groups of volunteers to help their communities before, during and after disasters. Recently CCDB joined the Building Disaster Resilient Communities project – a Christian Aid initiative on climate change adaptation. Under the project, CCDB will work with Moheshkhali inhabitants to increase their resilience to growing climate change threats.

Bangladesh is also known for the cyclones that cause huge damage and flooding in coastal areas. According to the IPCC, the frequency of cyclone formation in the Bay of Bengal has declined since 1970 but the intensity of the cyclones is increasing.²⁸ Government initiatives to build cyclone shelters and establish early warning systems have meant fewer lives have been lost, but more efforts are needed.

'The summer has become hotter and shorter – with an increase in the number of tornadoes and northwesterns (winds). The northwesterns cause havoc with the accompanied hailstorms – destroying the standing crops, and the tornadoes crumble everything in their paths. The monsoon has become unpredictable, sometimes too much (like this year) and some too little (last year), causing either drought or floods. A new phenomenon over the last 10 years is the cold waves during winter.'

Source: Health, Education and Economic Development²⁹

The Building Disaster Resilient Communities project³⁰

Christian Aid's Bangladesh field office has recently launched the Building Disaster Resilient Communities project in eight vulnerable locations across the country. It may not be a huge start, but it certainly has great potential. Its partner organisations conduct customised, location-specific activities to reduce the risk of disasters. These include:

- Building awareness among the communities (for example, school children, youth and families) and staff.
- Collaborative work to raise awareness on climate change and disaster risk reduction activities with local government authorities and other organisations. This includes training Village Disaster Management Committee members, and strengthening the Union Disaster Management Committee.
- Livelihood diversification and infrastructure development. For example: raising homesteads, public places and connection roads; planting trees, especially in coastal areas; building shelters; and, practicing ecological agriculture techniques and activities to conserve genetic resources.
- Organising and training local people to form groups, which can help communities prepare for disasters better and cope with them when they come.

A new 'cold war' comes to Bangladesh³¹

According to one of Bangladesh's most acclaimed poets, Jibananda Das, winter in Bangladesh was a time that revealed the 'inner beauty and soul of Bengal'. It was a pleasant season, eagerly awaited and planned for; a time when Bangladeshis took respite from the long summers. But things are different now. Winter is severe, with temperatures as low as 5°C recorded in January 2007 – reportedly the lowest in 38 years.

It is truly a 'cold war' in Gaibandha District in north Bangladesh; fields are covered with fog and temperatures are down to single digits at night. The fog is particularly difficult – thick, clinging and cold. Seventy-five-year-old Abdul Husain, who lives on the islands in the Brahmaputra River known as the 'chars', says life is harsh already: the rest of the year is spent avoiding devastating floods and monga (the lack of employment and food

crises), fixing broken homes, and rebuilding food stocks. People are ill equipped to deal with these new low temperatures and with unusual fogs that damage their crops.

Abdul Husain has been living on the chars for many decades now. Sitting in his front yard, he recalls how winter was once warmer and windier. 'It used to be drier those days, our skins would chap and feel dry during this month,' he recalls. But now things have changed. The water in the river is shallower than it used to be, Baigan or bitter gourd can no longer be cultivated and a lot of health problems develop due to the cold. The damp fog spoils the mangos he grows. Even the beginning of March can be unbearably cold. On such days he does not venture out of his home after 4 p.m. because of the severe cold outside. Families, especially women and children, are forced to spend hours inside their homes around kerosene lamps or in darkness as the chars have no electricity.

The BBC report that covered this unusual 2007 winter in Bangladesh, reported the same thing in India and Nepal. The cold wave killed over 130 people and affected thousands more. The government, United Nations and NGOs like Oxfam and their partners had to launch relief operations. One commentator observed: 'Most of the people have no winter clothes or blankets, and a lot of people died, especially new-born babies. It must be noted that no rich people died. Actually cold waves did not kill, poverty did.'

Links between climate change and health

Extreme events such as floods, droughts and cyclones directly and indirectly affect the health of people in Bangladesh almost every year. For example, floods in 2004 caused about 800 deaths, while the cyclone of 1991 killed 138,000 people.

Bangladesh is already vulnerable to outbreaks of climate-sensitive diseases. Incidences of malaria have dramatically increased in the last 30 years, and malaria is now a major public health problem. Out of 64 districts, 13 are classified as being in a high-risk malarial zone. A total of 14.7 million people in Bangladesh are classified as high-risk in terms of catching malaria.

Other diseases like diarrhoea, skin diseases, asthma, hypertension, dengue, and dysentery are also increasing, especially during the summer months. Studies suggest that climate change is likely to affect the distribution, lifecycle, and population dynamics of dengue. Climate change may also cause additional stresses such as dehydration, malnutrition and heat stress, especially among children and the elderly. These problems are closely linked to water supply, sanitation and food production issues. Climate change will mean that there will be less clean water for a country where water-borne diseases are already responsible for 24 per cent of all deaths. Climatic factors, such as temperature, rainfall and salinity, are positively correlated with diarrhoea, skin diseases, kala-azar and other diseases in different parts of the country. Seasonal rainfall changes have been linked to the prevalence of diarrhoea.



Families must find ways to cope with the cold and fog. Photo: Sahba Chauhan, Oxfam GB



Fog in rural Bangladesh, January 2007. Photo: Sahba Chauhan, Oxfam GB

'Due to lack of pure drinking water there is a rise in water-borne diseases (diarrhoea, dysentery, typhoid and hepatitis A). Due to a shortage of water people are suffering from skin diseases and conjunctivitis. In the summer season due to high temperatures some people are affected with heat stroke and dying. In the winter season due to lower temperatures people suffer.'

Source: The Salvation Army³²

'Decreasing temperatures in the winter season makes the lives of children and old-age people miserable and increases death rates.'

Source: Koinonia³³

Urban areas

The relationship between urban centres and climate change is complex and two-fold. On the one hand urban areas, with their energy consumption and burning of fossil fuels, help cause climate change, while on the other hand they are most vulnerable to its impacts.

The cities and towns of Bangladesh already face various environmental and developmental problems brought on by increasing populations due to migration from rural areas, a lack of compliance with national policies, inadequate utility services and few resources to address these issues. Adding climate change to the equation further aggravates the problems already burdening urban areas.

Dhaka, the capital city of Bangladesh, is one of the world's largest cities with a population of 13.1 million people living in an area of 1,353 square kilometres. Climate change will affect Dhaka primarily in two ways: through floods and drainage congestion and through heat stress. Increasing rainfall and the melting of glaciers and snow in the Himalayas will lead to more frequent flooding in Bangladesh. Waterlogging and drainage congestion due to excessive rainfall and flooding from rivers during the monsoon season are already seriously damaging the city. In recent years, Dhaka has experienced major floods in 1954, 1955, 1970, 1974, 1980, 1987, 1988, 1998, and 2004 from surrounding rivers overflowing. Of these, the 1988, 1998 and 2004 floods were the most damaging.

Dhaka may also face 'heat island' problems because temperatures in the city are a few degrees higher than in surrounding areas. This is because concrete buildings retain heat, and activities such as vehicle exhaust, industry and the increasing use of air conditioning warm the air. This problem will increase in the future as more and more people are moving to the cities.

The key sectors affected by floods include infrastructure, industry, trade and commerce, and utility services. These sectors cannot perform well during and after floods, thus increasing the vulnerability of city dwellers. Poor urban dwellers, in particular, suffer health problems and loss of life and livelihoods.

Flooding and the health crisis in Dhaka, 2004³⁴

A massive health crisis occurred during the flood of 2004 as sewage mixed with floodwater swirled through Dhaka. A CNN correspondent described the situation in many areas as 'quite grim'. Contaminated water spread all over Dhaka putting 10 million people at a high risk from water-borne diseases. According to Naseem-Ur Rehman, chief of communications in Bangladesh for the United Nations Children's Fund (UNICEF), the situation for children in urban areas was 'extremely dangerous'. The waterlogged city was filled with filth, and the children playing and walking through this filth were easy prey for infectious diseases. The United Nations said sludge was gushing out of manholes in many parts of Dhaka, and diseases such as acute respiratory infections, diarrhoea, dysentery, jaundice, typhoid and scabies were being reported.

The urban poor are also particularly vulnerable to climate change-related disasters. Around 40 per cent of the population lives in slums and squatter settlements. They earn a living from working in industry (such as garment, textile or leather manufacturing), the transport sector, shopping centres, hotels and restaurants, the construction sector, and as domestic workers. These people are severely affected by floods and waterlogging. A field survey conducted during the 1998 flood found that at least one in thirteen people had changed their occupation while 27.4 per cent were unemployed as a result of the flood. Working hours were also reduced for many people.

The other climate change impacts for urban areas include cyclone damage and saltwater intrusion especially for the coastal cities.

Coastal areas

Coastal areas are vulnerable to climate change in a multitude of ways. Cyclones, storm surges, drainage congestion, and sea-level rise directly affect coastal regions. Agriculture, industry, infrastructure, livelihoods, marine resources, forestry and biodiversity, human health, and utility services will all be affected. Coastal zones are particularly vulnerable because climate change combines with the forces of sea-level rise, land subsidence, cyclones and changes in upstream discharge. Much coastal infrastructure, built on the advice of international finance institutions, has already disadvantaged poor coastal communities, and is likely to reduce their ability to adapt to climate change yet further.

Bangladesh is one of the world's largest deltas, formed by a dense network of 230 rivers. Most of the country is less than ten metres above sea level, with about ten per cent less than one-metre above the mean sea level. One-third of the country is vulnerable to high tides. The IPCC expects sea-level rise during the early part of the twenty-first century to be an average of two to three millimetres per year due to

Mangrove ecosystems and biodiversity in Bangladesh

Bangladesh has the single largest mangrove area in the world, known as the Sundarbans, which has an area of around 577,000 ha. There are patches of mangroves in other parts of the coastal area. One of them, known as Chokoria Sundarbans (about 7,000 ha) has been completely denuded by humans. Climate change is a real threat to ecosystems and biodiversity especially in the Sundarbans which may be completely inundated by a one-metre rise in sea level. Increases in temperature and sea levels threaten flora and fauna and many species, perhaps even the Royal Bengal Tiger, may face extinction. St Martin's Island, the only coral island in the country, is also facing a high level of risk.³⁵

global warming, although this varies by area.³⁶ Erosion, coastal land subsidence, siltation of river estuaries, reduced sedimentation, waterlogging, and saltwater intrusion will all increase as a result. About one-quarter of the population lives in the coastal area, and the rest depend in some way or other, on the activities in the coastal region. If the sea level rises by up to one metre this century, Bangladesh could lose up to 15 per cent of its landmass³⁷ and as many as 30 million Bangladeshis could become climate refugees. According to a World Bank analysis, such a rise would also cost Bangladesh half its rice land. Another report estimates that a one-metre sea-level rise could lead to a decline in Gross Domestic Product (GDP) of between 27 and 57 per cent.³⁸

Saltwater intrusion due to sea-level rise will create acute water crises in the future. Saltwater from the Bay of Bengal already penetrates 100 kilometres or more inland up tributary channels during the dry season and this could get worse.³⁹ Salinity in the freshwater channels and also in the groundwater affects agriculture, forests and biodiversity, and human health. Growing populations require more and more water, which will further deplete fresh-water supplies.

'Seawater is intruding into estuaries and aquifers making the estuaries inhospitable breeding grounds for the fish and the aquifer water unfit for human consumption. Besides, salinity intrusion due to sea-level rise and low water flow from upstream during the winter season is causing excessive death of trees in the Sundarban mangrove including its adjoining areas and threatens regional/national food security. Recently, the production of our country's famous fish Hilsha has declined to a minimum level and some other old varieties are in a state of extinction.'

Source: Koinonia⁴⁰

Studies show that the intensity of cyclones and storm surges in the Bay of Bengal is increasing. Fortunately, Bangladesh has good early warning systems and cyclone



A school in the coastal village of Mongla in Bagerhat engulfed with tidal water in June 2007. This land was flood free when the school was constructed in late 1970s. The effects of sea-level rise around the Bangladesh coast are clear. Photo: Dwijen Mallick, Bangladesh Centre for Advanced Studies



The main road in Mongla Bazar, Bagerhat District, on 30 June 2007. People here have only experienced this tidal inundation in the last 10 to 12 years. Photo: Dwijen Mallick, Bangladesh Centre for Advanced Studies

shelters along the coast. Such government and community initiatives have reduced the loss of life, but houses, infrastructure and livelihoods are still shattered by the recurring cyclones. The increasing intensity of such disasters seriously hampers social and economic development.

Energy

Bangladesh contributes little to total greenhouse gas emissions from the energy sector so there is no energy emissions reduction policy at the national level. But as a 'no-regret' option to increase energy efficiency and reduce emissions, small local-level

Coastal fishermen are most vulnerable⁴¹

Coastal fishermen are more vulnerable to environment-related disasters than other professional groups in coastal communities. Fishermen earn their living from fishing in rivers, estuaries and littoral waters. Of all the open-water fish species, Hilsa is the most important and a major livelihood contributor for coastal fishermen and the nation as a whole. Coastal fishermen contribute to 22 to 25 per cent of the total fish production in the country, but ironically, they are often the first victims of disasters. During every cyclone or tidal surge, hundreds of fishermen die, and others are driven away to other areas.

On 19 September 2006, a sudden tornado hit the southwestern coast. It caused about 500 fishing boats and trawlers to capsize or go missing. Then on 19 October a violent storm meant some 3,500 fishermen went missing in the rough seas. Several hundred fishing trawlers capsized and rescuers only recovered 162 bodies. Winds also lashed the coastal districts damaging over 1,000 houses.

Coastal communities are poorer than average. They have a lower-than-average per capita GDP and lower average calorie intakes. In coastal areas, absolute and extreme poverty are 52 per cent and 24 per cent respectively, compared to 48 per cent and 22 per cent in non-coastal areas. Current coping methods include borrowing from local money lenders; selling labour in advance for fishing or agricultural work; selling fishing gear; sending children to work in urban areas; and selling livestock, land and houses. Climate change will increase this vulnerability and stretch existing coping strategies to the limit.

Using solar photovoltaics on boats to provide education and information services⁴²

In the remote region of Chalanbeel in Bangladesh, the charitable organisation Shidhulai Swanivar Sangstha works to improve the quality of life of waterside communities by bringing them services by boat, sometimes on a daily basis. Services include children's education, libraries, training in sustainable agriculture, health advice, mobile phones, and Internet access. The boats have been fitted with photovoltaic systems to provide electricity for these services. In addition, on some boats, the photovoltaic electricity supply is used to charge batteries for the solar home-lighting systems that Shidhulai has supplied to families. Solar lanterns have also been supplied for use in fishing boats. This work could be a model for renewable energy use elsewhere in Bangladesh.



The coastal villages of Chila, Kayabunia and Kalatala in Mongla, Bagerhat, faced severe erosion due to high tides and strong waves during the monsoon in 2007. Photo: Dwijen Mallick, Bangladesh Centre for Advanced Studies



Coastal villages are exposed to tidal surges and cyclones. Photo: Dwijen Mallick, Bangladesh Centre for Advanced Studies

initiatives are being carried out. Activities include producing energy-efficient light bulbs, introducing fuel efficient stoves, and household biogas plants.

Who is most vulnerable?

According to the IPCC, 'climate change impacts will be differently distributed among different regions, generations, age, classes, income groups, occupations and gender'.⁴³ Developing countries are particularly vulnerable to climate change, as are the poor and marginalised.

Bangladesh is characterised by a high population density, few resources, poor governance, and a high incidence of disasters. All these factors limit economic growth and exacerbate poverty. Progress with reducing poverty was slow in the 1980s, but slightly better in the 1990s. However, the absolute number of poor people has increased in the last few decades. Currently, Bangladesh has about 150 million people. Of them, over 70 million live under the poverty line, with inadequate income and food intake. Over 30 million people are extremely poor and do not have employment or income and suffer from continuous food insecurity, malnutrition, and social insecurity. These people cannot access civic amenities such as basic health services, sanitation, safe drinking water and education for their children.

Changing weather conditions, particularly the increase in the number and the intensity of extreme events, threaten the livelihoods of the poor in Bangladesh. These largely depend on natural resources and also employment and health, which are already affected by events such as drought and frequent floods. Poor people are at greater risk of losing their jobs, and also from degradation of the natural resources (land, water, fisheries, and forests) on which they depend. Climate change also threatens their food sources and nutrition as well as reducing the number of livelihood options available to them. They often live in fragile ecosystems, such as cyclone-, flood- or drought-prone areas, which are susceptible to climate change and disasters. And poor people are particularly at risk from disasters because they are unprepared and lack adequate shelter. They also have little ability to recover from disasters when they occur. Whilst poor people have a wealth of understanding and knowledge on how to cope with climate change, and some limited resources to help them do this, their coping strategies are constrained by a lack of resources and information and poor institutional capacity. This needs to change given the changes expected ahead.

'We are experiencing a major change in both weather and climate over the last 10 to 15 years. These changes, like almost all changes, affect and impact the lives of the poor...Crop failures, loss of capital investment, failure to replenish the inputs essential for recovery not only increases food insecurity, but also loss of household assets. These events increase not only vulnerability but push more people into the vicious cycle of poverty.'

Source: Health, Education and Economic Development⁴⁴



Mangrove forests protect coastal land from erosion and could be promoted as a community adaptation activity. Photo: Dwijen Mallick, Bangladesh Centre for Advanced Studies



Coastal communities protect their land and houses from river erosion, but they need help from local government and development agencies to build local capacity. Photo: Dwijen Mallick, Bangladesh Centre for Advanced Studies

Energy and smoke

Najma Khatun lives in Pazulia village in Gazipur. Her husband is a farmer and they have two daughters and a son. They also have a small poultry farm with 800 birds. Najma used to spend most of her time cooking and managing the poultry waste. She worried that she did not have enough time to care for her children. She was particularly concerned about her youngest child, who is three, and who was always with her in the kitchen inhaling smoke and dust from their inefficient traditional cooking stove. The stove burned biomass, which caused lots of indoor air pollution and smoke.

Najma was a member of the Bangladesh Association for Social Advancement, which invited her on a two-day training course on biogas plants. Following this, Najma built a 1.2-cubic-metre biogas plant inside her poultry farm with technical support from Practical Action. This provided tremendous and quick relief from her problems. She used poultry dung, which was difficult and time consuming to dispose of, to produce biogas, which she used for cooking and lighting.

Now she has more time to look after her children, who no longer suffer from dust and smoke inhalation. Najma can even do other work while cooking because there is no chance that a fire will start in the house. All this has cost her very little, so she is very happy. Najma's workload has also decreased because she no longer has to collect biomass. This saves her at least one hour each day, and another hour and a half is saved from reduced time spent cooking because it is quicker and easier when using biogas. Cooking utensils and kitchen cloths are not as dirty and the kitchen is cleaner saving Najma a further 2.5 hours a day. She also earns 150 Taka per month by providing biogas to her neighbour. With the time saved she enjoys caring for her children and plans to expand the poultry farm.



Najma with her two children in the family home.



Smoke and dust from the traditional biomass-burning cooking stove.



Najma's new biogas cooking stove has reduced indoor air-pollution levels.

Gender and climate change⁴⁵

In Bangladesh, women are more vulnerable than men to chronic poverty due to gender inequalities in various social, economic and political institutions. Men tend to control income distribution, property, access to credit, decision-making processes, and other entitlements. Women have limited access to and control over natural resources, and more importantly are less mobile and have limited access to information. These factors exacerbate the vulnerability of women during disasters. In Bangladesh, the gender aspects of climate change therefore need extra attention. Bangladesh needs gender-sensitive climate change policies and planning if the Millennium Development Goals are to be met.

“Climate change induced impacts include livelihood and food insecurity. When livelihood and security is under threat the children and women are the first and worst victims. They have increased working time and less and less food for themselves as the adult males consume most food and also use multiple sources of food (for example eating out in restaurants) where the women and children do not have access due to the lack of control over cash income of the family.”

Source: PRODIPAN, Bangladesh

When a cyclone and floods hit Bangladesh in 1991, the death rate for women was almost five times higher than for men. Men were able to warn each other as they met

in public spaces, but they rarely communicated information to the rest of the family. Many women are not allowed to leave their homes without a male relative, and simply waited for their relatives to return home and take them to a safe place. Moreover, as in many Asian countries, most Bengali women have never learned to swim.

'Due to the impact of climate change, migration increases. During migration in many cases the children and women are left at home without proper arrangement for food and other survival supports. The children and women left behind are socially and physically insecure. For food and security many of the women choose informal extra-marital sex relations and children embark on hazardous occupations.'

Source: PRODIPAN, Bangladesh

Women are the main users and carriers of water. They often have considerable knowledge about water resources, including their location, quality and reliability, restrictions on collection and acceptable storage methods. They are critical to the success of water resources development. Women and children provide nearly all household water in rural areas, both for domestic use such as drinking, cooking, bathing and washing, and for irrigating gardens and watering livestock. If water resources are nearby and of good quality, this will benefit women's crops and livestock and thus their families' food security. It will also reduce the amount of time and energy women must spend collecting, storing, protecting, and distributing water. The health of women's families is also affected, if water-borne diseases are present.

The vulnerability of women in areas prone to saltwater intrusion

The adverse effects of climate change in areas prone to saltwater intrusion in Bangladesh will have disproportionate implications for women. Salinity is already a major problem for people living in southwestern districts of Bangladesh such as Satkhira, Khulna and Bagerhat. The problem is particularly intense during the dry season. Women are generally responsible for providing their family with salt-free drinking water, but because nearly all local water sources have high salinity, women must travel long distances by foot every day to find drinking water, even if they are in poor health.

Many women in southwest Bangladesh must travel at least five to six kilometres per day on foot to collect drinking water. This makes finding time for other household duties difficult and women are often so tired they cannot concentrate on other issues. Husbands complain that their women are not serving food on time and some women are physically assaulted because of this.

Women suffer more illnesses because of the strain of collecting drinking water. Many of the women who travel long distances to fetch water are pregnant or have young babies. They often feel it is unsafe to leave their children at home while they collect water, so take their children with them. This affects their children's health, too.

The long walk for fresh water⁴⁶

Aleya is four years old and does not know the meaning of the word 'salinity', but she knows she will have to wake up before dawn and walk five kilometres with her mother, braving the morning chill, just to fetch drinking water. She knows that if they fail, her father will scold her because the whole family will have to drink salty water from a nearby shrimp-cultivating gher. Aleya's family and the others of Khaserabad Village in Satkhira's Ashashuni Upazila have no alternative but to walk such distances each day because their local groundwater is now saline. 'We have to walk this long way as the water of two ponds in our village has turned to saline and is too muddy to drink,' said Aleya's mother Laily Begum.



Aleya and her mother walk five kilometres to collect fresh water each day. Photo: Centre for Global Change

Women and children are the worst victims of the current salinity crisis, as they have to fetch drinking water by walking sometimes more than ten kilometres along narrow roads. Their ordeal is most acute during the rainy season, when roads become slippery and difficult to navigate. 'Male members do not go to bring non-saline water. I fetched water walking around two kilometres even before the day I gave birth to this daughter (four-year-old daughter in the picture). Just after two days of her birth, I again started fetching water and now I am suffering through the physical troubles,' says Laily Begum.

The crisis is even transforming old local customs and creating new cultural barriers. Ashura of Dumuria village in Shyamnagar is 20 years old and now finds her desire for marriage a distant dream. Her aged parents, fearing that there will be no one to fetch them drinking water, do not want her to marry. People living in areas where the water crisis is more moderate, meanwhile, refuse to arrange marriages for their offspring with people from the worst-hit areas. Salinity has become a social curse, which is likely to get worse with climate change.

Central Asia

Central Asia already experiences a high degree of water stress. Agricultural systems and ecosystems in some areas may be able to cope with some decreases in rainfall, but other semi-arid areas could be amongst the first to show the effects of climate change.

Rising populations will place demands on scarce water supplies, directing them away from irrigation farming. This is problematic because most Central Asian countries rely on groundwater to irrigate agriculture. In Iran, for example, agriculture accounts for 94 per cent of water use, and 55 per cent of the water used comes from groundwater sources.⁴⁷ Any decreases in rainfall could, therefore, significantly affect both agriculture and the availability of water for human consumption.

The climate in Central Asia

Between 1894 and 1997 the mean annual surface temperature in the Middle East and Central Asia rose by around 1.3°C.⁴⁸ Many countries are landlocked, and therefore most of the region receives very little rainfall. Climate change is likely to reduce rainfall even further. For example, the average summer rainfall in parts of Pakistan, Iran and Central Asian states such as Uzbekistan and Tajikistan could decline by more than 20 per cent over the next 100 years.⁴⁹

Some Central Asian states, such as Tajikistan and Kazakhstan, are also heavily dependent on meltwater from glaciers for their freshwater supply. These nations could face further water stress over the coming years. For example, Kazakhstan's glaciers have shrunk by more than 25 per cent in the last 50 years.⁵⁰

Mirzokhonova Munavara, 56, an agronomist in Tajikistan⁵¹ explains: 'There has been a change in climate in the last 15 years. It gets extremely hot and then extremely cold. People are struggling here because we have to adapt to this and we do not have the rain at times to water our land. The soil has become dry and crops have changed in quality and in colour. We have irrigation channels but no water. We cannot leave this village as we have nowhere to go and no money to leave. God has given us this weather so we will need to learn how to adapt, to change our seeds so that we can continue to work and grow food.'



Mirzokhonova Munavara, an agronomist in Tajikistan, says communities are struggling to cope with the change in climate. Photo: Marie Cacace/Oxfam GB



Salt deposits on land in Kazakhstan. Photo: Christian Aid/Mark Edwards



Livestock in Kazakhstan. Photo: Christian Aid/Mark Edwards

Changes in Uzbekistan⁵²

'In recent years, the change in climatic conditions in all seasons of the year is sharply felt. Changes in climate often influence agricultural yield, for example many kinds of grain crops do not have time to ripen. From 2000 to 2003, because of a drought none of the districts of Karakalpakstan could obtain productivity in grain.'

'...the problem of water facilities, especially drinking water and water for irrigating agriculture, recently has become one of the largest problems...because of the drying of the Aral Sea, on its former coasts the influence of dust storms and sand drifts is strongly felt. Almost in the whole territory of the Republic of Karakalpakstan

it is possible to see salt on the ground left over from evaporation. Salinity of the soil negatively affects vegetative cover. In many places, trees and other vegetations are drying out. Huge tracts of land and agricultural fields are covered by copious saline deposits. As a result, productivity drops and quality worsens.'

'In recent years, as a result of the change in climatic conditions and pollution, the frequency of allergic and bronchial diseases has sharply increased.'

'Little by little the extinction of not only many kinds of vegetation, animals and rare varieties of fauna fade away.'



Davlodmoh Inomova, a pumpkin farmer in Tajikistan, demonstrates the size of the hailstones that are now damaging her crops. Photo: Marie Cacace/Oxfam

'I've been farming in this area for the past 30 years and I've noticed that it's raining more and the temperature has changed. From October to May and March to April it's often very windy. I have also noticed that when it now hails, the hailstones are very big and damage our crops. From December to March it's very cold; this wasn't so five years ago. It's much colder than before and when it's hot it's very hot.'

Davlodmoh Inomova, 48, pumpkin farmer, Tajikistan⁵³

Tajikistan

Tajikistan is a low-income country, with a GDP in 2005 of just US\$2.3 billion. It is also the third-most disaster-prone country in Eurasia (after Russia and Afghanistan) and climate change is set to make life more difficult for many of its seven million inhabitants. Nearly the entire republic is mountainous, and its rivers rise in mountain glaciers. Steep valleys with few trees and the towering mountains leave towns and villages extremely prone to earthquakes, landslides, mud flows, floods, and avalanches. Such calamities occur regularly and pose a relentless challenge to long-term development. Even the smallest disaster can have huge impacts on a community.

'In March 2007, an eight-month drought in Vose District in Southern Tajikistan meant that there was no hydropower and therefore no electricity, so water pumps did not work properly and there was less clean drinking water. This drought was followed by excessive rain causing mudslides that swept away water pipes, including pipes constructed by Oxfam engineers. The mudslides effectively finished off the community's water supply system. Now people have to walk over one kilometre to get clean water. This has huge health implications, and typhoid and tuberculosis are now rife.



Flooding in the Hamadoni area of Tajikistan washed away roads and houses. Photo: Julia Griner/Oxfam GB

Changes in the climate also increase the smaller but daily, chronic, difficulties that people face, especially farmers who are already amongst the poorest people in the country – most farmers live on less than two cents a day. Unpredictable weather, combined with low incomes, means people cannot salvage their crops or adapt to a changing climate. This pushes them even further into poverty.

There have been more disasters here in the last two years and more floods. There are no early warning systems in place after the collapse of the Soviet Union so we cannot predict when a disaster will happen. The climate has become hotter and snow has melted from the high mountains, which has meant that we have more mudflows and floods. Because some people do not have the money to build their houses well, they collapse. When natural disasters strike, people are displaced and forced to move; they have to change their entire lives.'

Mahmad Kabir, a member of the Kulyab emergency committee, Tajikistan⁵⁴

Helping women adapt to climate change in Panjhok⁵⁵

Climate change is one of many challenges facing the people of Panjhok Village in northwestern Tajikistan. This remote community has no road access for up to five months of the year as a result of heavy snow. During winter, their diet depends primarily on grains and potatoes. Winters are cold and heating is inefficient. Fuel, usually a mixture of dung and straw, coal, or wood, is scarce, and its collection is labour-intensive. Job opportunities in the village are limited. As a result, many men migrate to Russia for work, and leave the women to care for the family, the garden and the livestock.

CARE, with support from the Canadian International Development Agency (CIDA), worked with a community-based organisation (CBO) in Panjhok village to better understand how climate change will impact the community, and what evidence of climate change is already being observed. When asked about key climate-related concerns, the community members noted that the beginning and end of the winter season were becoming less predictable, and that the snow pack seemed to be increasing. Both of these facts are corroborated by meteorological data from the last few decades. These changes are threatening the livelihoods of a community that already lives in a harsh environment with a short growing season.

The project worked with the CBO to design and implement pilot adaptation strategies in the community. In an effort to target the most vulnerable community members, the CBO prioritised women-headed households. The key issue tackled was the impact of the shifting winter season on food security.

To address the challenge of agricultural productivity in a shortening growing season, the project introduced simple cold frames. These are small greenhouses, which are used to start seedlings in the spring and to extend the growing season later in the year. Fifteen women in Panjhok were given cold frames and trained on their use and maintenance. As a result, these families were harvesting greens two months later in the year, and had tomato seedlings ready to plant as soon as the warm weather began in the spring.

The project also addressed the issue of food availability in winter by promoting techniques for food preservation. Female CBO members were trained to preserve tomatoes, onions, peppers and other vegetables commonly grown in kitchen gardens. This increased the variety and nutritional value of the winter diet, providing welcome diversity from the usual bread and potatoes.

Women's responsibilities in the home tend to be sensitive to changes in climate, so efforts to adapt must consider women's needs and priorities. This project demonstrates that small changes to livelihood systems can increase resilience in the face of a changing climate.



Umeda Ddinaeva says changes in temperature in Tajikistan have led to locust invasions, destroying her livelihood. Photo: Marie Cacace/Oxfam

'We work in the field to make a living and a few weeks ago locusts attacked our fields and our entire [watermelon] crop has disappeared. I have noticed that when the temperature is above 34 degrees, when it is much hotter than usual there is a more chance that locusts will come to attack our crops. I will have to take a loan out to buy more seeds and spend the next two weeks working on the land to get it ready to plant. Buying one bottle of seeds is expensive and we won't have an income for the next two months that it will take the watermelons to grow.'

Umeda Ddinaeva, 19, a watermelon farmer, Tajikistan⁵⁶

Community experiences of climate change in Tajikistan⁵⁷

'In 2005 women sowed wheat on three hectares but got nothing due to the unusually hot weather.'

Youth Ecological Centre, Tajikistan

In early 2007, two Tajik organisations, the Youth Ecological Centre and For Earth, researched community perceptions of climate change in Tajikistan. Christian Aid funded the research via the Act Central Asia consortium. Around 100 people were surveyed across three out of the four oblasts (or regions) of the country: Sughd (north), Khatlon (south) and Pamir/GBAO (east). Surveys showed that people in Khatlon and Pamir/GBAO felt most strongly that the climate had changed for the worse over the last five years. In Sughd, most people felt the overall situation was stable, but respondents nonetheless reported a number of important changes.

The two main changes observed were (i) greater extremes of temperature, with hotter summers and colder winters, and (ii) less predictable snow and rainfall. This was having a severe impact on farmers' crop yields. For instance, most respondents in all three regions said that the worsening climate had reduced their incomes. This is a major problem for a country in which agriculture is the mainstay of the domestic economy. Farmers like Burkhoni Saidbek, from Sughd province, are adapting their farming techniques to the new conditions. He used to grow wheat and peas in 2003, but when this became less successful he changed to onions in 2006.

People described several notable events in the last five years. Snowfall in October 2004 caused the loss of 40 per cent of the wheat harvest in Pamir/GBAO and a February 2007 snowstorm also killed or injured 2,600 livestock in one district of Khatlon. A heatwave in 2005 burned much of the melon and gourd harvest and caused the cotton harvest to sharply decline.

Respondents also reported that climate change had had a significant impact in areas besides crops and farmers' incomes. More infectious diseases, such as typhus and malaria, were observed, along with more disasters, particularly floods and mountain torrents. Out-migration had increased in some areas, as had conflict between communities over growing water shortages.

Average annual temperature increases between 1961 and 1990 were particularly large in low-lying valleys – where the majority of people live – and cities, with increases as much as 1.2–1.9°C over this period. Temperatures are set to rise even further in this century. A 2–3°C rise by 2050 will cause the disappearance of many of Tajikistan's smaller glaciers and a 25–30 per cent decrease in the volume of ice in all glaciers. Water flows in many river basins, including Zeravshan and Kafirnigan, are expected to fall considerably.

Three-quarters of those interviewed said they had insufficient information on climate change and possible adaptation measures. This may be because the Tajik Government and media do not prioritise the issue, and because of the relatively small number of environmental NGOs operating in the country (just 20 compared to 200 in neighbouring Kyrgyzstan). It is no surprise, therefore, that so few of the people questioned could correctly identify increases in greenhouse gas emissions as the principal cause of global warming.

A range of adaptive measures are available for these communities, including improved systems for measuring and forecasting hydrological changes, increased crop rotation, sustainable pasture management, crop insurance schemes, efficiency measures for irrigation, riverbank strengthening, and the development of disease-resistant varieties of wheat and cotton. However, minimal government funding prevents the rolling-out of these measures. Although the Tajik Government developed a National Action Plan on climate change in 2003, funds have not been made available to oblast or district authorities to carry out adaptive measures, in spite of the importance of agriculture for the national economy.

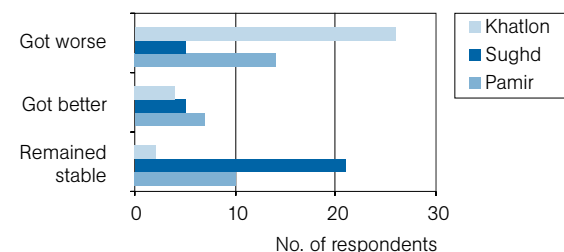


Figure 1: How do you see climate change in your region: has it increased, decreased or remained stable?

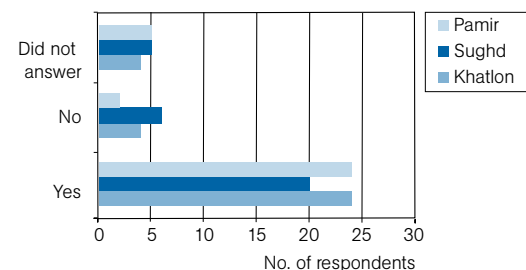


Figure 2: Were there any changes in precipitation levels or unconventional variations in temperature?



Industry in Kyrgyzstan. Photo: Christian Aid/Sarah Maliana

Kyrgyzstan

In Kyrgyzstan, temperatures rose by an average of 1.6°C in the twentieth century. This was much higher than the global average rise (0.6°C). In this century the Government predicts that the increase will be in the order of 1.8–4.4°C. This rise will result in increased desertification, which will aggravate existing problems of soil erosion. There will also be significant impacts on human and livestock health. In other respects, however, such as rainfall and water flows, the country will be less affected. One major concern is the lack of national regulatory bodies in the sphere of climate change, as this could hamper future adaptation measures.⁵⁸



Making wool in Kyrgyzstan. Photo: Christian Aid/Amanda Farrant

China is already experiencing the effects of climate change. Of particular concern is the affect that climate change has, and will continue to have, on the agricultural sector and Chinese food security. Extreme events, such as droughts, floods, cyclones and tropical storms, are increasing, and glaciers are melting faster and faster, which has implications for the nation's water supply as well as increasing the risk of the bursting of glacial lakes.

In June 2007, China launched its national climate change programme. The programme included strategies to reduce greenhouse gas emissions, alternative ways of fuelling its huge and growing need for energy, as well as ways to cope with the worst effects of climate change ahead. Civil society organisations in China are also preparing their own report to develop their commitment and participation in combating climate change.

Agriculture and environment

Meteorological records show that rainfall in China has, in general, been decreasing since 1965. But climate change will likely increase the average rainfall in China by 7–10 per cent, particularly in southern and northwestern China. But averages are misleading. At the same time water shortages in Chinese agriculture are likely to become more severe, especially in northern regions, where droughts are already common. This is because the climate will get more irregular so sometimes there will be no rain when crops need it most. Higher temperatures will also increase evaporation.



View of a dried up river during a long-term drought in Guangdong, China. Such droughts could become more frequent and more widespread if climate change continues. Photo: © Greenpeace/Gary Braasch

The climate in China

Experts warn that climate change would hit China hard. Rapidly melting glaciers in Tibet would lead to dangerously low water levels in some of its most famous rivers; the Yellow River and the Yangtze. Rising sea levels would have a massive impact on the country's coastal regions, which are home to the nation's most prosperous cities and provinces. More than 400 million people in China are already living with the problem of desertification, partly brought on by climate change. Higher temperatures would also affect agriculture and food production.

Source: BBC News, May 2007

Lastly, the projected increases in rainfall are likely to be very unevenly distributed, with some areas receiving more water, and maybe too much, leading to floods, while other areas will experience droughts.

Some of the environmental effects of these changes are relatively benign, such as the flowering of plants in spring occurring around two to four days earlier than in the past. But other effects, such as those on agriculture, could seriously affect the economy and local livelihoods.

The latest National Assessment Report on Climate change published by the Chinese Government,⁶⁰ estimates that climate change is having a negative impact on China's agricultural production as a whole. It estimates that if no action is taken, the gross productivity of the Chinese agricultural industry will decrease by 5–10 per cent. By the second half of this century, the production of three staple crops – wheat, rice and corn – may decrease by up to 37 per cent. In the next 20 to 50 years, the huge impact of climate change on agriculture will affect China's food security.

In the past, peasants knew when to plant seeds to have a healthy crop because the rains were regular. But climate change is making the weather more irregular, so droughts sometimes occur when farmers need rain. The warm winter of 2007 hastened the germination and growth of winter wheat, but this has made it vulnerable to frosts in the spring. In southern regions, water used to be plentiful, but in recent years, the irregularity of rainfall patterns and heat has caused water shortages. The cost of agricultural production will also rise, because of the increased need to control crop pests and weeds, brought about by temperature increases.

High temperatures and drought in Chongqing

At the beginning of this century, Chongqing City experienced a continuously high average temperature with evidence suggesting this was due to climate change. The drought in Chongqing in 2006 was severe, topping all meteorological records kept in China since 1891. Some 3775,900 hectares of crops in Chongqing were damaged due to drought, among which 685,800 hectares provided no harvest at all. The output of spring crops in Chongqing declined by 7,814,100 tons, a decrease of more than 30 per cent compared with regular years. Some 15 million people and 1.3 million cattle experienced temporary shortages in drinking-water supplies. In some areas, people had to carry water from 2.5 kilometres away.

In responding to the impacts of climate change on agriculture, the Government and civil society groups in China are trying to develop and implement new adaptive strategies to cope. These include promoting plantations that are drought resistant, clean energy sources in rural areas such as solar energy and biogas, water conservation projects, and dripping irrigation systems. In spite of these efforts, many marginal and impoverished rural communities are still threatened by the changes.

Disasters on the increase

China is one of the countries to suffer most from disasters, and the increase in climate-related extreme weather patterns has already had severe negative effects. In 2006, China suffered from extreme events to an extent not seen since the 1998 floods. Typhoons Kaemi, Saomai and Pearl landed in Chinese coastal areas, along with the tropical storm Bilis. Chongqing City and Sichuan Province also suffered from a summer heatwave whose strength has rarely been matched in China's history. Forest-fire-danger weather ratings rose because of the continuous drought, and one forest fire in northeast China was more severe than any experienced since 1987. With more

Tropical storm Bilis

Extreme events bring great losses to China. For example, in July 2006, tropical storm Bilis combined with warm moist air flows from southwest China to batter southern China with strong rainfall, causing severe floods, landslides and mud flows. Nearly 32 million people from six different provinces and autonomous regions were affected. Some 843 people died and 3.4 million people were urgently relocated. Over 1,337,000 hectares of crops were damaged, and 263,000 hectares of crops were not harvested at all. Some 391,000 houses collapsed and 471,000 houses were damaged. The direct costs of the disaster reached almost

Disasters, environment and livelihoods in Qingshuiling Village

Qingshuiling Village in Gansu Province is built on arid mountainous land. Severe soil erosion in the area has reduced the fertility of land, and has exacerbated the impacts of extreme events like droughts and floods. The output of village farmland is low, with poor yields of both wheat and corn. The average annual income of villagers is also low at around 300 yuan. The villagers cannot afford to buy coal because they are poor and rely on gathering wood from the mountain for heating and cooking. Local vegetation is therefore disappearing and the ecosystem is deteriorating. A vicious circle is formed in which poverty leads to ecosystem deterioration, which in turn increases poverty, because with a damaged ecosystem, the area and its people are more vulnerable to extreme events like storms and heavy rain.

Oxfam Hong Kong, recognising that disasters, environmental protection, and livelihoods are closely linked, is conducting an ecological project in Qingshuiling Village to explore ways to harmonise the relationship between the three. The project has helped solve many problems. Problems related to securing farmland fertiliser, livelihoods, and equality have been alleviated by raising cattle. Solar cookers have helped solve the problems of finding fuel, and planting clover has helped solve problems relating to water and soil erosion as well as providing fodder for cattle. The project has also helped villagers build a rain-collection vault for drinking water.

frequent disasters expected, government and non-government organisations are still discussing how best to cope.

In May 2007, the Chinese authorities announced that the country was likely to be hit by more adverse weather during the rest of 2007 than at any time in the past decade. The reason, they say, is because of global climate change. Official figures suggest that environment-related disasters killed more than 2000 people in 2006 and caused millions of dollars in damage.

Source: BBC News, May 2007

Currently, the poorest people in China are primarily located in environmentally vulnerable remote areas with poor infrastructure. Ethnic minorities represent a disproportionately high percentage of the poor, and are also most vulnerable to environment-related disasters. Droughts, flooding and other extreme climate events will seriously affect the lives and livelihoods of these groups.



Halong Glacier, Qinghai-Tibetan Plateau, China. During the past 30 years the Tibetan plateau has warmed by 1 degree increasing rates of glacial retreat. From 1966 to 2000, glaciers in the Yellow River Source region retreated by 17%, causing the loss of 2.39 billion cubic metres of water from the source of the river. Photo: © Greenpeace/John Novis

The fast pace of glacial melt

Some 82 per cent of the glaciers in western China are retreating due to climate change. Glaciers occur in six Chinese provinces or autonomous regions, including Xinjiang, Qinghai, Gansu, Sichuan, Yunnan, and Tibet. In Tibet, there are up to 22,468 glaciers, covering an area of 28,645 square kilometres. In the past 40 years, as temperatures have risen, the area of glaciers in China has shrunk by 3,248 square kilometres, which is a 5.5 per cent decrease compared to the 1960s. The total volume of ice has diminished by 389 cubic kilometres compared to the 1960s, which is a seven per cent decrease. Since the 1990s, the scale of glacial retreat has significantly increased. It is estimated that by the middle of the twenty-first century, the volume of glacial ice in western China will have decreased by a further 27.2 per cent.

This rapid melting of glaciers will bring a series of problems to China. First, when glaciers melt, glacial lakes can form. These lakes are trapped at the front of the glacier by a dam of moraine and ice. As temperatures increase and melt the glaciers faster, these dams can break causing so-called glacier lake outburst flood events. These floods can wipe out downstream houses, roads and bridges.

Glacier lake outburst flood in Yigong, Tibet

On 10 June 2000, the moraine lake in Yigong, Tibet, experienced a massive outbreak. Floods stopped the whole of the Sichuan-Tibet Highway from operating, crushing over 10 bridges including Tongmai Bridge and Jiefang Bridge, and flooding over 50 kilometres of roads. In India, which lies downstream from the lake, the effects were even more serious: 30 people died, 100 were missing and 5,000 lost their homes. Some 20 bridges were destroyed. The disaster led to a total loss of about US\$23 million.

Retreating glaciers also threaten China's long-term water resources, although in the short-term, the fast pace of melting could actually increase glacial runoff. In the northwest region as a whole, glacial runoff has increased more than 5.5 per cent since the 1990s as a result of higher temperatures. As the volume of glaciers decreases, however, water supplies could be under threat in some areas in the very near future. In areas where water availability in the dry season depends on glacial melt, serious water supply problems could occur.

Water resources

China is currently facing problems with water shortages, water contamination, and unequal water distribution. Using data from 2004, water resources per capita are about 2,185 cubic metres, which is less than one-third of the global average. But water resources are not evenly distributed throughout the country. The area to the north of the Yangtze River covering about 64 per cent of Chinese land, is home to 46 per cent of the population, 60 per cent of arable land, and 44 per cent of GDP. However, the region only has roughly 19 per cent of the nation's water resources. The Yellow River Basin, Huaihe River Basin and Haihe River Basin cover 35 per cent of arable land in China, contain 35 per cent of the population and provide 32 per cent of total Chinese GDP, but the area has only seven per cent of China's water resources. The average water resource per capita in this area is about 457 cubic metres, which is amongst the lowest in China.

Climate change is intensifying the conflict between supply of, and demand for, China's water resources, especially in the northern and western regions. Due to temperature increases and changes in rainfall patterns, water resources in northern China have been significantly reduced. This is particularly obvious in the Yellow River Basin, the Huaihe River Basin, the Haihe River Basin and the Luan River Basin, where surface water resources have been reduced by 17 per cent and total water resources by 12 per cent in recent years. In the Haihe River Basin alone, surface water availability has been reduced by 41 per cent, while total water resources have decreased by 25 per cent.

With increasing evaporation rates and a reduction in the size of glaciers, which traditionally act as a solid backup-supply of water, the problems of water availability may intensify. It is estimated that by the years 2010 to 2030, western China will see annual water shortages of 20 billion cubic metres.

Sea-level rise and coastal areas

The past 50 years have seen sea levels rise around the coastal areas of China at a speed of two to three millimetres per year.⁶¹ In the past 50 years, the sea level around the coast of the Yangtze River Delta and Pearl River Delta rose about 3.1 millimetres and 1.7 millimetres respectively per year.

Sea-level rise has already affected China's coastal economy and the stability of its ecological environment, particularly in 2004 and 2006. The effects of storm surges, coastal erosion and saltwater intrusion have been exacerbated, both in frequency and in intensity, bringing huge losses. In 2006, saltwater intrusion and coastal erosion all intensified in the Yangtze River Delta region. Frequent saltwater intrusion has already affected Shanghai City's water supply, reducing the quality of groundwater supplies and soils, and having a disastrous impact on local ecosystems.

Coastal areas provide an important habitat for many species and they also support the livelihoods of peasants, who will suffer from high tides, coastal erosion and saltwater intrusion as the sea rises. Sea-level rise also influences the reproduction and behaviour of fish living in river estuaries. Although detailed research is lacking, it is certain that sea-level rise will harm the fishing industry, which is already suffering from the harmful effects of overfishing. Coral reefs in the Gunagxi and Hainan provinces have already shown signs of albinism, perhaps due to increases in sea temperature and other pressures, and this could further damage the fishing industry.

According to one UNEP report, the ecology of the Yellow River Delta is one of the most vulnerable to climate change.⁶² Floods and erosion will affect the delta's coastal areas and wetlands. As a result, the tourism industry, water supplies, fish stocks, and biodiversity will be damaged. The report estimates that 40 per cent of delta areas will be inundated if a sea-level rise of about one metre combines with a two to three metre storm surge. By 2050, the sea level around the Yellow River Delta will rise about 0.48 m and storm surges will be a major challenge. Water supplies, which are already scarce, will be threatened further, and the expected impacts will bring unprecedented challenges to the local ecology and sustainable development of the local economy.

The Chinese Government has already taken many important steps to cope with climate change impacts in coastal areas and emphasises the importance of investment in construction to safeguard the coast. However, even if construction proceeds as envisioned by the Government, the costs as a percentage of Chinese GDP will still be far below the reasonable upper limits proposed by the IPCC. More intense and more frequent typhoons and storm surges could be disastrous for poor

Impacts on human health, ecology and transport infrastructure in Hong Kong and the Pearl River Delta⁶³

Rising temperatures are likely to have a negative impact on the health of people living in the region. Cardio-respiratory illnesses will increase, as will the prevalence of mosquito-borne diseases, such as malaria and dengue fever. Higher temperatures will compound the problems associated with already high levels of air pollution by accelerating photochemical reaction rates among atmospheric pollutants.

The ecology of the region, already damaged by rapid industrialisation, will suffer a severe blow. Delicate wetland ecosystems, such as the World-Heritage-listed Mai Po marshes, will be invaded by seawater, and if hemmed in by concrete, their natural adaptive capacity will be eliminated.

The risks of climate change impacts to the region's physical infrastructure have been inadequately considered. Roads and railways in the Greater Pearl River Delta will suffer damage from temperature increases and rising sea level. Higher temperatures may damage road surfaces and cause subsidence, while railway foundations may shrink, and rails become buckled and distorted. Storms and flooding can damage above-ground railway lines and flood tunnels. The region's ports are threatened by sea-level rise, storm surges and flooding. Sedimentation patterns around harbours could also change thus adding to port operating costs. The five airports in the Greater Pearl River Delta – including Hong Kong's Chek Lap Kok airport, which is built on reclaimed land – are vulnerable to storms and flooding.

and disadvantaged coastal township communities. The Chinese Government should therefore become more actively involved in actions to reduce atmospheric levels of greenhouse gases. It should consider the negative effects brought about by sea-level rise, and support more research on the relationship between coastal ecosystems and climate change. It should also improve its ability to cope with such matters and work more closely with local community groups, environmental groups, and other NGOs. This would help share information, improve decision-making processes, and encourage more participation in the subject area.

Energy

Chinese per capita greenhouse gas emissions are still a fraction of those in industrialised countries. Earlier this year, one estimate – from the Netherlands Environment Assessment Agency – suggested that China has now overtaken the USA as the world's largest emitter of greenhouse gases.⁶⁴ Many had not expected China to

Hong Kong – a vanishing winter⁶⁵

Hong Kong's winters could vanish within 50 years, with the number of cold days declining virtually to zero due to global warming and urbanisation, according to the head of the city's weather observatory. Speaking in June 2007, Lam Chiu-ying, director of the Hong Kong observatory, reported that, 'according to our projections, toward the end of this century... there will be less than one cold day each winter, so winter practically will have disappeared.'

According to Lam, cold days are defined as those with temperatures below 12°C at some point during the day. Despite its sweltering summers, Hong Kong enjoys a subtropical climate, with cool winter temperatures. Frost is sometimes found on its highest peak, Tai Mo Shan. Between 1961 and 1990, there was an average of 21 cold days every winter, but this figure had already halved by 2000.

'Over the past century, temperatures in Hong Kong rose around 1.2 degrees, almost double the global average,' said Lam, who warned that urbanisation would accelerate the loss of the city's winters. 'We would really start losing the very distinct seasonal march throughout the year... We would really look more tropical than we are now.' The number of summer 'hot-nights' in Hong Kong, with temperatures above 28°C, has already jumped to 30 a year – an almost four-fold increase from the 1990s, as heat trapped during the day by the concrete city and its teeming skyscrapers is unable to dissipate fully at night.

Lam attributed Hong Kong's predicted temperature rise of three to four degrees by the end of the century to urbanisation and global warming in equal measure.

overtake the USA until 2010 at the earliest. Yet, carbon footprint data from the Global Footprint Network show that despite having a population that is four times larger than that of the USA, Chinese per capita emissions are 87 per cent less than the USA and 71 per cent less than the UK.⁶⁶ A considerable proportion of growth in emissions is also due to the outsourcing of manufacturing industries from industrialised nations and demand from consumers in Europe and America. The launch of China's national climate change strategy is therefore welcomed. China hopes to tackle climate change through improvements in energy efficiency, more efficient coal-fired power stations, and renewable energy, such as wind and hydro. With continued rapid growth of the economy, China will inevitably consume more and more energy resulting in the release of large volumes of greenhouse gases. The main challenge for China to cut greenhouse gas emissions are the coal-dominated energy mix and lack of advanced clean technology.



Recent violent floods have caused a rapid rise in the river taking away rows of houses in Xinshao, Hunan Province, China. Photo: © 2005 Greenpeace/Hu Wei

Commercialisation of energy-efficient household stoves⁶⁷

The Beijing-based energy company, Daxu, has developed a stove that can burn crop residues, both loose and compressed, as well as wood. The stove partly gasifies the fuel, and then burns the gas with secondary air. This results in an extremely efficient (at 40 per cent) stove and much lower emissions.

Since most families in rural China cook and heat their homes using stoves that burn coal or wood, the system can reduce the cost of cooking and heating by 50 per cent. And, as around 20 million wood and coal stoves are sold each year, the health and environmental benefits from widespread use of this stove will be significant. Levels of air pollution and smoke in the kitchen are lessened, reducing damage to health from respiratory or eye-related illnesses. Improvements in efficiency and the move towards a renewable biomass fuel also reduces CO₂ emissions.

Developed countries

Poor countries will suffer most of the impacts of climate change, in part because of their location in vulnerable areas and in part because of their low capacity to cope with such changes. But climate change will also affect Asia's wealthier countries. Australia, Korea and Japan are already experiencing some of the impacts of climate change, and it is the poor people in these wealthy nations who are most at risk.

Australia up in smoke⁶⁸

Awareness and discussion on climate change in Australia has never been so high. Climate change makes headline news on a daily basis. Australia is currently in the grip of one of its longest droughts, and water is an election issue. Despite this, Australia has the highest per capita greenhouse gas emissions in the world, and a government that refuses to ratify the Kyoto Protocol and regulate emissions reductions. IPCC predictions for a temperature increase above 2°C means it is highly likely that Australia's iconic Great Barrier Reef will be devastated by coral bleaching, whilst the world-renowned Kakadu National Park, the Victorian Alpine regions and the Wet Tropics will suffer large biodiversity losses.⁶⁹ It is not only the natural environment that will suffer from climate change, however.

Aboriginal Australia

Over 100,000 Aboriginal Australians live in remote areas of Australia, the majority in settlements in the north of the country. Many of these communities have inadequate water, sanitation and power supplies. Dilapidated housing, few employment opportunities and insufficient health services are commonplace. According to the IPCC, Aboriginal Australians are amongst the most vulnerable people in the world to climate change.⁷⁰ Yet, in some instances, they are also often best able to adapt to climate-related threats, such as droughts.

Many of these communities are in low-lying tropical areas that are particularly vulnerable to storm surges and floods, which are expected to increase as the planet warms. A sea rise of one or two metres would wipe out dozens of populated homelands, particularly those in the Gulf of Carpentaria, northern Australia, where many live only a few inches above current tide levels.

Climate change will affect indigenous health directly, in the form of heat stress, for example. Indirect effects, such as damage to traditional homelands, can also threaten the cultural, mental and physical well-being of Aboriginal communities. Inland floodplains, such as the lowlands in the Kakadu region, will also be affected by increased sea-level rise, affecting 'bush tucker' with ensuing nutritional consequences.

Australian Catholic Church responds to climate change

Catholic Earthcare Australia was established by the Australian Catholic Bishops' Conference in 2002 to help protect the integrity of creation and the health of Earth's inhabitants and life supporting systems. Priority has been given to climate change and it organised a climate change conference in Canberra during November 2005. Its chair, Bishop Christopher Toohey, spoke at the Vatican Conference on Climate change in April 2007 where he said: 'To meet the challenge of climate change will require a change of mind and heart. The pastoral commitment of the Church will be to foster in a new and imaginative way a religious conversion to the will of God so that we will all have the courage and motivations under God's grace to do what we need to safeguard this garden planet.'

'Indigenous people don't see the land as distinct from themselves in the same way as maybe society in the southeast (Australia) would. If they feel that the ecosystem has changed it's a mental anxiety to them. They feel like they've lost control of their "country" – they're responsible for looking after it.'

Dr Donna Green, author of Climate change and health: impacts on remote indigenous communities in northern Australia.

Torres Strait

The Torres Islands are dotted across the international border between Australia and Papua New Guinea and are scattered across around 22,000 square kilometres. More than 8,000 people permanently inhabit 14 of the islands. Communities are often situated only metres from the beach, and some less than one metre above sea level. Interior parts of some of the islands are actually below sea level.

High tides, strong winds and heavy rain early in 2006 caused severe damage to half of the region's inhabited islands. Houses and other buildings were damaged and belongings destroyed; sewerage systems were flooded; and rubbish was strewn throughout residential areas and into the sea. These are not isolated events. Their occurrence is increasing every year during the wet season and, according to the residents of these communities, with increasing severity. The Yorke Island chairperson, Mr Donald Mosby, is in no doubt that global warming is to blame: 'You don't have to be a scientist,' he said, 'not when you see metres of beach disappearing every week.'

Australia is the hottest and most water-scarce continent in the world. Drought and bushfires are part of its history. Australia's Bureau of Meteorology has recorded major drought periods lasting from one to nine years since the late 1800s.⁷¹ But climate change is making Australia even hotter and drier.⁷² The Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) confirms that climate change impacts on Australia are costly and particularly damaging to two leading export earners: agriculture and tourism.⁷³ Higher temperatures increase surface-moisture evaporation, which combined with longer periods between rainfall has led to one of the most damaging droughts in Australia's history.

Drought was declared in most areas of New South Wales, Victoria and Queensland in 2001. It was widespread across the nation by 2002 and has continued with only approximately six months of relief in late 2005 to mid-2006. The drought continues today, and record low levels of rainfall in the past 12 months are now beginning to affect water supplies in major cities.⁷⁴ The Murray-Darling River Basin drains about 14 per cent of Australia and is often referred to as the 'nation's food bowl', because it accounts for more than half of Australia's food production.⁷⁵ In December 2006, less water flowed into the Murray River than at any time in the past century, seriously reducing the amount of water available for irrigation and severely compromising the ecological health of the river.⁷⁶

Between 2001 and 2006, AU\$1.2 billion was spent on drought relief.⁷⁷ By 2003, the drought had cost the Australian economy AU\$13 billion (1.6 per cent of GDP) and about 70,000 jobs.⁷⁸ The Australian Bureau of Agricultural and Resource Economics predicts that the 2007 winter grain harvest will be just over half the expected yield, at AU\$3.7 billion instead of the previously anticipated AU\$8.1 billion.⁷⁹

The price of fresh food is rising. In 2005, poor weather and higher fuel costs led to increases in the price of potatoes, broccoli, onions, tomatoes and a variety of fruit. Vegetable prices rose 6.8 per cent and fruit prices rose 5.8 per cent, contributing to a total increase in food costs of 3.6 per cent in 2005.⁸⁰

With only a 1°C rise in global temperature, New South Wales is projected to experience a 70 per cent increase in drought conditions. The AU\$17 billion livestock export industry (which is economically vital but also contributes to extensive land degradation) is at risk from increased heat stress, pests and diseases. National livestock-carrying capacity in native pastoral systems will fall by 40 per cent if temperature increases reach 2°C.⁸¹

Major Australian cities are now facing extreme water shortages with dam levels as low as 16 per cent capacity in Brisbane. Domestic-water restrictions are a constant source of public discussion, as many urban coastal Australians embrace new water-saving measures. Debates about more dams, expensive and energy-intensive desalination plants and water recycling have dominated Australia in the past 12 months.

Legend

- Eucalyptus species
- Eucalyptus species
- Eucalyptus species

0 1000 km

Map of Australia showing the distribution of Eucalyptus species. The map is divided into regions, each labeled with a species name. A legend in the top left corner indicates three types of distribution: 'Eucalyptus species', 'Eucalyptus species', and 'Eucalyptus species'. A scale bar at the bottom indicates distances from 0 to 1000 km. The map shows a high density of species in the eastern and southern parts of the continent, with fewer species in the western and northern parts.

Drought and high temperatures also increase dangers from extreme fires in summer seasons. While human interference (from poorly managed ‘controlled’ burns, unguarded camp fires and arson) often starts fires, the dry condition of bushland and forests enable fires to spread rapidly.⁸³ Permitting building in fire-prone areas also puts people at risk.

As with drought, Australia's history since European settlement has been marked by fire tragedies. In October 2006, the first bushfires of the season were recorded in New South Wales, marking an unusually early start to the bushfire season as temperatures spiked and wind speed rose.⁸⁴ By early February 2007, fires had been raging in Victoria, Tasmania and New South Wales for more than 60 days with fire-fighting contingents from Canada, the USA and New Zealand joining with Australian Country Fire Authority and Rural Fire Service teams.⁸⁵ The longest-burning bushfire was in Gippsland, Victoria, and only declared contained after 69 long days of fire fighting by over 19,000 fire fighters. By the time it was contained over one million hectares of public land had been burnt.^{86,87}

'After the fire engulfed our community and burnt all around my home I was shocked and expected the phone, electricity, roads and water to be out for weeks. Yet just two days later the lights, fridge and phone all worked. It's fires like that climate change will make all the more frequent and devastating. But most people in the world haven't the capacity to recover from such damage in two days. It drove home the Climate Justice problem; after beating a bushfire a cold beer became a moral dilemma.'

**Polly Buchhorn, a victim of the recent bushfires
on the east coast of Tasmania**

Climate change and Korea⁸⁸

Korea has been experiencing heavy snow, extreme drought, heavy rain, and storm damage as a result of climate change.⁸⁹ The year 1998 saw the hottest spring in Korea's history, several floods in summer and an autumn hotter than summer. The distinctions between its four seasons are becoming blurred, with the southern part of the nation turning into a subtropical area without winters. Observed environmental changes included early flowering and disruption amongst fish species. Forested areas are also being affected, and people are worried about rising sea levels threatening the marshlands along the southern and western coasts.

Yet the Republic of Korea was – and still is – a very significant emitter of carbon dioxide. Without drastic changes, such as industrial restructuring, energy conservation and increased use of renewable energy, emissions will only go up. The Republic of Korea's environmental movement first expressed concern that Korea was vulnerable to the impacts of climate change in the 1990s, and since then it has lobbied against nuclear energy and coal-fired plants and campaigned for energy alternatives. An eco-centre was established in Seoul, powered by solar and wind energy, and protests have been held outside a branch of Shell Korea, the US embassy and several Korean government offices. Educational campaigns have been run, particularly amongst students, to educate the public and to lobby political and industrial leaders on climate change.

The Korea Green Foundation was set up in 2002. Climate change is one of its primary concerns and in August 2006, it organised a special screening for opinion leaders and teachers of the Al Gore documentary, *An Inconvenient Truth*. Its 'STOP CO₂' campaign was initiated in April 2007, with a 'STOP CO₂' sculpture unveiled in front of Seoul's city hall in the presence of the city mayor and other dignitaries.

In June 2007, the Catholic bishops of the Republic of Korea issued a statement calling for a change in behaviour to ease the danger of global warming. Issued for World Environment Day, the statement urged individuals to change their habits and cut back on energy consumption.

Japan

Japan has already experienced sea-level rise of around two millimetres over the last 30 years. If the sea level rises by 30 centimetres, at least 57 per cent of the sandy beaches will be eroded. If the sea level rises by 65 to 100 centimetres, as much as 82 to 90 per cent of sandy beaches could be lost.⁹⁰ Japan is also vulnerable to extreme weather events. Hot days are expected to increase in frequency thus increasing health risks. Last winter was the warmest on record and snowfall was well below average. Whilst typhoons may decrease in quantity, they could become increasingly strong. Coral reefs are moving northward and Japan's Okinawa Island is also suffering from declines in alpine flora and bleaching of its coral reefs. Rice production and some fruits are expected to shift northward and there are concerns about the quality of production. Rice is particularly important because the nation relies heavily on it for food.⁹¹

Japan has trumpeted its role in the fight against climate change as the host nation of the Kyoto Protocol, although it is on course to miss its own targets under the treaty. Under the Protocol, Japan committed to cutting greenhouse gas emissions by six per cent from 1990 levels, but its emissions have in fact risen by eight per cent. Policies relating to industry rely on voluntary rather than mandatory action, so industry is rapidly increasing its use of coal.

Quake shakes up nuclear power plans⁹²

With few indigenous energy sources, Japan is focusing on expanding its nuclear power capabilities. Japan has 55 nuclear power plants that supply 30 per cent of its electrical needs. However, concerns about Japan's commitment to nuclear power were raised in July 2007 when an earthquake forced the closure of the world's biggest nuclear plant in the country. The Citizens' Nuclear Information Center, based in Tokyo, is calling for this power plant to be closed for safety reasons, and indeed for a phase-out of nuclear power in Japan.



Sculpture outside Seoul City Hall to launch the 'STOP CO₂' campaign. Photo: The Green Foundation, Korea

The Indian subcontinent is particularly vulnerable to climate change. India is a rising economic power and yet large proportions of the population still live in poverty. Over 250 million people live on less than US\$1 per day.

India is likely to suffer a wide array of impacts, ranging from insecure energy and food supplies and reduced availability of fresh water to extreme weather events, such as cyclones, flooding, heatwaves, and droughts. The worst-hit will be the poor in both rural and urban areas, who are more vulnerable and whose ability to recover from disasters is lower. Public health, human development goals and the country's rich biodiversity will all be hit.

'Periods of heavy rainfall over a very short period of time have been increasing over the last ten years. This is not usual. The frequency of cloudbursts is increasing, when there can be 60 millimetres of rain in five minutes. There have been two of these in the last three years and these weren't happening thirty years ago (in the northern mountainous areas). We are seeing many incidences of flash floods even in desert areas where we experience droughts.'

Source: The Evangelical Fellowship of India Commission on Relief, India⁹⁴

Climate in India

Indian climate is dominated by the southwest monsoon, which brings most of the region's rainfall. India is heavily dependent on the annual monsoon rains to meet its agricultural and water needs, and also for protecting and propagating its rich biodiversity.

While the total level of rainfall has shown little variation over the years, researchers have identified a tendency towards fewer, more extreme downpours. This has increased the potential for flooding by 10 per cent and it is still rising. Intense rainfall events occurring during the monsoon can cause substantial damages to infrastructure, property, animal and people.

The melting of the Himalayan glaciers⁹⁵



Gangotri Glacier. Photo: G. Areendran

Only the polar ice caps hold more freshwater than the Himalayan glaciers, yet by 2030, the size of the glaciers could be reduced by as much as 80 per cent. Some of India's most important rivers such as the Ganges, Indus and Brahmaputra are fed by the Himalayan glaciers. The Ganges is one of the great rivers of the Indian-subcontinent, the source of life for hundreds of millions of people. However, the IPCC has identified it as one of the rivers most endangered by climate change. Much of the water feeding the Ganges comes from glaciers high in the Himalayas. But rising temperatures means that many of the Himalayan glaciers are melting fast, and could diminish significantly over the coming decades with catastrophic results.

In the short-term, the rapid melting of ice high up in the Himalayas causes river swelling and floods. The formation of glacial lakes of meltwater creates the threat of outburst floods leading to devastation in lowland valleys. Earthquakes can trigger such outbursts. This problem faces not only India, but Nepal, Afghanistan, Pakistan, Tibet, and China. In the longer-term, water flow in the Ganges could drop by two-thirds, affecting more than 400 million people who depend on it for drinking water. Farmers would not be able to irrigate their land and hydro-electric

Storing rainwater in Rajasthan⁹⁶

Helping communities to assess and respond to the risks they face from extreme events will save many lives. The Discipleship Centre (DC), a Tearfund partner, is working with five villages near Jodhpur to help the communities assess the risks of future droughts and other related problems and to consider how they could boost their capacity to deal with the increasing risks they face. Through this exercise, a Village Development Committee (VDC) was formed, providing the first opportunity for men and women of different castes to meet together to discuss how to lessen the impact of future droughts. Already, two ideas have proved very successful.

Rainwater cisterns and bunds

The VDC decided to build rainwater cisterns about three to four metres wide and four metres deep. During the rainy season, rainwater is collected by channels which run into the cisterns. Each cistern can store 40,000 litres and is shared by three families. When full, the cistern can provide drinking water for these families all year round. It could also be used to store water brought in by tankers in times of drought.

The VDC was encouraged to restore a traditional practice of water conservation that had been abandoned or forgotten. A rainwater bund is an earth wall, which is one to two metres in height, built around the field. A large ditch is then dug out in front of the bund. The bunds help to prevent soil erosion from wind and rain. They help to hold water in the soil by preventing rainwater from flowing away.

These pictures of neighbouring fields were taken at the same time. The field on the left has a rainwater bund built around it, the other does not. Villagers were mobilised by the VDC to dig a bund around the field owned by one of the village widows. She was unable to survive on what she could grow and had been forced to find work in a nearby stone quarry. Her children had to go with her as she had no-one to care for them at home. This meant they dropped out of school and began working in the stone quarry as well.

After the first year, the widow's millet yield doubled. Now others in the village also want bunds for their fields. Although most households are able to build bunds for themselves, they cannot afford the time away from the stone quarry, which is the main source of local income. This is a problem that both the VDC and the DC are aware of and hope to find possible solutions for over the coming months.



Rainwater bunds to store water in Rajasthan. Photo: Oenone Chadburn, Tearfund



Water cistern. Photo: Oenone Chadburn, Tearfund

Water crisis

Adequate water supply is a major challenge for India, particularly as 60 per cent of the population is dependent on agriculture for its livelihood. Over the next 20 to 50 years, it is likely that India will face a major water crisis from the higher frequency of floods and drought due to increased variability of annual monsoon rains, and the unusually fast depletion of the Himalayan glaciers.

'Surface temperatures in most parts of India have increased by half a degree centigrade during the second half of century,' says Professor Srinivasan of the Centre for Atmospheric and Oceanic Sciences in Bangalore, adding 'the surface air temperature in the Himalayas has increased by one degree during the same period. This has led to the rapid melting of the glaciers in the Himalayas.'

There is enormous potential for rainwater conservation at the national level. The nature of the Indian monsoon is such that the subcontinent receives the maximum amount of rainfall in a very short time. Given this, nationwide rainwater conservation is one of the most important adaptation strategies necessary to cope with increasing rainfall variability. Local communities are already responding to water stress.

Local responses to water scarcity

There are anecdotal reports of farmers shifting in response to climate change from water-intensive crops to ones that require less water. Several civil society organisations have been working with local communities to develop water-harvesting technologies as well as to promote local decentralised mechanisms for watershed development. In Rajasthan, for some years now, NGOs like Tarun Bharat Sangh have been involved in channelling water to farmers using locally adapted techniques despite a history of drought in the Alwar district. Such local community initiatives have happened even without the support of local or national governments. However, state policies like mandatory water-harvesting laws in some cities (such as Chennai) are seen as a timely adaptation response in the face of climate variability.

'A time may not be far when the Great Thar Desert will expand and cover up the entire north. Gangotri and Jamunotri will become memories of history, like the Saraswati. All this is due to intense meddling by humans.'

Source: Kisan Mehta, Priya Salvi Prkruti and Save Bombay Committee



Bhagirathi River Valley in the Himalayas. Photo: G Areendran



Gangotri Valley in the Himalayas. Photo: G Areendran

The impact of extreme rainfall events during the monsoon season⁹⁷

In July 2005, the coastal city of Mumbai was hit by exceptionally heavy rains – almost a metre of rain fell in one day alone. The metro flooded and as many as 500 people died in the city, many of them from Mumbai's overcrowded slums. In the western suburb of Andheri, a further 72 people living in slums at the foot of a hill died in a related landslide. The city was brought to a standstill for several days and communications broke down completely. Outside Mumbai, at least 60,000 villagers had to move into temporary camps because their homes were flooded. The flooding came at the worst possible time as the planting of the paddy fields had just been completed. The floodwater cost an entire harvest for the farmers affected, destroyed farming infrastructure, and left the soil covered in silt washed down from the surrounding mountains. A year later, the desert area of Barmer in Rajasthan experienced unprecedented floods. Some 577 millimeters of rainfall was recorded in just three days – more than double the average rainfall it receives for an entire year. The floods killed at least 140 people and tens of thousands were displaced from their homes.

Disasters due to extreme weather events

Two-thirds of all disasters in India are climate or weather related, mainly due to drought, flooding, and storms, damaging infrastructure and affecting millions, especially those already weakened by poverty and disease. The number of strong tropical cyclones has continued to increase over the past three decades. When the temperature of the Indian Ocean rises, the moisture in the atmosphere increases, thus increasing the strength of storms.

'I have never seen such high speed winds... [the] frequency of depression at the Bay of Bengal is much higher now-a-days. We have been experiencing delayed monsoons every year over the last 12–15 years.'

Source: Mr Anil Kr Khara, Bamankhali of Sagar Island

Climate change will make big dams in Asia even more redundant and dangerous⁹⁸

Indian novelist, Arundhati Roy, suggested in her 1999 essay *Greater Common Good* that at least 30 million Indians have been displaced to make way for large dams since 1947. She rails against big dams and, in a broader sense, against all 'Big Projects' dreamt up by the Government notionally to improve the lives of the people as a whole but which impose seemingly intolerable costs on particular people, such as indigenous tribal communities.

A new report by the International Rivers Network (IRN) – *Before the deluge: coping with floods in a changing climate* – shows that flood control based on dams and embankments has failed to stop the rapid rise, severity, and number of floods.⁹⁹ Dams and levees can never be fail-proof, and when they do fail they can cause catastrophic damage. In addition, by creating a false sense of security, they encourage questionable development on vulnerable floodplains.

In 2006, engineers at India's Ukai Dam released monsoon waters to stop the dam breaching. However, 120 people were killed, and many millions of dollars in damage was caused. At least 39 people walking across the Sind River in Madhya Pradesh during a religious ceremony were washed away by sudden releases from the Manikhedha Dam.

These stories were repeated in many river basins across India in 2006, including the Mahi, Sabarmati, Chambal, Narmada, Krishna, Godavari, and Mahanadi basins. Sudden high releases of water from dams were the prime reason for most of the flood damage in these basins. There have been many other dam-related catastrophes in Asia over the last 30 years in China, Pakistan, India, Afghanistan, Uzbekistan, and Kyrgyzstan.

The IRN report advocates a realistic set of practices that will help reduce flood damages. To reduce the size, speed and duration of floods, it proposes measures such as: moving embankments back from rivers and restoring wetlands, floodplains and meanders; improving warnings and preparedness for evacuation; and, reducing the amount of floodplain development. It is also based on an understanding that floods are not inherently bad – and are in fact essential for the health of riverine ecosystems.



Practicing evacuation in Bihar.
Photo: Tearfund

Local efforts to fight climate extremes¹⁰⁰

Vast stretches of dead, barren farms, covered with dried-up stunted cotton and other crops lie abandoned even as jobless farmers and labourers gather at village chaupals doing nothing. They have done their best: some even sowed three or four times. But with produce dwindling to just a few kilos, they have turned into paupers, too numb to respond to the calamity.

This is the situation in the Vidarbha and Marathwada regions of Maharashtra where drought is becoming a perennial and recurring feature. Nearly 10,000 villages are severely affected. Nearly 10 million people's basic livelihood systems are broken.

Assessing this situation, the Poorest Areas Civil Society Programme (PACS), managed by Development Alternatives, chalked out a road map to eradicate drought in Maharashtra within the next 10 years. Thus the Maharashtra Drought Forum (MDF), an informal alliance of several Maharashtra civil society organisations was formed. A two-month padyatra (long walk) was also organised to highlight the issue of drought in Maharashtra. The padyatra covered around 60 villages in nine districts. Makarand Sahasrabudhe of GreenEarth noted that in Kasari Village in Beed District, 60 per cent of the population had migrated for employment, mainly in cutting sugarcane. Remaining families had planted crops twice, but their efforts were in vain. The



padyatris encountered many such instances of hardship and injustice. Overall, around 10,000 people participated; on any given day there were at least 150 people walking in the padyatra.

Walkers in the padyatra. Photo: Development Alternatives

Preliminary legal processes for the formation of a Maharashtra Vikas Nidhi (Maharashtra development fund) have been set in motion. The villagers of Varawada in Latur are also working to alleviate the problem of drinking water. Women's groups in Mhalumbra have decided to go beyond their savings and credit activities and fight for their entitlements, such as rations, through the public distribution system, and work under the Employment Guarantee Scheme.

People from the villages visited have started calling up the padyatris to report what they have done and to seek guidance on what they wish to do. A team of volunteers has been identified to undertake the follow-up and support actions. At the end of the padyatra, a long-term action plan to work in selected villages emerged. The padyatra helped identify issues that require detailed study.

Forests, wildlife and biodiversity

According to the IPCC, an estimated 20 to 30 per cent of plant and animal species in India are likely to be at increased risk of extinction if the global average temperature exceeds 1.5 to 2.5°C above pre-industrial levels. While very little is known about the full impacts of climate change on individual species, indicator species in different floral and faunal groups, which are known to have a narrow range of temperature and rainfall requirements, provide some clues into the vulnerability of the natural environment to climate change.

Critical ecosystems like deserts, grasslands, coasts, and mountains are at particularly high risk. For example, a rapid-warming scenario could have a significant impact on mountain ecosystems which harbour rare and endangered plant species, including

Working together to reduce the vulnerability of the forests

Several national initiatives involving forest policy have the potential to limit vulnerability to climate change. Strengthening and enforcing existing laws and acts can also help reduce vulnerability. For example, the current national schemes on Joint Forest Management (JFM) could be expanded to give a more effective role to key stakeholders. While this has had a mixed response in some states, it will be useful for building resilience.

Institutional mechanisms like the National Wasteland Development Board and the National Afforestation and Eco Development Board have emphasised regenerating degraded forestlands and lands adjoining forest areas. These measures have, to some extent, helped in reducing the impact of deforestation as well as contributing to increasing the carbon pool of forests in the country.

The Forest Survey of India monitors the change in forest cover every two years. While there is a general increase in forest cover, specific forest regions continue to face the threat of ever increasing deforestation. Under the Reduced Emissions from Deforestation and Degradation Framework of the UNFCCC, India has had a comparatively lower level of deforestation. Land conversion practices and monoculture-dominated afforestation projects could enhance vulnerability.

In order to strengthen the forest carbon sinks and their conservation, it is vital to strengthen mechanisms like the Protected Area Network in the country through enforcement of the existing legal instruments like the Wildlife Protection Act. Conserving flagship species (the tiger, elephant and rhinoceros) in critical ecosystems through a landscape-based approach could be a way forward to increase the adaptive capacity of forest ecosystems and benefit biodiversity and local communities.

The Sundarbans



Coastal mangroves in the Sundarbans. Photo: Prakash Rao

Coastal ecosystems like the mangroves are also under threat. The Sundarbans, meaning 'beautiful jungle' in the Bengali language, is the largest mangrove forest in the world. Lying at the mouth of the Ganges River, it forms a seaward fringe of the delta which spreads across areas of Bangladesh and West Bengal.

Mangrove ecosystems not only provide a rich habitat for many rare and endangered species, they also provide invaluable protection against erosion from wave action and tidal surges. Mangroves have impenetrable, webbed roots, cushioning the impact of high tides and strong waves.

medicinal plants which are adapted to colder climates.¹⁰¹ India's extensive forests, which cover around 20 per cent of its land, provide vital services for biodiversity, the supply of biomass, watersheds, and the livelihoods of communities. Around 200,000 villages are located in or near forests. Climate change is likely to cause a shift in forest boundaries and forest dieback having significant implications on all communities who depend on forest resources and services.¹⁰²

Eroding coasts and rising seas

'Coastal areas are by far the most populated areas in the world. One has to be very careful about building expensive and sensitive infrastructure along the coasts, such as airports and thermal/nuclear power stations.'

Dr Baba, Director of the Indian Institute of Technology, Madras

Climate change-related sea-level rise could create climate refugees by the millions along the coasts of India and in neighbouring countries like Bangladesh, forcing people to move into already-crowded interiors.

'We have experienced sea-level changes on certain islands that are unrelated to the tsunami. Coastal sea levels are changing in some places. In Pondicherry, the Government started building sea walls because in the last five to six years the sea has started encroaching into the city.'

The Evangelical Fellowship of India Commission on Relief, India¹⁰³

Observations show that sea levels are rising at an average rate of 3.14 millimetres per year. A one-metre rise – predicted to occur by the end of this century without major cuts in greenhouse gases – would inundate about 1,000 square kilometres of the Ganges Delta. Already, over the past two decades, four islands – Bedford, Lohachara, Kabasgadi and Suparibhanga – have been submerged leaving 6,000 families homeless. Some of the most recent predictions suggest that one of the largest islands – Sagar Island – could lose at least 15 per cent of its habitat area by 2020.

Development along India's 6,500-kilometre coastline has damaged natural ecosystems that have historically provided defence against coastal erosion and acted as a buffer to prevent flooding from wave action or tidal surges. Now, over seven million people are vulnerable to coastal flooding and rising sea levels.

'Coastal areas constantly face hazards...we need long-term planning and ecological protection to reduce disaster vulnerability. The coastal area should be seen as a complete ecosystem.'

Dr Sanjeevaghosh, Fishery Scientist, Thiruvananthapuram

Public health and climate change

Climate change will have significant impacts on health in India. The most vulnerable will be the poor, disabled, and youngest and oldest members of the population, as they already face limited access to health facilities and have limited disposable income to cover additional medical costs.

According to one recent report, the range of climate change-related health impacts are diverse, and include heat-related deaths, vector- and water-borne diseases, loss of life due to extreme weather events, and the effects of food and water insecurity.¹⁰⁴

Angry earth and troubled waters

India's coastal ecosystems, which include coral reefs, mangroves, sand dunes and sand bars, all act as a line of defence against wave action and coastal surges. Removal of such defences is common due to fishing practices or construction of embankments and other developments in these regions. In the case of construction, natural drainage systems can be damaged to the extent that, in some areas, the discharge of fresh water is completely cut off. This results in an increase in the salinity of the adjacent area, damaging surrounding ecosystems. The mangrove ecosystems of the Sundarbans are particularly vulnerable to changes in salinity. Some of India's richest biodiversity depends on mangroves, along with many people's livelihoods. Indigenous mangrove species like *Heritiera fomes* have declined considerably over the past few years. Other species like horseshoe crabs, which were common in the Sundarbans, have drastically declined due to increased salinity levels.

Of these, malaria is of particular concern, as climate change could increase the occurrence of malaria in areas that are already malaria-prone and also introduce it into new areas due to shifts in climate zones.

Already, periodic epidemics of malaria, which occur every five to seven years, resulted in the loss of 577,000 Disability Adjusted Life Years in 1998. Records also suggest that outbreaks of Dengue and Chikungunya, two other vector-borne diseases, are also increasing. Climate change could increase heat stress and other vector-borne diseases. In addition, decreases in water availability and food production will indirectly affect people's health.

'During floods all the boreholes get damaged by mud. People have to go far away to a river for water – even to drink. People get sick with diarrhoea.'

**TK Joy, c/o The Evangelical Fellowship of India
Commission on Relief, India**

Women will face the largest burden of climate change health impacts. Various studies in India have shown that over the past decade, more women than men have suffered from premature deaths because of heat and cold waves and other climate-related extreme events. The growing public health threat will require greater emphasis on planning for health facilities. In addition, the medical community will need to increase its capacity to cope with rising demands, particularly for the most vulnerable.

Women also play a huge role in improving the public services sector in India. Since India's 1992 constitutional amendment which mandates the reservation of one-third

of panchayat¹⁰⁵ seats for women, relative spending on public water and latrines for low-caste communities has increased when women are in a majority in panchayats. Women also have a potential role as health providers within the Indian Government's National Rural Health Mission which proposes to appoint 250,000 accredited social health activists, a parallel initiative to that of the previous government programme promoting women as community health volunteers.

Agriculture and the environment

The agricultural sector represents over one-third of the Indian economy, and around 60 per cent of the population is dependent on subsistence agriculture as its primary source of income. Any effects that climate change has on agriculture will, therefore, significantly impact the lives of millions, and could potentially curb the country's development. Food security is a serious threat for many. India's large rural population, which is heavily dependent on rain- and meltwater-fed agriculture, is already beginning to experience climate change impacts.

'The rain does not come at the right time. People start cultivating and there is no rain. Then it comes after a month, so the seeds die and again we have to plant.'

**Latika Sagar, c/o The Evangelical Fellowship of India
Commission on Relief, India**

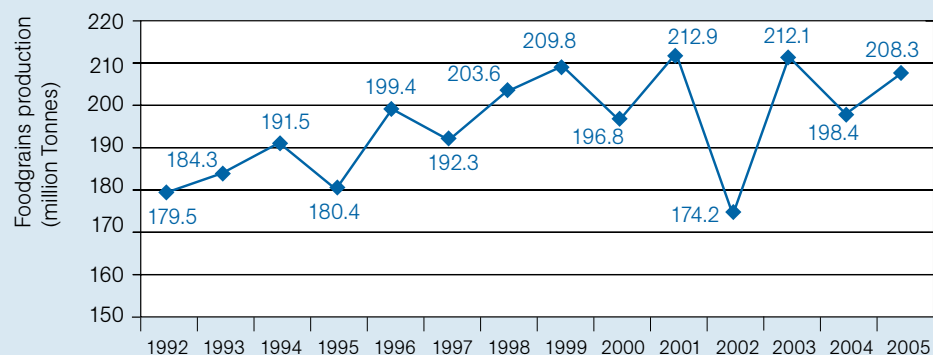
Changes to rainfall patterns driven by the monsoons will increase the risk of extreme events, for example causing flooding and destroying crops and soil quality through erosion or contamination. Melting glaciers due to rising temperatures in the Himalayas may also increase water volume in the short-term. On the other hand, failure of the monsoons due to an intense El Niño event could cause drought.

'Water is the biggest problem for me: sometimes we face floods, sometimes drought. Agriculture is my one source of income so during floods or drought my whole livelihood is threatened.'

Kasti Bag, c/o The Evangelical Fellowship of India Commission on Relief, India

Climate change is already significantly affecting agriculture. The growth in production of food grains has stagnated since the late 1990s, and this has been accompanied by large year-to-year variations (Figure 3). In fact, the rate of growth of production and yield from 1991 to 2005 has been the lowest since India gained independence.

Figure 3: Foodgrain production in India from 1992 to 2005



Less water for rain- and meltwater-fed agriculture could cause a loss of up to 30 per cent of India's agricultural production including foodgrains.¹⁰⁶ Rainfed agriculture, which makes up around 60 per cent of India's agriculture, would be hit even harder. This implies that production losses in the case of rainfed agriculture could exceed 30 per cent. This is bad news for India with its growing population. Since 1991 per capita availability of foodgrain has steadily declined from 177 kg to 155 kg in 2001. This is among the lowest in the world with only Sub-Saharan Africa and some other least developed countries (LDCs) recording lower per capita availability of foodgrains.¹⁰⁷

'Soil has lost the fertility. The same area of land produced 400 to 480 kg of paddy earlier is now yielding merely 240 to 250 kg. There is urgent need for water harvesting. Canal excavation started during 1972 and this initiative was further taken up by NABARD in 1982. But now many of the canals have totally dried up. After 10 years you will find lands totally useless for cultivation.'

Mr Natabar Manna, Bagdanga, Mousuni Island, India

Small farmers already weakened by government policies¹⁰⁸

Indian eco-feminist Vandana Shiva has criticised Indian government policies which have already marginalised India's small farmers and made them more vulnerable to climate change. 'Policies driven by corporate globalisation are pushing farmers off the land, and peasants out of agriculture,' she said in April 2007. In her view, 'this is not a natural evolutionary process; it is a violent and imposed process and the 150,000 farmer suicides are one aspect of this violence.'

Her work with Navdanya – an organic farming organisation she founded in 1991 – has shown how small farms are actually more productive than larger ones and promote biodiversity. She says that farmers in West Uttar Pradesh, for example, have got 62.5 quintal per hectare using a native wheat variety for organic production compared to 50 quintal per hectare for chemically produced wheat. Shiva suggests that 'the totally inappropriate model of industrial corporate agriculture has been applied, farmers are in distress, the soil has been destroyed, and the water has been over exploited and polluted.' She feels a change in policies is called for. It is particularly important to recognise women as the primary food producers and food processors.

Further, as agricultural systems either suffer from declining productivity or complete collapse, people will be forced to migrate in search of work. Distress migration from rural to urban areas could result in rising social tensions and conflicts as well as the overstretching of urban infrastructure and amenities.

The diversity of agriculture in India, as argued by the Ministry of Agriculture, already demonstrates climate adaptation. Farmers and farming communities have always adapted when allowed by the availability of technology and their socio-economic capacity. Predicted climate change impacts may, however, induce additional stresses in the agriculture sector and will need adaptation strategies like changes in land use, cropping patterns and water conservation.

Community organisation and empowerment transforms lives and the environment in Rajasthan¹⁰⁹

The village of Vahigatia in Rajasthan lies within the humid climatic zone of India, with the average annual rainfall of 650 millimetres concentrated in the months from June to September. In recent years, rainfall has been increasingly erratic. Water levels in wells were sinking by two to three metres per year, and perennial sources of drinking water dried out. As a result, agricultural production was in decline.

The farming population had no choice but to leave the village in search of a better living but at a large cost to their children's education, family life, and elderly people, who were left behind at home. Without intervention, it is likely that Vahigatia would have been rapidly engulfed by the great Thar Desert of Rajasthan.

Caritas India is now implementing a project to drought-proof the village through conservation of soil, water, and biomass. People have been trained in organic farming, and efforts have been made to bring back the traditional agricultural ways and to increase crop diversity. Farm bunds, dams, and contour trenches have conserved monsoon water, decreased water run off, and reduced soil erosion.¹¹⁰

Now, water levels in the community's wells are rising due to the recharging of groundwater resources in the project area. The community is enjoying an increase in agricultural productivity, and has started to cultivate new crops. In addition, the land area under cultivation has increased due to the project. Areas that once lay vacant are now covered with vegetation. Due to the increase in the soil moisture content and the net cropping area, crop yields have risen by 25 to 30 per cent. The project has also improved the socio-economic situation and health status of the village and the ecological situation. Some 40 per cent of villagers used to migrate for work, but now this number has decreased. Malnutrition has also been reduced due to increased yields and income. Education for children is no longer at risk.



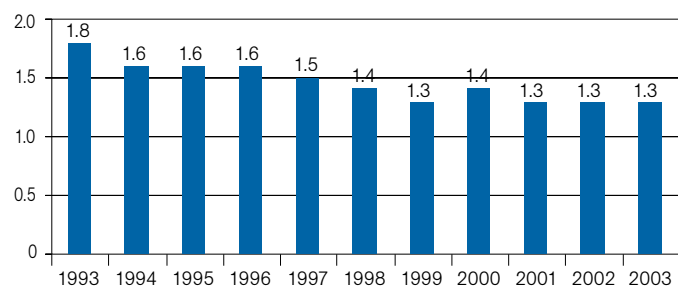
Collecting water in Vahigatia, Rajasthan. Photo: Caritas India & CAFOD

Adaptation – a policy response through the NREGA (National Rural Employment Guarantee Act)

There are a number of policy measures that the Indian Government has in its armoury that can be used to deal with the impacts of climate change on the agricultural sector. Foremost among these is the NREGA. In a situation of uncertain weather, where rural populations could be faced with droughts and/or floods and crop losses from too much, too little, or untimely rainfall, the NREGA could be used to ensure that people have a safety net to fall back upon. Further, the NREGA could be used to 'climate proof' communities through judicious public works based on the principles of community-based planning, which are embedded in the provisions of the Act itself.

In addition to NREGA, the Government also has in its policy folds the PDS (Public Distribution System) for food and other commodities. Both the PDS and the NREGA need to be expanded and universalised in order to ensure food and livelihood security for all vulnerable people. The trend of restricting PDS through BPL (below the poverty line)/ APL (above the poverty line) targeting needs to be reversed, and the NREGA needs to be expanded to cover all districts in the country. It should also be available to all rural people who demand work, without some of the restrictive clauses, such as employment for only one person per family, which currently exist.

Figure 4: Investment in agriculture as a per cent of GDP



dryland agriculture, which is practised on 60 per cent of India's agricultural land and which is extremely vulnerable to climate change. In this regard, establishing a National Rainfed Area Authority is a welcome step. However, this body needs budget support to be effective. Farmers also need help to find markets where they can get a good price for their produce. None of these measures will work, however, if agriculture as a sector continues to be neglected. Since the 1990s, investment in agriculture as a percentage of GDP has been steadily declining.¹¹¹ To adapt to climate change, the Government will have to find the resources to reverse this trend.

Furthermore, the current trend of declining public investment in strengthening agricultural research and extension services must be reversed. Adapting agriculture to climate change requires that farmers are educated in more appropriate farming techniques and have access to hardier seeds that can withstand variable weather conditions.

Special attention is needed for

Local energy-saving initiatives

There are already local-level energy-efficiency initiatives in India. In many homes individuals are opting for power-saving bulbs and other energy-efficient appliances despite the higher upfront costs. However, there is a limit to what individuals or communities, especially those who are most vulnerable, can do without an enabling policy framework.

In the village of Binola in Gurgaon District of Haryana State, if you try looking for an incandescent bulb in any households, shops or lanes, you will not find even one! A total of 98 households and shops have shifted completely from incandescent bulbs to power-saving bulbs, reducing the total gridload in the village by close to 50 per cent. The Dakshin Haryana Bijlee Vitaran Nigam who initiated this, say that four more villages on this Binola lighting feeder line will soon see this shift making it a 100 per cent energy-efficient lighting feeder line. A total of 110 tonnes of carbon dioxide emissions would be reduced just from efficient lighting in these four villages.

There are other examples. One Municipal Council in Saswad, a small town in Maharashtra State near Pune, has introduced a building regulation stipulating that all buildings with a built-up area of over 1,000 ft² must use solar power for lighting. Another example from the same State is that of the Bank of Maharashtra, which has introduced a scheme to finance solar home-lighting systems in rural areas. This may be a response to the crippling power shortages that have plagued the State in the past.

As far as adaptation measures are concerned, there are again reports of communities using existing schemes and enabling policy frameworks like the NREGA or JFM to regenerate forests or conserve watersheds in and around their settlements. In general, the concept of bottom-up planning must be fully integrated into government schemes and programmes to help people effectively adapt to climate change.

Energy

India is the world's fourth-largest greenhouse gas emitter and produces about four per cent of global carbon dioxide emissions. Per capita emissions are very small, however. In 1998, they were one-quarter of the global average of four tonnes per year (and one-twentieth of US per capita emissions). The main contributor is the energy sector, which the Government wants to grow significantly by 2012 to provide electricity for the half a billion people currently living without it.

The total size of India's electric power systems is 124 GW. Of this, coal comprises 55 per cent, hydroelectric 26 per cent, natural gas 10 per cent, renewables five per cent and nuclear makes up three per cent of the total installed capacity.¹¹²

Energy efficiency

Electricity saving potential in India has been conservatively estimated to be in the region of around 95,000 GWh, cutting across various sectors or applications such as industrial, lighting and motors for industry, and agriculture usage. This translates to a reduction in total carbon dioxide emissions of close to 150 million tonnes per annum. In the lighting sector alone, there is a huge potential of saving electricity to the tune of 10,000 GWh, which translates to 55 million tonnes per annum.

India's planned expansion of power generation

India's current eleventh Five Year Plan describes plans to expand its power-generation capacity by using coal-fired power plants to generate 70,000 MW, because coal is supposedly cheap and abundantly available within the country. However, this is obviously not good news for reducing greenhouse gas emissions from the power sector. India needs to provide access to electricity for close to 79 million households by 2012 as per the Government's stated policy intent. If the Government were to consider the environmental costs of coal, then it would see that using a combination of energy efficiency along with renewable energy technologies would be both cheaper in the long run, as well as less carbon-intensive.

Efficiency in transportation

The growing market for cars and other vehicles coupled with poor public transport infrastructure has led to substantial growth of carbon dioxide emissions in the transport sector, despite the fact that India is perhaps one of very few developing countries which have adopted European emission standards. Total 2005 emissions were around 210 million tons. The key issue which continues to be unaddressed is public transport infrastructure and a policy for energy-efficiency standards for vehicles.

In addition to addressing the issue of urban transport infrastructure, policy-level changes using a 'top runner model' for energy efficiency in vehicles is needed. The top runner model would be legislation which would cap fuel consumption per kilometre, depending on the size and category of vehicles. This would also phase out vehicles that do not conform to the standards, with the cap on fuel consumption progressively

India's eleventh Five Year Plan

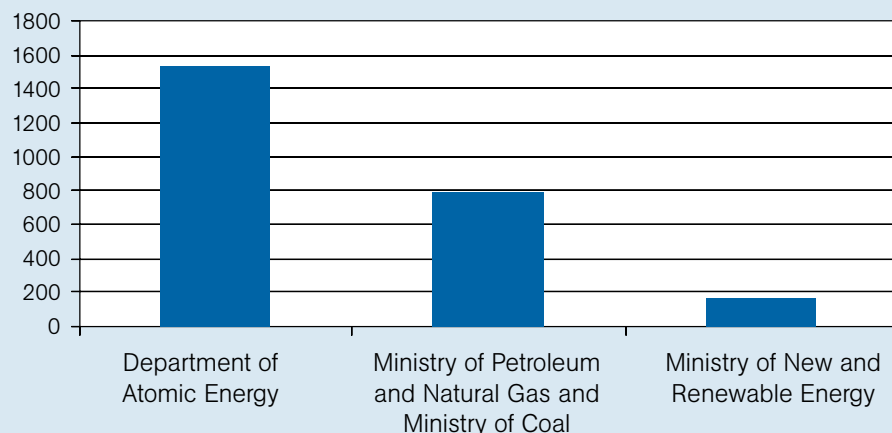
As part of the eleventh Five Year Plan, the Government proposes to add approximately 70,000 MW of coal-fired super thermal plants. Conservatively, estimates for carbon dioxide emissions per unit of electricity from most power plants suggest a range between 0.8 and 1.2 kg/KWh. Given this, the 70,000 MW of coal-fired super thermal plants would result in carbon dioxide emissions of 350 million tons. India's current total emissions are around 1,100 million tonnes and with this addition, its total emissions would go up to 1,500 million tons, thus overtaking Russia and placing it third in terms of national emissions (excluding emissions from deforestation). In terms of capital cost, a conservative estimate of US\$1.25 million is required for every MW of coal-fired power plant. Hence, in terms of cost, 70,000 MW of coal-fired power plants would cost US\$87,500 million.

In terms of the environmental cost, a very conservative estimate of the cost due to carbon emissions would be in the region of five rupees for every KWh – or about 12.5 US cents per KWh. Assuming a plant load factor of 72 per cent with operations for 300 days in a year, 70,000 MW of coal-fired power plant would translate to 360,000 million units. This would in turn translate to an additional cost of US\$4,500 million.

If, on the other hand, the country opts for a combination of energy efficiency to generate 30,000 MW of power, with the balance coming from a combination of wind, solar photovoltaics and biomass for rural electrification, the costs would work out as follows. With a conservative estimate of US\$1.75 million for every MW of renewable energy, the total cost of generating 40,000 MW would be US\$70,000 million. The capital cost of energy efficiency would be approximately US\$0.25 million for every MW, which is an additional US\$7,500 million. The total cost of meeting the requirement through alternate power sources would be only US\$77,500 million, compared to the cost of US\$92,000 million for 70,000 MW of coal-fired power plants for rural electrification. Furthermore, adding the additional environment costs on an annual basis, coal becomes a costly proposition from all angles.

increasing every third year. Specifically, India could legislate that from 2012, the average carbon dioxide emissions from all new cars must not exceed 130 grams per kilometre, which in fuel efficiency terms is 5.5 litres per 100 kilometres for petrol cars and 4.5 litres per 100 kilometres for diesel cars. On the basis of sales statistics from previous years, mandatory fuel-efficiency standards for different categories of cars are needed. Average fuel-efficiency standards will gradually increase meeting the target of 70 grams per kilometre of carbon dioxide emissions by 2020.

Figure 5: Government expenditure on energy sources: Union Budget 2007–2008



Renewable energy share in the energy mix – abandoning the growth of coal-fired power in India

The market in India for renewable energy is estimated to be worth US\$500 million and is currently growing at a rate of 15 per cent.¹¹³ The potential for renewable energy is very high in India, with very conservative estimates being in the region of around 150 to 200 GW. Its current share of the energy mix is very low at fewer than four per cent. Perhaps the only country to have an exclusive ministry at the central level to promote renewable energy solutions, the Government must do more in this area.

Renewable energy could meet roughly 60 per cent of India's total electricity supply by 2050 in a phased-in manner. However, to ensure that this happens, the Government needs to change its own spending patterns on energy.

In the Union Budget for 2007–2008, for example, government expenditure on energy sources reveals that the allocation for the Ministry of New and Renewable Energy is about 25 per cent of the allocations being directed to the ministries dealing with hydrocarbon energy sources and even less when compared with the Department of Atomic Energy. The Department of Atomic Energy receives government funding for strategic and defence purposes in addition to energy provisioning, but the allocations to the Ministry of New and Renewable Energy are clearly inadequate.

While the Government is pressed for resources and needs to prioritise its expenditure, it still manages to provide enough incentives to industry and other economic sectors

Solar photovoltaics enabling small businesses to develop in South India

While viewed as an expensive source of energy compared to grid electricity, for the 57 per cent of the population who do not have access to mains electricity, photovoltaic systems are far cheaper than expensive kerosene or dry cell batteries. These systems also have the added benefit of reducing carbon dioxide emissions. Installing 71,000 systems avoids the emission of around 21,000 tonnes of carbon dioxide per year, including the amount of 'carbon dioxide equivalent' embodied in the manufacture of the system.

SELCO is a private business based in Bangalore which provides photovoltaic battery charging systems which supply single lamps for street vendors and poor homes. One of the benefits of lighting is extended hours for income generation. The increased income can quickly cover the cost of the system. SELCO's innovation department has also provided other affordable photovoltaic-powered systems, for example, power for sewing machines to increase the productivity of sewing businesses; power for soldering irons for television repair; and small photovoltaic-powered silk looms. As most people who acquire photovoltaic systems require a loan, SELCO further assists its customers through its strong relationship with banks and microfinance organisations. As a winner of the 2005 Ashden Awards, SELCO used some of the prize money as a 'down-payment guarantee' so that banks will provide loans to households who can afford the monthly repayments, but not the down-payment.

to encourage investment and production. By its own admission, the Government foregoes revenues from the corporate sector in the form of various tax breaks and incentives, to the tune of US\$12,519 million. This could instead be diverted to renewable energy, or to require the corporations receiving these incentives and tax breaks to conduct mandatory time-bound reductions of their carbon footprint. Similarly, the Government could offer tax incentives to people who invest in renewable energy in their homes. In short, a fiscal and regulatory framework that encourages renewable energy sources and provides incentives to consumers to opt for them is needed, in addition to investing in the infrastructure required to maintain and service renewable energy technologies.

Biofuels

Part of India's energy exploration is to diversify its domestic energy base while at the same time improving the rural economy through biofuels (liquid fuel, biogas and biomass). Biofuels have the potential to promote employment and rural infrastructure, and stimulate the role of agriculture and forestry as energy producers. They also

Management of domestic and municipal waste produces biogas for cooking and electricity generation – South India

In recent years, a number of non-profit organisations have set up biogas systems in both rural and urban areas. Biogas is produced from the decomposition of organic material in anaerobic (without oxygen) conditions. The gas can be used directly for cooking, as a safer alternative to liquefied petroleum gas (biogas cannot be lit accidentally by a spark). Burning biogas as a fuel also prevents the release of methane from unmanaged decomposition of organic matter, a greenhouse gas that is 23 times more damaging than carbon dioxide. Moreover, the effluent from the digester can be used as a fertiliser due to its high nitrogen, phosphorous and potassium content.

BIOTECH in urban Kerala has developed biogas digesters for managing food waste and other organic wastes in 12,000 households, 220 institutions and 19 municipal sites. These projects avoid the emission of around 37,000 tonnes of carbon dioxide or its equivalent per year by replacing liquefied petroleum gas for cooking and diesel for electricity generation.

Under another scheme in Karnathaka, SKG Sangha supplies biogas plants to households in rural areas of South India. So far, SKG Sangha has installed plants that benefit over 210,000 people. Each plant also saves around four tonnes of carbon dioxide or its equivalent by replacing the unsustainable use of wood. In this region, biogas stoves save women on average two to three hours a day from collecting wood and cooking. The fuel switch from wood to biogas also has many health and welfare benefits as biogas abates respiratory or eye problems associated with wood fires. Additionally, kitchens and cooking equipment are cleaner.

Biogas systems also improve waste management. In rural areas, food waste can be used as food for animals, but in urban environments this is not usually feasible. Urban regions of India, with door-to-door waste-collection services by the local council, often suffer from hygiene problems as animals tear open waste sacks to access food waste. Rural areas with poor waste-disposal schemes can benefit from improved waste management, and residue from the biogas plant can also be sold as a fertiliser, generating income.

contribute to domestic energy security. But the climate change mitigation benefits need to be assessed on a case-by-case basis, and biofuels often have negative economic, social and environmental impacts. These can include increased pressure on available agricultural land and water resources, and biodiversity loss through large-scale mono-cropping.

For example, the widespread mono-cropping of low-cost jatropha (a semi-wild crop used to make biodiesel), is being driven by economic incentives due to its assumed 'green' credentials. A recent report by the Society for Promotion of Wastelands Developments, however, has identified that the large-scale production of jatropha is significantly affecting surrounding biodiversity.

The use of biofuel crops (such as sugarcane, maize, sweet sorghum, karanja and jatropha) for transport fuels is being promoted. In response, a new National Biofuel Development Board has been proposed that would determine the minimum prices for biofuel crops and formulate a national biofuel policy. There are calls for government subsidies and financial support to oil processors for extraction of oil from seeds and for the blending of auto-fuels. By and large, the biofuel debate in India is mainly driven by the promised profitability of ethanol production and the potential trickle-down effect of biofuel-related business ventures. Contract jatropha farming initiatives have started to proliferate in Maharashtra while in Chhattisgarh and Gujarat, state agriculture ministries encouraged farmers to cultivate jatropha. Other options for ethanol production (besides sugarcane and jatropha) have also been pursued by a number of Indian-based research institutions.

The Indian public has grasped the profit potential of biofuel production as both a local energy source and an export product. But the link between biofuels and threats to food security is less well understood.

In India, various policies and strategies have been framed to integrate economic and social objectives with environmental objectives.¹¹⁴ Nevertheless, civil society organisations in the country remain critical of the translation of these policies into plans and programmes. In integrating climate change concerns into the national planning process, it is essential to identify capacity gaps, build institutions to bridge these gaps, provide adequate finance and undertake advance research and development. The challenge now is to further identify and implement integrated development and climate strategies that address development priorities and at the same time capture climate benefits.

Indonesia, the Philippines and East Timor

Indonesia, the Philippines and East Timor are archipelago nations between the Indian and Pacific oceans, and hence face similar climate change-related challenges. The Asian monsoon and ENSO significantly affect the climate of these countries. El Niño occurs every four to seven years, but climate change is altering its frequency and intensity. Most climate models predict that rain will come later in Indonesia, but that more will fall when the monsoon finally begins. Due to warmer, drier summers, however, land will rapidly dry up. The Philippines will be exposed to increases in rainfall variability, and East Timor is expected to become drier, hotter and with an increasingly variable climate.

The region already suffers from a multitude of environmental problems such as deforestation and illegal logging, forest and peatland fires, loss of the region's rich biodiversity, disaster events, such as typhoons and floods, and unsustainable mining practices. Climate change will exacerbate these problems, and the ingenuity and resourcefulness of the region's population will be stretched by the growing need to find ways to cope with the changes ahead.

El Niño

El Niño and its counterpart La Niña are important in Indonesia, affecting forest-fire frequency and agricultural outputs. Indonesian rice yields already vary by seven per cent each year depending on whether it was an El Niño or a La Niña year.¹¹⁵

El Niño significantly affects the variability of East Timor's climate. One government report states that El Niño years change the timing and volume of rainfall.¹¹⁶ In places like Ainaro, Lolotoe, Lore, and Lospalos, annual rainfall could be reduced by up to 50 per cent in El Niño years. In others areas, such as Baucau and Oecusse, annual rainfall is greater than average. However in all places, El Niño causes a reduction in rainfall in the January–March wet season, with some places only receiving 25 per cent of their usual rainfall. In El Niño years, the wet season is usually delayed by two to three months, and this affects food production and security. In the year following an El Niño event, rainfall can be higher than average, which can also lead to flooding with associated damage to crops and infrastructure, especially roads and bridges.¹¹⁷

Farmers in East Timor already identify rainfall and water availability as the principal constraint on agricultural production.¹¹⁸ A drought in 2001–2002 followed by the late arrival of the wet season in 2002–2003 resulted in a 34 per cent decrease in maize production between 2002 and 2003.¹¹⁹ This meant that over 110,000 people needed food aid. An increase in the magnitude and frequency of El Niño events is likely to make food security issues even more important.

*'We once dwelled in valleys below;
Where streams and rivers used to flow.
Then loggers stripped the countryside,
Chain saws ripped, and the rivers died.
Next, lowland farmers claimed the land,
And we moved here to where we stand.*

*This mountainside was our last hope,
We clung to life upon its slope,
And asked the spirits living here
To let us grow some food each year.
We cleared a little patch of ground,
But then the rains began to pound.*

*The lightning cracked; the clouds exploded;
In rivers of mud our hope eroded.
The lashing rain dissolved the soil,
Wiping out our fruitless toil.
Our land, our life washed to the sea;
These dying hills, our legacy.'*

Subanen indigenous women of Western Mindane, the Philippines.



Subanen indigenous women of Western Mindane, the Philippines.
Source: Columban Faith and Justice

Changing rural livelihoods

Throughout Indonesia, the Philippines and East Timor, farmers are exploring alternative ways to earn a living and feed their families under changing climatic conditions. One study suggests that by 2050, some of Indonesia's most important rice-growing areas will experience a month-long delay in the onset of monsoon rains, and that

El Niño impacts in Baucau¹²⁰

Marito Reis, the former District Administrator of Baucau, the second-largest city of East Timor, comments that El Niño changes rainfall patterns which in turn causes landslides which destroy fields and other infrastructure. Marito Reis explains that 'the floods bring large amount of sediments, which deposit on lowland agriculture land silting up fields, and the flash floods also destroy intake structure for irrigation system.' Denuded hillsides also increase the size and frequency of flash floods, for example in the Seixal River watershed. Marito explained that this is also linked to El Niño and climate change.

Indonesia's poorest hit first and worst¹²¹

Oxfam has been helping the poor in the province of East Nusa Tenggara for several years and has noted many climate anomalies in the last few years. In 2002 and 2003, for instance, the rainy seasons were late, so farmers were also late planting. In 2006 and 2007, the rainy seasons and dry seasons were so unpredictable that farmers did not know when to start planting. This resulted in many farmers failing to harvest what they planted, creating a drastic drop in income and widespread hunger and malnutrition, especially among children. 'Income level has dropped by 25 to 40 per cent while the level of malnutrition among children in East Nusa Tenggara currently has reached 36 to 50 per cent. At the beginning of 2006, over 60 per cent of families in Central North Timor and Belu, for instance, did not have enough food,' said Laksmi Prasvita, spokeswoman for Oxfam GB in Indonesia.

The IPCC said in its recent report that an extra 130 million people across Asia would be at risk of hunger because of climate change.¹²² 'There are 39.05 million poor people in Indonesia, 80 per cent of which live in rural areas. They depend on the agricultural sector, a sector vulnerable to climate shock such as flood, drought and longer dry seasons,' said David Macdonald, Country Programme Manager of Oxfam GB in Indonesia.

late summer rainfall could drop by as much as 25 per cent. This could make it almost impossible to plant rice and other crops during these months without irrigation.¹²³ 'Within two generations, climate change will likely cause increasing hardships for the 100 million poor and 15 million very poor in Indonesia who overwhelmingly rely on rice production for the bulk of their food and income,' says Roz Naylor of Stanford

Indigenous ways still work¹²⁴

The forest has been a constant companion to Virgie and her family. As a girl born to indigenous Ata-Manobo and Mandaya parents in Davao Province in the southern Philippines, Virgie often wondered how her parents knew when certain staple foods and crops should be planted to ensure their survival. But as she grew up she left the land and the forest behind.

Virgie only realised how much the environment had changed when she stepped into her parents' role. When she began to farm, yields were smaller and the soil seemed harder to work and had less of its familiar, rich organic smell. The spring water was still sweet but was only a trickle of its former self. Nor was it as cold as Virgie remembered from her childhood morning baths. Forest fruits took longer to find, so much so that at times it seemed better to buy candy from peddlers just for a taste of sweetness. She and her family worked hard, but Virgie felt they never achieved as much as her parents who could still dance, sing and tell stories after a day of work, while she was at times so tired that she just wanted to sleep.

Virgie began to notice the forest retreating around her and the parched land before her. In the past she often woke to fog, but now it was only cooking fire smoke that reminded her of such moments. Fog now occurs higher up the mountains. Only mountain tops still show the same mix of dark greens, white clouds and blue skies that coloured her childhood. Today, she rarely hears the songs of many of the birds her father showed her and she misses the mysterious forest sounds that frightened her as a girl. These days she only hears the wind blowing through the eaves at night.

Challenged by these events and thinking of her people's future, Virgie realised she had to act to reverse the mindless desecration of the land. She decided to revive the ancient ways of nurturing trees, crops and other plants, re-establishing beneficial synergistic relationships between them. Virgie learned that falling leaves and ripening fruits are nature's signals for planting and harvesting. She now realises that nature is quite willing to teach those who listen and is using again methods founded on accumulated indigenous wisdom, shaped by generations of practice.

Organic farming in Leyte¹²⁵



Manong Greg, PhilNet.
Photo: Christian Aid/Amanda Farrant

Manong Greg lives on the central Philippine island of Leyte, an area often hit by disasters and exposed to drought. Locals here are used to erratic climatic changes affecting agriculture. Manong Greg has been expanding his farm for the past five years. He knows the climate is changing and he understands that conventional chemical farming techniques could damage his land, health and income stability. He plants disaster-tolerant crops to secure his family's food needs, and for more than half a decade, he has been practicing organic rice farming, crop diversification and livestock integration.

Rice hay and husks are gathered and composted in his Vermi worm cast and compost production system. Gone are the billows of smoke from burning rice hay after the harvest, which contribute to greenhouse gas levels. Vermi cast and compost are used as fertiliser along with other natural farming

inputs like fermented fruit and plant juices and fish amino acids. Oriental herbs are also used to combat pest and insect infestations, which threaten crop yields and lead to casualties among his livestock.

Manong Greg plants pineapples, cassava and squash on the slopes to stop soil erosion and supplement his dry-season income. Gentle slopes are planted with ground-cover crops, tubers and madre de cacao. He also plants some of the 107 organic varieties of rice that he has 'engineered' for the past six years with the help of resource agencies like RDI-Leyte, PhilNet and the Leyte State University in Baybay.

To ensure a steady supply of irrigation water during very dry seasons, he diverts water from a nearby stream to his property and has built a pond where he now farms fish and raises ducks. The overflow of pond water irrigates his rice in the fields below enabling him to maintain three cropping cycles a year despite the erratic climate.



Manong Greg's farm and training centre, PhilNet.
Photo: Christian Aid/Amanda Farrant

Manong Greg believes the sun's scorching heat has become more intense in recent years. He has noticed the disappearance of two types of slimy tree frog and asks, 'have they retreated to a place where humidity is more tolerable or are they lost permanently because of the heat?' The intense summer sun also seems to have dried out the medicinal, but rare and endangered staghorn fern, which grows on branches of the star apple tree. Manong Greg also reports that, recently, seven hens and three roosters died of dungoy or atay, a disease that afflicts domestic fowl during hot months. Fatalities have been increasing in the past few years and spiked during the recent El Niño-induced drought.

The dry period has become more and more unpredictable. Manong Greg only hopes he has done enough and can continue to find ways of coping to secure his family's daily food supply and income in these challenging times.

The Masipag Project¹²⁶

In the early 1960s, the 'Green Revolution' promised Filipino farmers dramatic increases in rice yields. But there was a catch! High-yielding rice varieties were part of a package including petroleum-based fertilisers, pesticides, machinery, and irrigation. Practices were tied to Western science, values and economic organisation. Increasing grain yields had other costs: soils became acidic and nutrient-poor due to intensive use of chemical fertilisers; biodiversity was lost and there was a resurgence of pests and diseases; and mono-cropping meant many diverse sources of food were lost. The devastating effects of the Green Revolution on small farmers led a group of progressive scientists from the University of the Philippines and some NGOs to meet and explore alternative models for agricultural development. As a result, in 1987, Masipag was founded.

Masipag is now a coalition of those advocating sustainable agriculture and the empowerment of small farmers. It has 490 organisational members and serves over 30,000 farmers nationwide.

The Masipag Biodiversity Center (MBC), located in the province of Bukidnon on the island of Mindanao, opened in October 2005. The Director, Bobby Pagusara says 'the aims of MBC are; the protection and conservation of our biodiversity, a place where the organic farming technologies of our farmers can be displayed and a center for alternative and renewable energy systems.' Ten hectares of land provides a home for rice, maize, vegetables, fruit and forest trees, fishponds, and livestock. Over 1,000 native varieties of organically grown rice and 40 varieties of maize (collected by farmers from all over Mindanao) are cultivated and conserved. Seeds are distributed to farmers all over the island and beyond. MBC also provides training for farmers, community development workers and university students.

For Masipag, agriculture is not just about food production, it is about survival and a way of life. It is about restoring soil fertility, saving seeds, and protecting biodiversity. It points the way forward for agriculture in the Philippines and provides a sound model for averting climate change impacts and providing a secure and sustainable future.



Entrance to the Masipag Biodiversity Center.
Photo: Oliver Mccrossan



Masipag Biodiversity Center rice fields and conservation area. Photo: Oliver Mccrossan



Perfecto Vicente, a Filipino rice farmer and breeder with some of his rice varieties. Photo: Oliver Mccrossan

University.¹²⁷ Crop diversification, drought-tolerant rice varieties, and water storage and irrigation infrastructure will be important adaptation measures.

Farming communities in Pagadian, Mindanao, the Philippines have been affected by changing rainfall patterns over the last three years. Usually the rainy season is from March to November. However, the dry season is becoming longer and hotter, and rainfall has been arriving as late as June. Farmers' customary timing for planting and harvesting is no longer applicable, resulting in low farm productivity and reductions in income and food supply. Mercy Delantar from the local organisation JPIP says 'changing weather patterns are greatly affecting the lives of people in the communities we are working in. The farmers we work with are poor. They are dependent on the produce of their farms for their livelihoods, which is now being affected by increased aridity and extreme rainfall distribution.'¹²⁸

Fair trade and mango trees¹²⁹

Preda is a non-profit foundation near Olongapo City, the Philippines, set up 25 years ago to uphold human rights. One Preda initiative has involved establishing fairtrade partnerships and exporting dried fruits, such as pineapple, tamarind, guava, and especially mango. The carabao mango thrives in poor soil, and its roots mesh together to arrest soil erosion. The trees encourage soil-insect and worm populations, which in turn attract songbirds. These are food for small snakes, which in turn feed their predators, monitor lizards. Naked land soon becomes a tropical paradise. The trees also provide shade for livestock, whose milk and meat sustain farming families, and whose dung fertilises the land.

Preda is committed to planting 1,000 trees annually and offers practical assistance to do this. It gives mango saplings to farmers free of charge, and it grants interest-free loans to alleviate hardship between planting and harvest time. Preda also promises to buy each entire crop, and pays a premium price for it. Conservation and eco-consciousness are an integral part of Preda's vision. Farmers are taught how to stop fruit flies from laying their eggs in the mango blossom, a problem that prevents the flower from being fertilised and fruit from growing. To do this, bamboo scaffolding is erected around each tree. Families climb this to staple bags made of recycled newspaper around the blossoms. This system, coupled with the planting of neem trees, whose antiseptic properties help to keep the surrounding soil disease free, does not rely on expensive artificial pesticides, yet still yields blemish-free fruit, increasing the crop's value at harvest time.

Coastal areas

As for most coastal, low-lying nations, the Philippines and Indonesia are at risk from sea-level rise. Indonesia's Environment Minister, Rachmat Witoelar, warned in January 2007 that his country – comprising about 17,000 islands where millions depend on fishing and farming – could lose 2,000 small islands by 2030 due to a rise in sea levels as a result of climate change. A June 2007 report by PEACE – a Jakarta-based environmental advisory and consultancy – says thousands of Indonesian farmers in productive coastal areas will have to look for other livelihoods if predictions for sea-level rise come true across the vast archipelago nation.¹³⁰ Jakarta, Indonesia's capital, is particularly at risk.

East Timor is also at risk, and if sea-level rise reaches 88 cm, coastal flooding and erosion, destruction of coastal mangrove ecosystems, and saltwater contamination of fresh-water aquifers will occur. Sea-level rise will also damage reef ecosystems, and rising sea temperatures could bleach the coral reefs of East Timor's relatively undeveloped coastline.

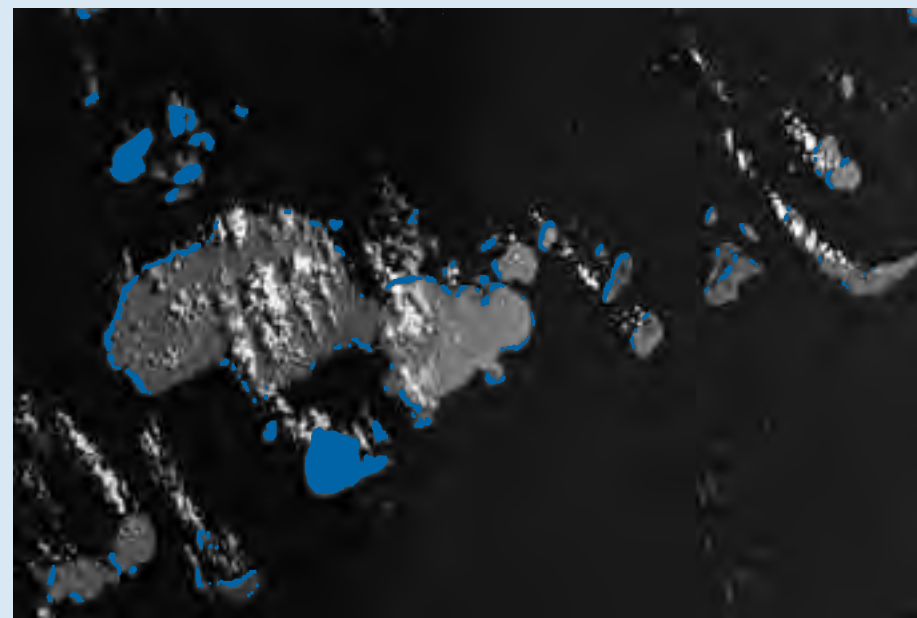
Urban poor at risk: Jakarta¹³¹

The major climate change-related risks to Indonesia's capital, Jakarta, will come from sea-level rise and flooding, both of which are expected to increase in frequency and severity. Much of the population, an estimated 1.2 million people, is concentrated in the vulnerable coastal slum communities in the north, where population density is 12,635 people per square kilometre – the highest in Indonesia.¹³² Over 277,000 people in Jakarta live below the national poverty line, but this figure does not include unregistered citizens in the poor northern communities who cannot afford basic services like clean water, sanitation and education. Lack of infrastructure in these slum communities leaves residents vulnerable to climate change-related events, and without the resources to cope.¹³³

Sea levels in Jakarta Bay are expected to rise at a rate of 57 millimetres per year, resulting in the predicted submergence of as much as 160 square kilometres of northern Jakarta by 2050.¹³⁴ When combined with subsidence due to groundwater extraction and soil compression,¹³⁵ poor urban planning, and continued upstream deforestation in the watershed, poverty stricken areas of the city could be left devastated. The impacts of climate change on Jakarta will likely be borne by its poorest and most vulnerable citizens.



'We just can't predict the weather any more,' says 52-year-old Damin, a fisherman from Tunda Island in the South Java Sea, 'so we don't know when we can go out to fish.' At the end of 2006 the storms lasted an unusual three months and people went hungry because they could not go to sea. With Oxfam help the community is building a new 'coral reef' using old tyres to attract the fish back. Photo: James Painter/Oxfam



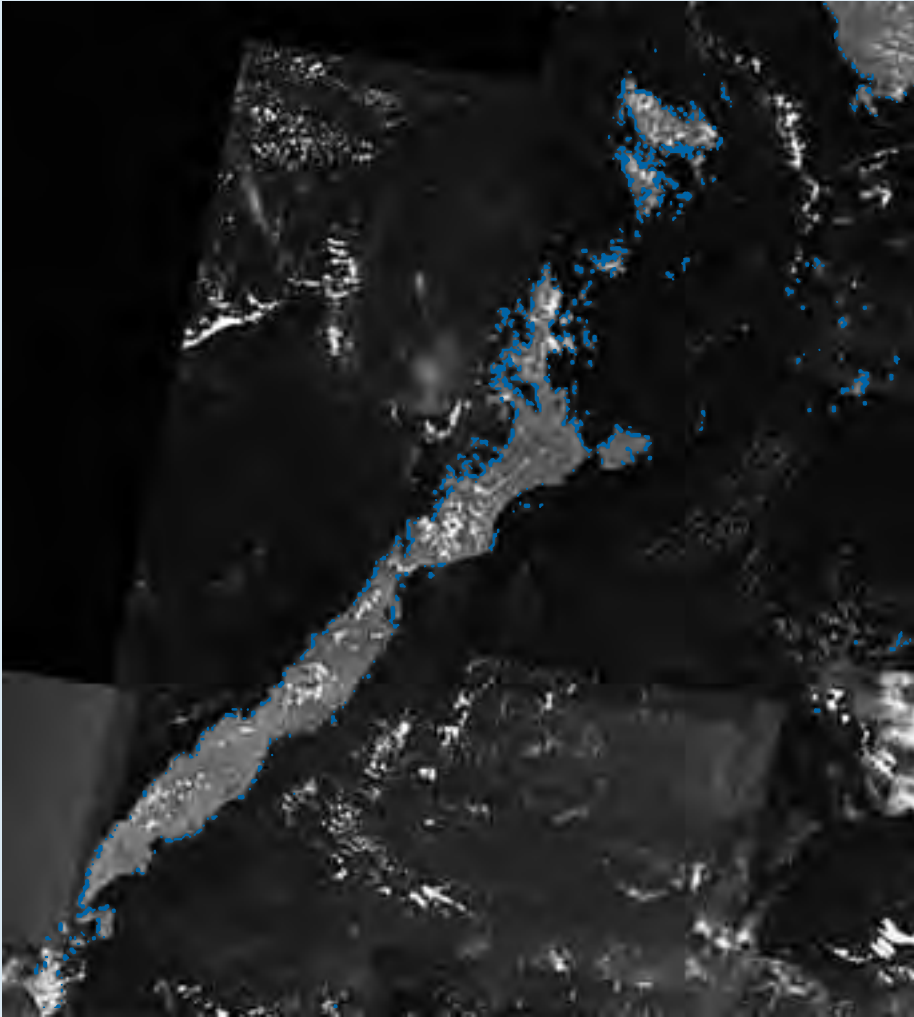
Satellite map of the province of Sulu in the Philippines. Blue markings indicate areas that are vulnerable to a one-metre rise in sea level. Sulu ranks first as the province most vulnerable to an increase in sea-level in terms of land area that is at threat. A one-metre rise in sea level is projected to inundate 7,973 hectares of land. At least 90 per cent of the land area of the municipality of Pata and 34 per cent of the municipality of Marunggas, both in the province of Sulu, are at threat, potentially displacing communities, damaging infrastructure, and affecting livelihoods. Sulu is in the southernmost part of the Philippines about 950 from Manila. It has a population of at least 619,668 people, which includes the Badjaos or 'sea gypsies' of the Sulu seas. It is famous for its Pearl Farm in Marunggas Island as well its white sand beaches and coral reefs. Credit: Greenpeace

Fishing livelihoods suffer¹³⁶

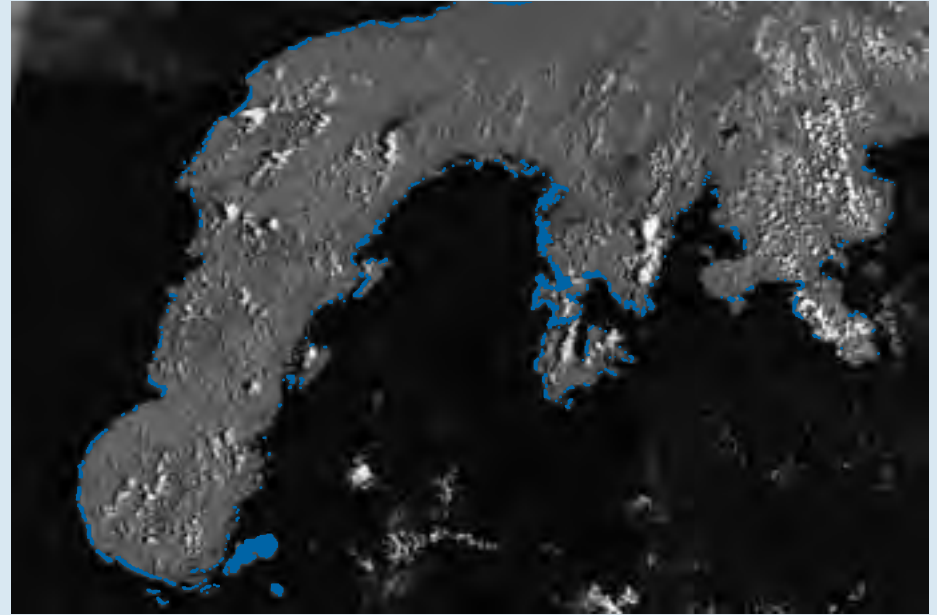
Climate change, which has caused high tides in many parts of Indonesia and unusual sea-temperature patterns, has negatively affected the income of fishermen in many islands in Maluku Province in recent years. Fishermen 'have complained that they can no longer predict the right time and where to catch fish because of the different climate pattern than before', said Laksmi Prasvita, spokeswoman for Oxfam GB in Indonesia.

Rising seas in the Philippines

The Philippines archipelago has the second-largest coral reef cover in the world (26,000 square kilometres) and a coastline which is roughly equivalent to the circumference of the Earth (36,289 kilometres). Sea-level rise threatens coastal areas, island ecosystems and low-lying communities, which are already struggling with subsidence and haphazard coastal development. Greenpeace has mapped out areas that are vulnerable to a one-metre sea-level rise and found that such a rise will affect 64 out of 81 provinces, covering at least 703 out of 1,610 municipalities, and inundating almost 700 million square metres of land.



Satellite map of the province of Palawan in the Philippines. Blue markings indicate areas that are vulnerable to a one-metre rise in sea level. Palawan ranks second as the province most vulnerable to an increase in sea level in terms of land area that is at threat. A one-metre rise in sea level is projected to inundate 6,428 hectares of land. Palawan is considered the Philippine's last frontier. It is approximately 586 kilometres southwest of Manila. It has a population of at least 755,412 people, which comes from 81 cultural groups. It is famous for its World Heritage Sites – the Puerto Princesa Subterranean River National Park and the Tubbataha Reef Marine Park. Credit: Greenpeace.

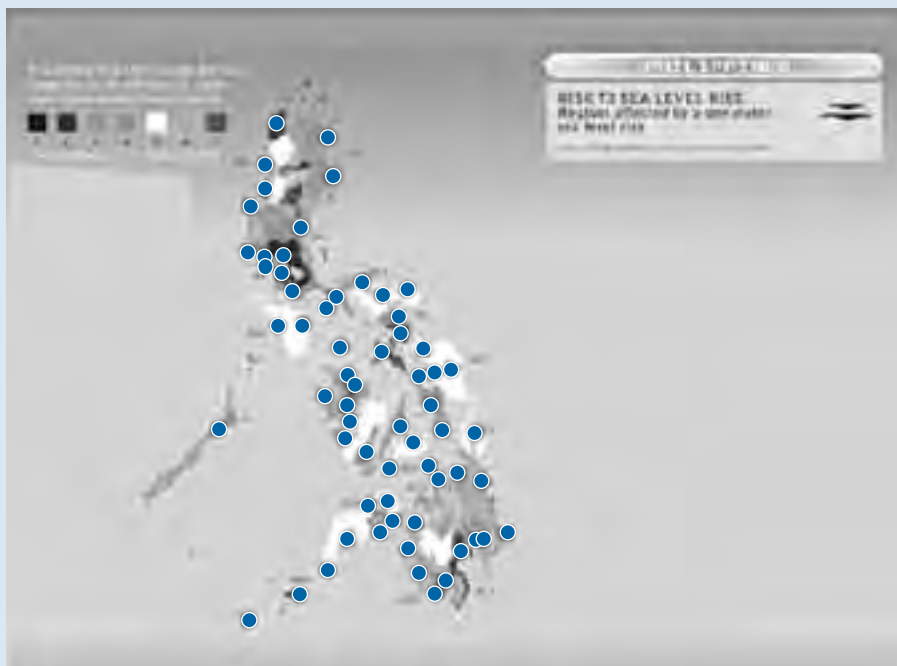


Satellite map of the Zamboanga Peninsula in the Philippines. Blue markings indicate areas that are vulnerable to a one-metre rise in sea level. Zamboanga del Sur, Zamboanga Sibugay and Zamboanga del Norte rank third, fifth and nineteenth as the provinces most vulnerable to an increase in sea level in terms of land area that is at threat. A one-metre rise in sea level is projected to inundate 3,782 hectares of land of Zamboanga del Sur, 3,274 hectares of land in Zamboanga Sibugay and 1,057 hectares of land in Zamboanga del Norte. Zamboanga del Sur, Zamboanga Sibugay and Zamboanga del Norte comprise the Zamboanga Peninsula or Region 9 which has five major cities. It is situated south of Manila. Region 9 is considered the second-most vulnerable province to sea-level rise. Credit: Greenpeace

Disaster strikes

East Timor is already highly vulnerable to extreme events, such as destructive storms, flooding and landslides, many of which could be caused, in part, by climate change. Drought is not uncommon and the UNDP has linked El Niño events to the occurrence of droughts.¹³⁷ Following an El Niño year, rainfall can also be higher than average, thus increasing the risk of floods.

Flooding in the south side of East Timor often causes landslides, which damage property and rice paddies.¹³⁸ Steep topography along with farming practices that remove vegetation from highland slopes and increase soil erosion exacerbate flooding.¹³⁹ Forest cover in East Timor has already decreased by nearly 30 per cent from 1972 to 1999, which was roughly the period of Indonesian occupation.¹⁴⁰ Flooding also affects water quality due to the increase in suspended particles.



Map of the Philippines. Icons indicate provinces that are vulnerable to a one-metre rise in sea level. Sea-level rise is projected to affect 64 out of 81 provinces, covering at least 703 out of 1,610 municipalities, and inundating almost 700 million square kilometres of land. Out of 16 regions in the Philippines, there is only one region that will not be affected by sea-level rise – the Cordillera Autonomous Region (CAR). Ironically, CAR is at high risk from extreme weather events, such as typhoons and increases in rainfall. Credit: Greenpeace

In the Philippines, typhoons are growing in intensity year by year and there is evidence that this is as a result of climate change. They are destroying infrastructure, crops and peoples' lives. Towards the end of 2006, one devastating super typhoon roared through the central Philippines leaving around 1,000 people dead, many of them buried under gigantic mudslides.

The effects of these weather extremes are exacerbated by the country's denuded hillsides. After 60 years of indiscriminate logging, more than 80 per cent of the Philippine forests are gone, most being irreplaceable rainforest. Without trees the thin topsoil washes away, leaving nothing for subsistence farmers or for coastal fishermen whose catch is displaced by the soil washed into the sea.

Climate change worsens Indonesian floods

A deputy environment minister has acknowledged that climate change contributed to the extreme weather conditions in early 2007 that triggered the worst flooding in the Indonesian capital in years. The floods submerged huge areas of Jakarta and its surroundings, killed 50 people and displaced hundreds of thousands more. 'It's a natural phenomenon affected by climate change. It's been made worse by negligent behaviour,' Masnellyarty Hilman, a Deputy Environment Minister in charge of drafting a national strategy to deal with climate change, said. She added that warmer seas had heated up monsoon winds that carry moisture from the ocean to the land, leading to extra-heavy rain.¹⁴¹

The Philippines has a low ability to cope with such disasters. With data provided by Dr Leoncio Amadore, Greenpeace mapped out nine tragedies from 1991 to 2006 triggered by extreme weather events. These events have one thing in common – persistent torrential rains, causing landslides and flash floods, killing people, and destroying properties and the environment.

International financial institutions undermine sustainability¹⁴²

Millions of the poorest Filipinos depend on coastal fishing and farming in the coastal plains for their subsistence and income. But the increasing intensity of storms and the possibility of rising sea levels threaten their existence. Lethal landslides and flash floods are also a growing problem.

The administration of President Gloria Macapagal Arroyo recognises the threat posed by climate change, especially along the eastern seaboard. Yet, at the same time as developing disaster preparedness programmes, the Government, pressed by international institutions to pay its debts, is also pursuing so called 'national development' policies that make future disasters more likely. Take the mining industry for instance. In the 1990s, the World Bank and Asian Development Bank successfully pressed the Philippines to liberalise its legal framework and facilitate a massive expansion of mining in the country, financed by foreign direct investment. The Government persists in massive expansion of mining despite strong opposition from the Churches, civil society groups, indigenous peoples and even local government units. Some 23 priority projects are among more than 2,000 mining license applications currently being processed. They are mainly large-scale mining for gold and copper. Open-pit mining will be used in many of them, causing extensive deforestation in vulnerable watersheds and generating millions of tonnes of waste and toxic materials. Mine-tailings ponds in the Philippines are notoriously susceptible to

Living with the threat of disasters¹⁴³

The town of Infanta sits at the foot of the Sierra Madre mountain range in the southeastern part of Luzon Island in the Philippines. It is a major gateway for typhoons entering the Philippines from the Pacific. During the onslaught of four consecutive typhoons in late November 2004, deforestation of the Sierra Madre caused a flow of debris (a deadly mixture of heavy logs, water, soil, rocks and vegetation) that literally buried the towns of Nakar, Infanta and Real in the island's Quezon Province.¹⁴⁴

The landslides occurred largely as a result of excessive rainfall on mountains whose vegetative cover had been severely depleted by logging activities, shifting cultivation and charcoal manufacture. The loose soil structure and steep slopes exacerbated conditions. Growing populations and increasing amounts of land conversion also played a role. Forests continue to be logged despite a government-imposed logging ban, and reforestation efforts just cannot keep up with rampant deforestation rates.

The Sub-Regional Social Action Center of the Catholic Church in Infanta, Quezon Province (SAC-Infanta) has started a project to conserve and encourage sustainable use of biodiversity as a means of protecting communities from harsh climatic events. The project promotes diversified sustainable agricultural practices in the lowlands and reforestation and agro-forestry in the uplands. These activities provide the population, particularly the poor, with food, fibre, medicines, building materials, bio-energy and water for households and agriculture. The interventions also secure the mountain slopes thus reducing the impact of disasters.

SAC-Infanta has also worked to create stronger community coherence. Neighbourhood church-based community groups participate in and strengthen local government disaster coordinating councils. With help from the state agricultural university, they are experimenting with new soil types to cover land following a landslide. Adapted agricultural technologies are now being practiced and new cash crops are providing sustainable sources of income. Integrated farming methods incorporate livestock production and reforestation using income-adding fruit trees and biofuel-producing trees to diversify household livelihoods. SAC-Infanta provides marketing support and access to capital.

There are two responses to danger: fight or flight. With no other place to call home, the communities of Infanta chose to stay put and nurture the goodness that the earth of Infanta has yet to offer.



Marie Fe Ritual, Social Action Center – Infanta. Photo: Christian Aid/Amanda Farrant



Quezon Province landslides 2004, Social Action Center – Infanta. Photo: Christian Aid/Amanda Farrant

Environment and energy

The region is rich in biodiversity, which is threatened by shifting climatic zones. Sea-level rise, combined with prolonged drought, and heavy rainfall leading to floods and tidal surges are further threats. High rates of deforestation add to the problem.

Biofuels – ‘silver bullet’ or ‘fools gold’?

Biofuels are seen as a way to combat climate change and provide an alternative source of fuel in the face of decreasing global oil reserves. However, oil palm plantations used for the production of biodiesel are a major driver of deforestation in tropical Asia, as they require a humid tropical climate to give commercial yields. Indonesia, alone has some six million hectares of land under oil palm and the Government is actively encouraging further expansion by offering incentives and subsidies to attract both domestic and foreign investment in plantations and processing facilities. In 2007, the Indonesian Government signed 58 agreements worth US\$12.4 billion in order to produce about 200,000 barrels of oil-equivalent biofuel per day by 2010 and replace 10 per cent of the country's total oil-based fuel needs.

If these plans are implemented, a further 6 million hectares of land will be needed. Given that oil palm plantations are already the main cause of forest loss in Indonesia, it is likely that additional land requirements will result in an acceleration of deforestation, in a country which globally, already has the highest rate of deforestation. To make matters worse, a large proportion of forests in Indonesia are located on peatlands.

Global peatlands account for nearly 30 per cent of all land-carbon stores while covering only three per cent of the land area, and many peatlands are still actively taking up and storing carbon. Research by Wetlands International and the Dutch Consultancy, Delft Hydraulics, reported that deforestation and drainage of peatlands releases phenomenal amounts of carbon dioxide. As the peat dries, rather than storing carbon, it starts to decompose, and emits carbon dioxide at rate of between 70 to 100 tonnes of carbon dioxide per hectares per year. Already, it is estimated 516 million tonnes of carbon dioxide are emitted each year in Indonesia as a result of peat drainage. A further 1,400 million tonnes of carbon dioxide is released to the atmosphere through annual fires on peatlands.¹⁴⁶

Oil palm plantations on deforested peatlands generally require heavy drainage. And, it is estimated that at least 50 per cent of future plantations will be developed on peatlands, as much of the more desirable ‘drylands’ are already occupied. Given this, deforestation and drainage required to meet Indonesia's ambitious biofuel target could result in the emission of an additional 300 million tonnes of carbon dioxide to the atmosphere each year – cumulatively, the contribution to global carbon dioxide emissions could be very significant. This also implies that for every tonne of palm oil created in South East Asia, 33 tonnes of carbon dioxide are emitted – ten times as much as conventional petroleum.¹⁴⁷

Kampar Peninsular

According to Eyes on the Forest, a coalition of three local environmental organisations in Riau, Sumatra, Indonesia,¹⁴⁸ half of the 700,000 hectares Kampar Peninsula natural landscape has been changed to make way for acacia and oil palm plantations. The peninsula is a peat swamp forest, rich in biodiversity with four wildlife reserves and rivers used by local communities for their livelihood. Sumatran tigers, arwana fish, crocodiles and sun bears are amongst the many species present in the peninsula. A further 21 species are on the brink of local extinction due to landscape conversion.¹⁴⁹

Biofuels in the Philippines

In the Philippines, implementation of the Biofuels Act began this year. This legislation calls for a mandatory mixing of one per cent biodiesel in petrodiesel and five per cent bioethanol in gasoline. This has raised fears amongst some national environmental organisations that the destruction of the country's remaining forests could be accelerated as farmers rush to meet the biofuel demand. It also threatens to increase poverty, as the costs of basic commodities are expected to increase as food and fuel crops compete for land and resources.

ECOWEB is a local NGO promoting the sustainable use of natural resources in upland farming communities. Community concern about climate change is increasing so ECOWEB is beginning to explore the potential impacts of biofuels and carbon sequestration in relation to natural-resource management in local communities. It is also exploring climate-related activities such as community risk assessment, land use and resource mapping, and integrated community development planning. Nanette Salavador Antequisa from ECOWEB states, 'the great challenge for the civil society is how biofuel cultivation can be of benefit to poor upland farming communities, when the reality is that it will surely benefit first the big business companies.'¹⁵⁰

Water resources

In Pagadian, Mindanao, the Philippines, deforestation is increasing the impacts of changing weather patterns. Pagadian supported vast areas of rainforest until the 1970s. Upland forests retained water during the rainy season and made water available throughout the year. In the 1980s, there was rampant logging of upland areas, and almost all of the native forest was cleared. This changed the ecological balance and resulted in water shortages in upland areas and drought due to extended dry seasons. Beth Montazana from the Social Action Centre, Pagadian, comments, 'one of the impacts of the absence of vegetation in upland areas is that the ground is left vulnerable to the intense heat of the sun and becomes less fertile. In addition, the open fields store significant amounts of heat from the sun and start to release this at dusk, creating warmer summer nights.' Forest plantation programmes introduced by the Government in the last 15 years are doing little to ease this problem. 'The Government has introduced a number of non-native species of trees, such as the gemelina species. These fast-growing slender trees absorb large amounts of water and have reduced groundwater availability.'¹⁵¹



Rodrigo Costanilla, 58, is an organic rice farmer in the Philippines who must rent his land from a large landowner. Photo: CAFOD



Ruel and Rudymer are grandsons of Rodrigo Costanilla. They are small-scale organic rice farmers, and are receiving training, loans and equipment from JPIP. They lease land from a large landowner and pay rent in rice. Small farmers have no support from the Government. Photo: CAFOD

Investing in the land¹⁵²

CAFOD partners Social Action Centre, Pagadian, and JPIP, have been working with local communities to improve water supplies to upland areas through irrigation projects. They have also been working to promote sustainable agriculture techniques, such as contour farming, organic fertiliser use and crop diversification, which can help people adapt to the changing ecological conditions. 'Sustainable agriculture provides an alternative to our farmers, and a chance for them to address weather changes. A challenge for them is how to promote the technology to other farmers.'

The majority of farmers do not own the land they are cultivating as most of it is owned by wealthy plantation owners. This is a further obstacle to promoting the use of sustainable agricultural practices. Such practices are time- and resource-intensive and farmers often do not want to risk these investments as they could be forced from the land at any time. Mindanao has also been an area of conflict for many years and peace is not yet fully established. When conflict breaks out, people are often forced to leave their land, again reducing incentives to engage in land improvement.



Rice harvesting in the Philippines: small farmers must often lease their land from large landowners and pay their rent in rice. Photo: CAFOD



The Buhayan children going to school in the Philippines. Their family has received training from JPIP in sustainable agriculture. The children go to school and help in the house and farm. Photo: CAFOD



Elizabeth Monteza, the only female and non-priest director of a Social Action Centre in Zamboanga del Sur, Mindanao, the Philippines. She is an advocate of small-scale farming and has noted the impact of changing weather patterns on her community. Photo: CAFOD

Local manufacture and installation of village water pumps¹⁵³

Poor access to fresh water in the remote hillsides of the Philippines means that for many people the journey down steep slopes to collect water for basic needs can be a difficult one. Furthermore, the absence of a regular water supply leads to poor hygiene and sanitation, and also limits agriculture.

The Alternative Indigenous Development Foundation Inc., installs hydraulic ram pumps to provide a good supply of water from the rivers to the hillside villages. These ram pumps use the power of the water alone to lift a small fraction of the water up 200 metres vertically, and sometimes pump it over a kilometre to where it is needed.



A boy plays in water from a hand-pump in a slum on the outskirts of Manila. Many in this area had signed up for a connection from the Maynilad water company which had installed meters. However, frustrations were running high as while the water failed to flow the bills did not stop, leaving residents forced to pay while relying on existing local sources. Privatisation of water management in Manila has proved highly controversial and inefficient, with the poor losing out most. As the effects of climate change bite deeper in Asian cities like Manila, questions of how water is managed and who has access to it are becoming increasingly urgent. Photo: Rod Harbinson/diversityphotos.com



A girl collects water from a hand-pump in a slum on the outskirts of Manila, in an area where many people were paying for water from the Maynilad water company which failed to flow. Photo: Rod Harbinson/diversityphotos.com

Experiences of climate change in East Timor¹⁵⁴

No detailed assessment of climate change in East Timor has been conducted. But the people that live in East Timor report the disappearance of spring water, changing planting seasons, extreme flooding, landslides, and other environmental changes.

Angelina is a prominent leader amongst the indigenous women in Tutuala, the most eastern part of East Timor. She says that ten years ago people in her village collected water from a nearby spring, but that today the water has disappeared. Fetching water is normally the task of women and children so this increases the workload of women in Angelina's village. They now have to walk more than two kilometres to collect water.

Women and children are most vulnerable¹⁵⁵

Climate change is known to affect vulnerable groups first. The poor are badly affected, but Beth Montazana from the Social Action Centre states 'women and children are vulnerable because they are usually the first to suffer from the impacts of changes in weather conditions such as lack of clean and safe drinking water. Scarcity of food often has a greater effect on nutrition levels of women. Among Filipinos, when there is not enough food for consumption for a certain month, the mother prepares to eat less, giving priority to her husband and her children. Why the husbands? In most cases it has become part of the culture among Filipinos that wives save a meal for their husbands because they are the ones who provide the food, but forgetting that wives also carry the burden of taking care of the children, animal care and other household activities.'

Children are also affected when education no longer becomes a priority for their families as they struggle to meet their basic needs. Mercy, from the Filipino organisation JPIP, says, 'as earning a living from agriculture is becoming more difficult, many children and young girls in our communities, especially those from very low-income families, have stopped attending school. Instead they try to find employment in urban centres to supplement their family income. What future will there be for our communities without education, and without a new generation to keep the farms productive?'



Aureliana Siki cuddles her 18-month-old daughter Amelia Jessica. 'She just won't eat, I am so worried she is going to die,' she says. Most children in her village in West Timor are also losing weight. Bad weather halved Aureliana's harvest last year. She says the dry and wet seasons are becoming all mixed up and unpredictable. Oxfam is working with local partners to help people store water and grow vegetables in home gardens. Photo: James Painter/Oxfam



The Philippines: Inday, aged eight, goes to school and helps at home by tending the farm goats. Photo: CAFOD



John Mike is aged eight. He goes to school in the Philippines and helps in the house, fetching water from the spring and cooking dinner. Photo: CAFOD

Empowering women through carbon sequestration¹⁵⁶

CARE implemented the Forest Resource Management for Carbon Sequestration (FORMACS) project in Indonesia from 2002 to 2005. Project activities were implemented in 36 villages in Nunukan District in East Kalimantan. The project aimed to improve household livelihood security and increase carbon sequestration through sustainable natural resource management. Key challenges included illegal logging, forest conversion for agriculture and palm oil production, and the threat of forest fires. Insecure land tenure and unsustainable land-use practices have also contributed to



Maryann and Inday are ten and eight respectively. They both go to school and help at home tending the farm goats. Photo: CAFOD

the loss of forest resources, and the low capacity of local government authorities to support sustainable forest management has exacerbated the situation.

Project activities aimed to empower women, and used practical exercises to identify the different activities and roles of men and women in the household. Barriers to women's participation in new livelihood activities included early marriage (and consequent low education levels), existing workloads and discriminatory social customs. A combination of approaches was used to overcome these barriers.

Table 1: A daily activity schedule for Agabag men and women in Kalimantan, Indonesia, shows the high existing workloads of women¹⁵⁷

Adult Males		Adult Females	
05:00-06:00	Get up, bath, check traps, drink coffee, and chat with friends.	04:00-06:00	Get up, boil water, prepare coffee/tea, make breakfast, wash dishes, clean the house and look after children
06:00-07:30	Eat breakfast, drink tea/coffee, chat	06:00-07:30	Eat breakfast, look for vegetables
07:30-09:00	Drink tea/coffee, chat	07:30-10:00	Work in the garden
09:00-11:00	Set fish traps, work in garden, check traps	10:00-11:00	Wash clothes, bath, clean the house
11:00-13:00	Eat lunch, rest	11:00-13:00	Housework, prepare lunch, eat lunch
13:00-14:00	Check traps, fish, hunt	13:00-14:00	Housework
14:00-15:00	Work in the garden	15:00-16:00	Gather vegetables for supper, gather firewood, clean house, wash dishes.
18:00-19:00	Bath	18:00-19:00	Cook supper, bath, clean house, fetch water.
19:00-20:00	Eat supper	19:00-20:00	Eat supper, wash dishes
20:00-22:00	Watch TV, chat, drink coffee	20:00-22:00	Watch TV, make handicrafts, put children to sleep
22:00-05:00	Sleep	22:00-04:00	Sleep

Alliances were formed with progressive community groups to address discriminatory social customs. Women were also offered literacy training. The project showed that both men and women could perform agroforestry activities, but that workloads must be balanced. Men were encouraged to become involved in activities that were traditionally the responsibilities of women, such as childcare and fetching water and fuel.

Community organisations were established to undertake project activities, and women were encouraged to take on leadership roles in these organisations. The organisations worked with communities to map land uses and plan village development. Inventories of forest resources, including carbon stocks, were undertaken, and forest management plans developed and endorsed by local authorities.

A key lesson from the project is the need for appropriate entry points: it is necessary to deal with immediate critical issues before expecting communities to plan for the long-term. Therefore, activities with short-term benefits, such as vegetable cultivation, are important in getting trust, particularly from women's groups. Secure land tenure is also essential to ensure sustainable management of forest resources.

The Lower Mekong and Malaysia¹⁵⁸

With extensive coastlines and a tropical climate characterised predominantly by seasonal weather patterns associated with two monsoons, the Lower Mekong Region is considered by the IPCC to be highly sensitive to climate change. The region encompasses the territory, ecosystems, people, economies, and politics of Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, and Vietnam.

Over the last century, average temperatures in the Mekong Region have risen 0.3 to 0.8°C. Further temperature increases are expected along with more extreme weather events, such as floods and droughts, changes in the amount and distribution of rainfall, disruption of seasonal monsoons, and rising sea levels.¹⁵⁹

Climate change could have major impacts on ecosystems and biodiversity, hydrology and water resources, agriculture, forestry and fisheries, mountains and coastal lands, and human settlements and health. The countries of the Mekong must link hands in order to minimise the impacts of global warming and to cope with the consequences of climate change. Adaptation and mitigation measures are crucial and should be incorporated into future development plans adopted at the country level. Reducing greenhouse gas emissions in the energy sector by depending less on fossil fuels, particularly coal, and moving rapidly towards sustainable energy alternatives, is imperative for the Mekong Region.

Sea-level rise

According to the IPCC, a one metre sea-level rise could flood 15,000 to 20,000 square kilometres of the Mekong River Delta and affect half a million square hectares of the Red River Delta. In this scenario, 2,500 square kilometres of mangrove will be lost, and around 1,000 square kilometres of cultivated farmland and mariculture areas will become salt marshes.¹⁶⁰

East Asia will be significantly impacted by sea-level rise. The impact on GDP is much larger in East Asia than for any other region. In South Asia the impacts are related to the height of sea-level rise, particularly if it is above three metres. Above this, Bangladesh suffers major impacts on agriculture, population, urban areas and GDP.¹⁶¹

Vietnam will suffer most from sea-level rise according to a new World Bank report.¹⁶² Should climate change result in a one metre sea-level rise, Vietnam could incur losses totalling US\$17 billion per year and lose more than 12 per cent of its most fertile land.¹⁶³ The best agricultural land, together with 50 per cent of the population, is on the low-lying Red River and the Mekong Delta regions. Over 17 million people could lose their homes, 14 million of whom live in the Mekong Delta region. Intrusion of saline or brackish water could also affect the irrigation of paddy rice.¹⁶⁴



Traffic clogs a Bangkok street in Thailand. As the Asian economy continues its formidable growth, more people are in a position to buy cars, the manufacture and running of which are major contributors to climate change. Photo: Rod Harbinson/diversityphotos.com

Deforestation and pollution of water resources have already devastated much of Vietnam's rich biodiversity. With rising sea levels, Mangrove and cajeput forests – important ecosystems in low-lying areas – may die back or be entirely lost.¹⁶⁵ One estimate suggests that with a 90cm rise in sea levels, 33 per cent of reserves and 27 per cent of biodiversity could be lost.¹⁶⁶

"First, the overall magnitudes for the developing world are sobering: within this century, hundreds of millions of people are likely to be displaced by sea-level rise (SLR); accompanying economic and ecological damage will be severe for many. The world has not previously faced a crisis on this scale, and planning for adaptation should begin immediately. Second, international resource allocation strategies should recognise the skewed impact distribution... Some countries will be little affected by SLR, while others will be so heavily impacted that their national integrity may be threatened. Given the scarcity of resources, it would seem sensible to allocate aid according to degree of threat".

Source: The World Bank, 2007¹⁶⁷

In Thailand, much of the country's most fertile agricultural land is situated in low-lying plains near river deltas. Rising sea levels could cause saltwater intrusion of up to 40 kilometres up the Chao Praya, Tachin and Bangprakong Rivers, threatening saltwater sensitive crops. The Chao Praya River is also the main source of drinking water for Bangkok, with its 10 million or more residents. Bangkok is barely above sea level and already suffering from extensive land subsidence.

Coastal erosion and the role of mangroves

Cambodia's 435-kilometre coastline is particularly vulnerable to climate change. Coastal zone development has already accelerated erosion in many areas. For example, mangroves cover around 26,650 hectares and act as a buffer against storm and tidal surges. They have, however, been cut on a large scale for the production of charcoal, aquaculture and housing. This has increased the vulnerability of the coastal region.

Mangroves also protect coastal zones in Vietnam, where their destruction (due to climate change or coastal development) is accelerating coastal erosion. More frequent and severe typhoons could exacerbate this erosion. Privatisation of coastal lands has resulted in huge areas of mangroves being cut down for shrimp farming. Now many international donors and NGOs are supporting coastal communities to restore mangroves. In Kien Thuy, a four-metre high storm surge in 2005 was reduced to a 0.5 metre high wave by the time it passed through the restored mangroves.¹⁶⁸

Mangrove Restoration and Fisheries in Malaysia¹⁶⁹

The Penang Inshore Fishermen's Welfare Association (PIFWA) in Malaysia has been working for about 20 years to replant mangroves in areas that were cleared for development and aquaculture projects. They began by campaigning to raise public awareness on the importance of wetlands, especially mangroves. Mangrove forests serve as a spawning and breeding ground for marine life including crabs and prawns, and they reduce coastal erosion. The forests also protect villagers from sea-level rise, strong winds and huge waves, thus protecting villagers' lives as well as their livelihoods. The need to restore and protect mangrove forests as well as coastal forests has intensified with the threat of climate change. According to Rousli Ibrahim, 61, an inshore fisherman for 37 years, the mangrove forests in Sungai Acheh have protected them each time there is a storm surge or a high tide. The tsunami in 2004 demonstrated the effectiveness of mangrove forests as natural wave breakers because they protected nearby villages from the worst of the impact.

To date, the fishermen have replanted 100,000 seedlings of 'bakau kurap' and 'bakau minyak' in seven places without the help of the authorities. PIFWA, which lends its voice to some 600 fishermen, has encouraged inshore fishermen in neighbouring states to do the same. Additional efforts to lobby the state government to protect the coastal mangrove belt have also been paying off: the Penang Government has gazetted 316 hectares of mangrove forests in Balik Pulau and Byram as permanent forest reserves. The state has also drawn up guidelines to deter development, particularly aquaculture projects that destroyed vast areas of mangrove forests in the past. It has also identified two other places that will soon be gazetted.

Agricultural livelihoods

Whilst landlocked Laos (officially Lao Peoples Democratic Republic) may not suffer from sea-level rise or coastal erosion, irregularities in the monsoon could significantly affect its agricultural sector, which accounts for 55 per cent of the economy. Indeed, agricultural production is the basis of livelihoods for millions of people in the Mekong Region. It is the main source of income for at least 80 per cent of Lao PDR's population. In Thailand, this figure is around 60 per cent, and in Vietnam 75 to 80 per cent. As the region's climate changes, rice and most food crops will be more difficult to grow, yields will become more uncertain, livestock more difficult to raise, and it will be more difficult to catch fish in the region's rivers, lakes and wetlands. According to the World Food Programme, even small changes in weather patterns in Lao PDR, such as a delay in the monsoon of just a few weeks, will threaten the livelihoods of subsistence farmers. Rice is the most important crop and vast populations of rainfed



Mrs Doung Som borrowing rice from rice bank, Tareach Village, Chumikiri District, Cambodia.
Photo: Development Partnership in Action, Cambodia

farms growing rice in the lower Mekong River region rely on stable climatic conditions. Changing precipitation patterns could have significant impacts on rice productivity, with yield reductions possibly reaching 10 to 15 per cent in various areas of Lao PDR and Thailand.

'Paddy rice cultivation in our village is mainly dependant on rainfall. Increasingly we have been experiencing drought and low rice yields. We no longer are producing enough rice to eat for the full year. We are relying on initiatives, such as the community rice bank, for our survival. If not, we would have to go to private money lenders to borrow money to buy rice to meet our families' needs. They charge very high rates of interest (around 30 per cent per month).'

Ms Duong Soum, 58, Tareach village, Chumikiri District, Cambodia¹⁷⁰

Managing drought in Vietnam¹⁷¹

Temperatures in inland Vietnam are rising and the weather is becoming both more extreme and unpredictable. Average temperatures are now 1°C higher than they were about 100 years ago. Changes in rainfall patterns are complex and depend on location but the main trend is towards hotter, longer and more arid dry seasons and more intense rain in the wet season.

A major study by Kyoto University, Japan, in association with Oxfam in Vietnam, recently examined both people's attitudes towards climate change and the capacity and strategies of communities and government when it came to adaptation and response. The study took place in Ninh Thuan Province, which has experienced a drought every year since 2002. The drought in 2004 was the worst on record. Whilst annual rainfall has been steadily increasing, the farmers experience droughts because the rain now comes in intense, concentrated bursts. More water storage to capture rain for use in the dry season is urgently needed. Irrigation systems are also inadequate. Women, in particular, suffer from having to walk far to fetch water in extreme temperatures. Children and old people also suffer more from the intense heat.

At the same time increasing human demands for land, fuel, and water cause deforestation and the over-exploitation of aquifers. The amount of available water per person declined from about 17,000 cubic metres per year to 4,600 cubic metres in 2005. Rising temperatures and a changing climate exacerbate these and other increasing pressures on the environment.

Communities are always seeking new ways to adapt. Farmers work together to grow crops and keep herds of goats, and also sheep of the Sultan breed from India, which can tolerate high temperatures. Farmers have switched from growing rice to maize and changed to more drought-resistant varieties. They have devised ways to economise on water use and reuse water. In particularly difficult times family members will migrate to the cities to find work. Some of these adaptation techniques are productive, but others carry a cost. Migration of young people increases the workload of the older people left behind. Women sometimes go without water in order to give it to their husbands or children.

Rising temperatures need not be a disaster for the people of Ninh Thuan if government and organisations working there take the appropriate measures. The most important thing is to involve communities and hear what they want. Such measures could include enhancing weather forecasting; improving water storage and irrigation; enforcing regulations to restrict water usage and allocate it fairly; soil conservation; micro-credit; and finance for, and knowledge about, such things as animal rearing, fodder storage, improved seeds and new crops. These are all being discussed with the Government as a result of the research, which is also being extended to Cambodia.

Extreme weather events, particularly prolonged droughts, severe floods and more intense rainfall between 1994 and 2004 reduced rice production by as much as 45 per cent in Thungkula-ronghai field, the heartland of the famous jasmine rice fields in the Mekong Basin in northeastern Thailand. From 1991 to 2000, damage to agricultural areas caused by droughts, floods and storms across Thailand cost up to 50 billion baht.¹⁷² Possible rainfall increases in northern Vietnam could also result from more frequent and severe typhoons.¹⁷³ This will affect agriculture along with increases in pest numbers, more soil erosion and declining soil fertility.

Water resources

Glaciers and snowfall in the Himalayas play a critical role in the provision of water to mainland Southeast Asia via snowfed rivers. As increasing temperatures and other climatic changes cause glaciers to melt and snowfall patterns to change, rivers such as the Mekong will be affected. Flow in the Mekong River may increase in the short-term due to accelerated snowmelt, but is projected to decrease in the long-term as snow stocks decline. Variation in rainfall and increased sediment yields will also affect river flows. In some areas, wetlands, streams, and small rivers that serve as community fishing grounds and important animal habitats may become 'seasonal', meaning they will only have water when it rains.

Changing precipitation patterns in Cambodia may also adversely affect the quantity and quality of water supplies. Rising sea levels will affect fresh water availability by increasing saltwater inundation of low-lying areas.



Lake Tonle Sap in Cambodia is a critical source of water on which much of the country depends. Thousands of fisherfolk earn their livelihoods from the abundant fish comprising 850 species, and a critical source of nutrition throughout the country. During the rainy season the huge lake expands up to 70 kilometres in length flooding the rice plains around its edge which benefit from the fertilising effects of the sediment left behind. The lake, fed by the Mekong River, is like many other water sources at risk from changes brought about by climate change. Photo: Rod Harbinson/diversityphotos.com



Song Trau: empty canal in Ninh Thuan, Vietnam. Photo: Water Resource Department/Ministry of Agriculture and Rural Development, Vietnam



Caption: Suoi Hanh Reservoir in Khanh Hoa Province, Vietnam, in the dry season. Credit: Water Resource Department/Ministry of Agriculture and Rural Development, Vietnam



Canal rehabilitation in Cambodia. Source: Development Partnership in Action

Community reforestation in Cambodia¹⁷⁴

Cambodia's rapid deforestation has had devastating consequences for rural people who depend on forests for wild foods and resources. New legislation allowing for formal recognition of communally owned forests means rural villagers can now play an important role protecting tree cover that is both vital for local economies and could help mitigate the impact of environmental changes, such as climate change.

Cambodia is prone to climate extremes and there is evidence that these extremes are worsening. Summer floods often alternate with periods of drought when the sandy soils dry out. Windstorms and soil erosion are also problematic. Maintaining adequate forest cover could be the key to helping prevent the worst effects of climate extremes, as forests help retain soil moisture, provide shelter from sun and wind, prevent erosion and add vital organic matter to the soil.

The Prey Koki Forest in Svay Rieng Province, illustrates the difference a community forest can make to the lives of rural people. It was severely degraded during Cambodia's years of conflict, after which surrounding villages were impoverished and demoralised. In 1994, monks from Santi Sena, a local Buddhist organisation, began working with local people to regenerate the forest. A tree nursery was established and seedlings were distributed to over 1,000 families in five nearby villages. A variety of species at a density of around 1,200 seedlings per hectare were eventually planted. Another NGO now called Development and Partnership in Action (DPA) worked with Santi Sena to help local people organise and understand the benefits community forestry could bring.

Importantly, a large fishpond adjacent to the forest serves as the local fish-spawning ground, as it remains full of water until the end of the dry season when other ponds have dried out. During the summer floods its fish are carried to other ponds in the neighbourhood to restock them. The forest helps maintain this water source.

Obtaining legal recognition of the Prey Koki community forest was a slow and difficult process complicated by an attempt by a private company claim rights to the land. Support from NGOs and the local commune council was essential. Thoeung Setha, Programme Officer for Community Forestry for DPA, is enthusiastic about the potential of the new legislation: 'The forestry law seems good. If implemented, it will secure the heritage of this community. During the French era, the forest was policed and intruders ejected. During the conflict it was destroyed. Now it is again a source of fish, wild animals and birds.'



Santi Sena representatives Thoeung Setha and Mr Tep Sarom.
Photo: Nadia Saracini, Christian Aid.

Volunteers now look out for forest fires from a watchtower. The families who tend the forest sell the mushrooms that grow within it and collect leaves for use as cooking fuel. The residents of one nearby village, Ang Khdourch, say the forest has helped to reduce drought and provides a range of local produce. Waving at the expanse of green visible from the forest watchtower, Setha says, 'This is the young forest which the company wanted to destroy. They thought it would be easy because they had money, but they hadn't reckoned with the local community. They know the value they get from the forest.'



A girl stands beside logs felled from the ancient rainforests of Laos, awaiting export on the banks of the Mekong River. The country is under intense pressure from its neighbours, Thailand, Vietnam and China to supply timber. Large-scale development projects such as the Oxiang gold and copper mine and hydropower dams backed by international finance are also taking their toll. To deforest the site of the Nam Theung two dam loggers worked 24-hours-a-day for seven years, cutting under floodlamps at night. The project supported by the World Bank and Asian Development Bank has led to the deforestation of one of the last intact areas of primary rainforest in mainland Southeast Asia and home to the rare Vu Quang Ox, a large mammal only discovered by scientists in 1993. The forested mountains of Laos provide an important watershed that supplies many rivers, including the Mekong, on which millions of people depend. The forests also store vast amounts of carbon, which is released into the atmosphere when they are destroyed.
Photo: Rod Harbinson/diversityphotos.com

Biodiversity and environment

The Lower Mekong region is known as a 'biological hotspot' because of its rich biodiversity. And yet of the national parks and wildlife sanctuaries in Thailand, 32 are also situated in 'climate change hotspots', because they will be severely affected by changes in average temperatures and rainfall. A 10-square-kilometre area of Thailand's forests could contain up to 750 species of trees and 1,500 species of higher plants, numbers higher than the total tree and plant diversity of North America. Tropical rainforests contain many species that have as yet unknown value, for example in the production of new pharmaceutical products. But increasing aridity resulting from global warming will damage these forests before such values can be realised.



Logs burning at a log-storage depot in the heart of the Sarawak Rainforest in Malaysia, which has been systematically logged for years. Much has now been cleared and replaced with palm oil plantations. The hunter-gatherer Penan tribe continue to fight for their right to live a nomadic life in the forest. The island of Borneo, of which Sarawak is a part, continues to release vast amounts of carbon into the atmosphere through forest fires caused by loggers. Ironically palm oil is promoted by proponents as a solution to climate change if it is converted into transport fuel. Critics say that the destructive practices used for its cultivation add to greenhouse gas emissions and destroy biodiversity.
Photo: Rod Harbinson/diversityphotos.com

Marine biodiversity is also at risk. For example, almost all the islands around the Cambodian coastline support coral reef ecosystems, but increasing ocean temperatures will threaten these with bleaching.



Cam Ranh Reservoir in Khanh Hoa Province, Vietnam, in the dry season. Photo: Water Resource Department/Ministry of Agriculture and Rural Development, Vietnam

Energy

In Vietnam, drought risks could increase both inland and in the south.¹⁷⁵ Over the past three years, exceptionally dry seasons have also resulted in low water levels in reservoirs behind hydropower schemes in the north. This has affected power generation and reduced water supplies for irrigation activities downstream.¹⁷⁶

Health-related climate change impacts in Chumikiri District, Cambodia¹⁷⁷

Rural communities in Cambodia are struggling to cope with the impact of worsening climatic conditions on their health and livelihoods. Along with local communities, staff at CAFOD's partner, Development Partnership in Action (DPA), which implements integrated livelihood programmes in rural communities, have observed an increase in extreme weather over the last three years. DPA's target communities in the district of Chumikiri have experienced both floods and droughts. These have resulted in death and injury to people and livestock, damage to crops, spread of communicable diseases and water-borne diseases and reduced access to potable water supplies (and related effects such as dehydration and diarrhoea). Longer-term ecological disruption is also devastating agriculture and incomes because of increased pest prevalence and reductions in yields as crops fail.

Renting photovoltaic systems in remote Laos villages¹⁷⁸

Many poor people in rural areas of Laos rely on firewood and kerosene for lighting. Pollution from both fuels can cause respiratory and eye problems as well as being unsustainable and releasing carbon dioxide into the atmosphere.

Sunlabob Renewable Energies Ltd introduced high-quality photovoltaic systems to rural areas in Laos that do not have access to grid electricity. By renting out portable solar lamps at prices lower than families spend on kerosene for lighting, households can benefit from safe lighting in the evening. Sunlabob also trains technicians in villages to perform day-to-day maintenance.

Myanmar biofuels¹⁷⁹

In 2006, the military junta in Myanmar began implementing a plan to replace all of its 40,000 barrels-per-day of conventional oil imports with biodiesel from homegrown jatropha nut oil. Without any prior announcement, farmers are now being forced to grow this crop. This policy will eventually result in the conversion of between half a million to seven million acres of land to jatropha plantations.

Currently, Myanmar does not have the technology necessary to efficiently extract and process the jatropha nut oil as a replacement fuel for diesel engines, leaving a product that can only be used in small engines. If this experiment fails, millions of acres of cultivatable land could be lost in a nation where at least 40 per cent of children under three suffer from moderate to severe malnutrition.

One argument for the cultivation of jatropha on wastelands in Myanmar is that it will release rural people from their dependence on fuel wood, and therefore prevent deforestation. Yet on Myanmar's southwest coast, jatropha is being grown on the remains of recently cleared rainforest.

Farmers only have the cultivation rights to their land. If they fail to grow crops specified by the state, or the land is deemed useful for other projects, their land will be seized. Already in Chin State, the death penalty is in place for anyone who dares to criticise the policy on jatropha.

Both disasters and longer-term ecological disruption have increased migration, which in turn has its own health implications, particularly in countries such as Cambodia with a high prevalence of HIV/AIDS. People who are separated from their families and communities are more likely to contract the disease. In turn, people living with HIV/AIDS are more vulnerable to other illnesses, such as malaria, dengue fever, dysentery and cholera, all of which could increase under a changing climate. Families of those living with HIV/AIDS or who have lost a parent to HIV/AIDS are vulnerable to any negative impacts on food security or livelihoods.

DPA has been helping communities cope with these impacts. It has supported community agricultural practices which help people adapt to the changing climate, for example by introducing more resilient strains of rice and encouraging communities to develop disaster preparedness and disaster response plans. DPA has also introduced mobile health clinics and HIV/AIDS prevention and care services to improve access to health services in remote communities and reduce future vulnerability to disease.



Mr Vanna, a voluntary village vet in Tareach Village, Chumikiri District, Cambodia. Photo: Development Partnership in Action

'The changing climatic conditions within our communities are resulting in decreasing rice yields. Villagers, particularly in the dry season, are being forced to migrate outside the village to find jobs, and many have returned having contracted HIV/AIDS. This is a real problem in the communities which we are working in.'

Mam Sambath, DPA, Cambodia

'Increasing occurrence and severity of drought has caused an increase in infectious diseases in the community and has caused a reduction in income from livelihoods sales. We village vet volunteers have to work hard to support villagers against common infectious diseases. Our community is really concerned about increasing frequency of drought. If drought may happen every year then it will continue to cause infectious diseases in our community and also in our livestock. We depend on our livestock for income generation and to help us with our labour. We village veterinary volunteers have to work hard to encourage villagers to vaccinate animals against common infectious diseases.'

Mr Vanna, 46, voluntary vet with DPA's livelihoods programme, Tareach Village, Chumikiri District

Disasters – floods hit South East Asia¹⁸⁰

Vietnam, which has a long coastline facing the South China Sea, is frequently hit by typhoons and tropical storms. At least 18 people were killed there in November 2005 when typhoon Kai Tak hit. The rains also destroyed thousands of hectares of farmland in ten provinces and disrupted transport, submerging a section of the north-south railway. Kai Tak was the eighth typhoon to hit Vietnam that year.



Mrs Sophanny, a voluntary village vet in Tareach Village, Chumikiri District, Cambodia. Photo: Development Partnership in Action

Record floods in the Mekong Delta in 2000 killed more than 350 people and displaced hundreds of thousands of others. Nearly 500,000 homes were inundated and in Dong Thap, one of Vietnam's worst-affected provinces, 90 per cent of the land was under water for weeks, and before farmers could harvest their rice crop.

These floods also hit areas upstream in Cambodia, Laos and Thailand, affecting almost a million people. In Cambodia, flooding caused considerable damage in 11 out of Cambodia's 24 provinces. River banks in and around the capital were fortified with sandbags, but some outer areas of Phnom Penh were flooded and a state of emergency was declared. Officials said the flooding, which began with unusually widespread and heavy monsoon rains in late July, was the worst to hit Cambodia in 70 years. The rainy season does not usually reach its peak until September. Large areas of farmland were destroyed.

Oxfam Hong Kong and the Red Cross were amongst the agencies providing flood relief and other assistance in the Mekong River Basin. Temporary latrines were constructed in evacuation areas and strong plastic sheeting provided for emergency shelters. For longer-term rehabilitation, rice and rice seeds for the next crop were provided.

'One of the biggest challenges we are facing in our development work is increasing occurrence of natural disaster. What we have achieved over many years is being destroyed by storms and washed away by floods.'

Mr Kim Rattana, Caritas Cambodia¹⁸¹

Nepal and Pakistan

Nepal

Nepal's key vulnerabilities to climate change are water and biodiversity. Earlier snow melt and ensuing changes to water availability could affect hydropower infrastructure and efficiency. While Nepalese rivers can potentially provide 43,000 MW of electricity, changing rainfall patterns and timing of snow melting could reduce this potential.¹⁸² Rainfall patterns are also changing, and intense rainfall has been difficult for people living in traditionally built flat-roofed houses made of mud and stone. Roof leakage and wall erosion are major problems, particularly for low-income families who cannot afford to repair their homes.¹⁸³

Forests and agriculture are at risk and human health could also be affected by climate change. For example, mosquitoes may move to higher altitudes due to warmer temperatures, carrying with them greater risk of malaria, and water-borne diseases could increase during disaster events. Climate change could increase levels of Japanese encephalitis and kala-azar.¹⁸⁴

Upgraded water mills to improve livelihoods in the Himalayas¹⁸⁵

The Centre for Rural Technology in Nepal runs a programme upgrading traditional water mills (ghattas) used to grind flour so that they can operate more efficiently. There are many ghattas in the remote villages of the Himalayan Mountains and foothills of Nepal.

By upgrading the mills, millers are able to earn more income and work shorter hours. Additionally, the flour from water mills is of higher quality than from diesel mills, which have recently come into the region. Although diesel mills are faster, the flour is of lower quality, has a shorter shelf life, is less nutritious and has a lower market value. This is because diesel mills heat the flour up more due to their higher grinding speeds compared to the traditional ghattas.

While the timber parts of a traditional ghatta need to be replaced once every two years, the upgraded and modified water mill only needs replacement every ten years. In addition, as the upgraded water mill can cope with variable water speeds, the mill can also be used during the dry seasons when water flow is reduced.

Glacial melt

Glaciers are the freshwater reservoirs at the top of a mountain watershed and act as the source of many rivers that wind their way through thousands of kilometres of grazing, agricultural and forested land, and are used as a source of irrigation, drinking water, energy and industry. Hundreds of millions of people throughout China and the Indian subcontinent – most of whom live far from the Himalayas – rely on water supplied from these glaciers.

As rising temperatures in the region melt the glaciers, glacial lakes are rapidly filling with water. Many are now close to bursting – causing glacier lake outburst floods. The IPCC has concluded with high confidence that climate change has caused 'enlargement and increased numbers of glacial lakes'.¹⁸⁶ Such events have devastating impacts on mountainous ecosystems and infrastructure. Out of around 2,323 glacial lakes in Nepal, 20 are potentially dangerous, and when outbursts occur, the impacts are catastrophic. In August 1985, a glacier lake outburst flood caused a 10 to 15 metre high surge of water and debris to flow down the Bhote Koshi and Dudh Koshi rivers for 90 kilometres, leaving a trail of destruction behind it, including a small hydropower project. More floods and changing rainfall patterns could also affect human health, for example with changes in patterns of malaria and Japanese encephalitis.

Food security

As for most other Asian countries, Nepal will experience declines in food security due to changes in rainfall patterns. This will affect livelihoods, as over 80 per cent of the population depends on agriculture. Increasingly erratic monsoon rains have been observed. The monsoon season now starts earlier and ends later, but July, the main paddy-planting month, is becoming drier. Without rain, the paddy cannot be planted, and late planting reduces yields. Farmers have been struggling to cope with repeated failures or low yields of paddy, the main foodgrain in Nepal.

Glacial retreat near Everest¹⁸⁷

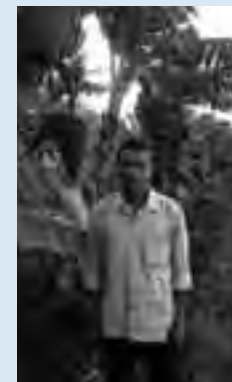
Sagarmatha National Park is an area of exceptional natural beauty, dominated by Everest, (Sagarmatha), the highest peak in the world at 8,848 metres. Several rare species, such as the snow leopard and the lesser panda, are found in the park. In 1979, the United Nations Educational, Scientific and Cultural Organization (UNESCO) designated the park as a 'World Heritage Site', but unprecedented rates of glacial retreat noted by high mountain communities are causing concern. Unless urgent action is taken, many Himalayan lakes in and around the park could burst, threatening the lives of thousands and destroying an irreplaceable environment.

A number of measures can be carried out to prevent outburst floods. These include strengthening lake banks and decreasing lake water volumes to safe levels. Hazard maps and installation of monitoring and warning systems can help, and 'trapping dams' with enough capacity to capture the debris and to dissipate impact of the outburst can be built below vulnerable lakes.

Pro Public, Friends of the Earth Nepal has petitioned UNESCO to place Sagarmatha National Park on the World Heritage Danger List due to climate change. Putting the park on the Danger List would oblige UNESCO to assess which glacier lakes are close to bursting and stabilise those most at risk. The petitioners also argue that Parties to the World Heritage Convention are legally obliged to transmit World Heritage Sites intact to future generations, and that this requires significant cuts in greenhouse gas emissions (mitigation) as well as action to address the adverse effects of climate change (adaptation). Unfortunately, states that sit on the World Heritage Committee (including the United States), have so far adopted the view that mitigation is only relevant under the UNFCCC and its Kyoto Protocol, thus trying to avoid these legal obligations.

Changing crops to cope with change¹⁸⁸

In 2005, Practical Action Nepal organised an educational tour to raise farmer awareness on crop diversification as a way of reducing the risks of climate change impacts. Pushkar Timsina, a 21-year-old farmer from in Tarai, attended the tour. He was impressed by banana growing in the area visited. He learned that bananas could fetch more money than the paddy from the same piece of land. In addition, bananas are more resilient to changing rain patterns than paddy. His family has a small piece of land – only 0.27 hectares – which provided little foodgrain that erratic monsoon rainfall threatened to reduce still further. Pushkar's father was not confident that the family would benefit more from bananas, and they would also have to wait at least a year before newly planted bananas could be harvested. But Pushkar planted 250 banana trees on the land and sought alternative income sources until the banana plants produced fruit.



Pushkar Timsina in his banana orchard. Photo: Dinanath Bhandari

Pushkar purchased fresh vegetables from other farmers and took them to the market in Narayanghat by bicycle. This was possible because Practical Action trained village farmers in vegetable farming under its climate change adaptation programme, thus increasing village vegetable production. Practical Action also helped villagers collect milk from different households for sale to the Kalpana Dairy in Narayanghat. Pushkar transported more than 50 litres of milk per day to the dairy, which paid him for this service. These alternative income sources helped him feed his family while their banana plants grew.

His banana plants are now providing fruit. Each year he hopes to harvest at least 250 bunches of bananas providing an annual income of at least Rs35,000. With the help of Practical Action he has also planted other fruit trees like mango, lemon and grapes to further diversify his crops. He has introduced pineapple as an under-storey crop, and he grows fodder on the edges of his field. He grows vegetables under the banana plants for sale at the nearby market. He has also introduced beehives to his banana orchard. Although Pushkar left school after Grade 2, he is supporting his sisters who are currently in Grades 3 and 5.

Pushkar has noticed the impacts that climate change has on farming and has diversified his crops and enterprises accordingly. He recognises that annual crops like rice are more sensitive to climate than perennial crops like bananas. He thinks cultivating crops that are resistant to climate variables is important. His work has also encouraged his neighbours to diversify their activities.

Pakistan

Temperatures in Pakistan have increased since the 1970s, but as for India, some of the largest climate change impacts will be because of the increased variability of the monsoon. An increase in extreme weather events has also been experienced over the past decade. In June 2007, for example, the hottest day for 78 years was recorded.

Changes to the summer monsoon patterns have resulted in early or delayed monsoon rains; and unlike the usual pattern the rains come in short heavy bursts resulting in flooding, which can affect densely populated areas and agricultural land. Floods in agricultural areas could lead to salination, chemical contamination or soil erosion, all of which could affect food security.

Climate change through the eyes of a Sherani tribal community elder¹⁸⁹

In the Sulaiman Ranges and Balochistan, a Sherani tribal community elder Mr Azam Khan explains his observations of climate change: 'Large numbers of Urial herds and flocks of Chukkar Partridges have not been swept away by the bullets of hunters. It is the climatic change which means that now we seldom find and see wild ungulate through binoculars, while about 40 years ago they could be found in our agriculture fields during night. In fact, in past we were helpless in protecting our agricultural fields from Chukkar Partridges.'

He added: 'Even the mosquitoes are reduced in the valley bottom and now they shifted to our uphill summer huts...the summer season flash floods are now more common than in the past. The Lahar streambed was just 12 feet wide during our grandfather's time is now about 300 feet at the same point. These floods have eroded our irrigation channels and agricultural field. The decline in arable area reduced our agricultural produces. Now we have to purchase most of our staple food from market. Those families who have no remittance from abroad are forced to cut Chilghoza Pine (*Pinus Gerardiana*) forests and sell as a timber to get money for their survival which is of course considered unwise activity according to our cultural values but what should they do! Our options for survival are shrinking day by day.'



Thal's rangelands: not so green but more adaptable to a dry climate and a sustainable source of fodder for livestock. Photo: Rural Development Policy Institute, Pakistan

Returning to historic livelihoods in Thal¹⁹⁰

Locals in the Thal region of Punjab are experiencing an expanded summer season and shorter winters. A few decades ago the region was mostly grazing land, with livestock being a major source of income for people. Human populations were low, and comprised of nomads moving around in search of livestock fodder. Big herds comprising hundreds of camels, goats and sheep roamed the massive rangelands. Agriculture was only practiced at a subsistence level and comprised largely of cultivating traditional wheat varieties on small pieces of land using water from wells.

In the early 1960s, with the advent of the Green Revolution, increased land entitlement led to more irrigated agriculture and a drive to bring more land under cultivation. Big tracts of rangeland were cleared to make room for agriculture. In areas where canal irrigation water was made available, non-local tribes moved in and locals were left with no option but to abandon their traditional nomadic culture.

Where canal water was not available, gram was grown as a cash crop providing Thali farmers with a new source of income. But the four-month gram crop depends on sufficient and timely rains, which are becoming increasingly uncertain with climate change. Locals now describe gram cultivation as a complete gamble. If rains come on time, no crop can match gram because it requires no fertilisers or pesticides. But when rains fail, everything is lost. Gram cultivation also requires the removal of natural



The four-month bonanza: sand dunes covered with gram plants. Photo: Rural Development Policy Institute, Pakistan

vegetation from the land, which used to be a source of fodder for livestock throughout the year and could resist the dry climate. During 1998–2002, Pakistan faced one of the worst droughts in its history. Many Thalís reverted to traditional livelihood patterns comprising of natural vegetation use, indigenous trees and livestock. Practical Action and its local partner, the Rural Development Policy Institute, are showing farmers how to adapt to climate change by helping them adopt the drought-resistant livelihood patterns that they abandoned decades ago.

Disasters

While recent disaster trends show more frequent and massive flash flooding in some areas, other parts of the country are subject to prolonged and frequent spells of drought. This increased frequency and magnitude of disasters in recent years has exacerbated the vulnerability of poor communities living in these disaster-prone areas.



The price of gram cultivation: severe dust storms. Photo: Rural Development Policy Institute, Pakistan



The price of gram cultivation: denuded sand dunes. Photo: Rural Development Policy Institute, Pakistan

Community based flood preparedness in Southern Punjab, Pakistan¹⁹¹

Oxfam GB in Pakistan has started its three-year project on sustainable livelihoods in the disaster prone areas of Pakistan (mostly focusing on flood- and drought-prone areas) using an integrated approach to disaster risk reduction and climate change.¹⁹² The main theme driving the project is the impact that climate-induced changes will have on livelihoods unless effective measures are taken through disaster risk reduction and adaptation strategies. As part of its project on community-based flood preparedness in southern Punjab, participatory approaches were used to help form community-based organisations. Oxfam GB along with its partner conducted a series of activities to reduce vulnerability to floods and enable people respond actively to flood threats. The activities included:

- Mobilising communities (men and women) and forming community-based organisations.
- Building community awareness, especially amongst school children.
- Networking with government and forming local community forums to raise awareness about disaster risk reduction.
- Small-scale disaster mitigation works, such as building emergency shelters and raising homesteads, and community-based early warning systems, such as forming and training early warning committees.
- Training in social forestry techniques and soil and water testing.

Glacial melt

The recent melting of glaciers in the Himalayas and Hindu Kush cause sudden increases in river volumes resulting in flash flooding in areas not historically prone to flooding. This impacts mountainous villages and also heavily populated downstream plains causing massive destruction to crops, shelter and lives.

During the Alpine Wetlands survey of May 2002, the elders of Broghal Valley, Chitral, Pakistan, said 'the alpine glaciers are retreating at the rate of about 20 metres per annum and the increased spells of summer torrential rainfall hinders our agricultural productivity because of lowering of the temperature, which otherwise entirely depends on June, July and August high temperatures. On

Benefits of community-based early warning systems – preparing for the floods

During the summer of 2006, the early warning committees in the villages of the Mizafargarh District¹⁹³ in south Punjab got timely information about the arrival of floods giving the communities an opportunity to take proactive action. Community members built a production bund (embankment) around their villages. The protection bund is 22 kilometres in length and stretches to five villages. Community members from all five villages built it collectively. The 2006 flood level was higher than the 2005 flood but the timely building of the bund resulted in smaller losses to agricultural land compared to the previous year. In 2005, in the absence of timely access to information through their early warning committees, people panicked and ran for safer places without protecting their crops and houses. This initiative is a classic example of the effectiveness of community-based early warning systems that allow communities to take collective action independently of 'outside assistance' to protect their lives and livelihood sources.

*the other hand winter precipitation is declining and reducing the alpine pastures productivity. As a result our pastoral production is also decreasing. The number of wild ungulate has sharply declined and the predator attacks on our herds are also increasing. Our young people are forced to migrate for to work for remittance which again reduces our potential to maintain our own economic system.'*¹⁹⁴

The region is also facing water scarcity. While melting glaciers increase river volumes, this occurs only temporarily, and is not enough to meet the needs of water-scarce areas. Many studies in Pakistan and the surrounding region also served by glacial meltwaters have found that the longer-term impact of melting glaciers will be severe water shortages.

The blight of glacial lake outbursts

Shimshal Village lies at 3,100 metres and most of the cultivatable area lies between 3,000 and 3,300 metres. The short growing season at this altitude allows cultivation of only one crop per year. Major crops are wheat, barley, potatoes, and peas. Shimshal is one of the few communities in Pakistan's northern areas that grows enough agricultural produce to feed itself. It is the sole steward of vast areas of high-altitude pasture, and extensive herding of sheep, goats, cattle, and yaks allows Shimshalis to earn much of their income from the sale of livestock and livestock products. But more rainfall in mountain regions could accelerate rates of soil erosion and landslides. Glacial lake outburst floods are a cause of particular concern.

'In my lifetime I witnessed the disaster of the bursting of the Shimshal [glacial] lake...about three times but one was really destructive as it washed away half of the village...It was summer season when the lake burst, people were busy with their agricultural activities; the high tides of the flood washed away our ripe crops and our fields, houses and gardens. At that time the army was deployed in Shimshal so they assisted the locals in dismantling their houses and shifting their belongings to the safe places. So it was the most destructive disaster I had ever experienced.'

Chughbai, a 65-year-old farmer from Shimshal Village¹⁹⁵

Sea-level rise

The impacts of sea-level rise are less severe than for some of Pakistan's neighbours, but the Karachi shoreline is already retreating. The Indus Delta south of Karachi is also retreating due to a reduction in the silt load: some 25 per cent of the area could be lost with a one metre rise in sea level. The intrusion of saltwater into freshwater supplies is putting mangrove ecosystems and fisheries at risk.

Increasing risk to major urban centres

Though no scientific research has been conducted in Pakistan, heavy rainfall in areas previously not prone to rainfall is increasingly common. And yet large cities like Karachi and Lahore lack the infrastructure, basic services and preparedness measures needed to withstand major floods. This has increasingly affected urban dwellers, with heavy rainfall damaging their livelihoods and causing injury and death. Government and other stakeholders must therefore conduct systematic research on which areas are prone to disasters and what the main climate-related vulnerabilities are.

The Pacific islands¹⁹⁶

The Pacific is a diverse region that contains some of the smallest countries in the world with many nations only a few metres above sea level at their highest point. There are nearly 30,000 islands in the Pacific Ocean, and they are of two types: atolls: low-lying limestone deposits from coral reefs situated on a volcanic base, and mountainous volcanic islands surrounded by a reef fringe. Around 1,000 of these islands are populated¹⁹⁷ with a total regional population of almost seven million. The region is divided culturally and geographically into three distinct cultural groups:

1. Melanesia, comprising Papua New Guinea, the Solomons, Vanuatu, New Caledonia and Fiji.
2. Polynesia, which includes Samoa, the Cook Islands, French Polynesia, Tonga, Tuvalu, Niue and Tokelau.
3. Micronesia which includes the Federated States of Micronesia, the Marshall Islands, Nauru and Kiribati.

Pacific islanders are particularly vulnerable to climate change due to predicted sea-level rise and increased intensity and frequency of cyclones. The natural variation in the elevation of Pacific islands caused by tectonic shifts and seasonal El Niño cycles, along with populations concentrated in coastal areas, or in the coastal plains and valleys of the larger islands, exacerbates these risks.

Climate change poses significant public health risks such as an increase in vector- and water-borne diseases caused by warmer temperatures. Food systems and living conditions could be seriously affected and any recent development gains could be reduced or reversed. These threats challenge both individual countries, and regional stability and security.

Ecosystems and coastal zones

Pacific societies are highly dependent on their natural environment and are also at the front-line of climate change. Communities, agricultural land, tourist resorts and associated infrastructure are concentrated in coastal zones and are particularly vulnerable. Climate change will cause a significant rise in sea levels by 2050, and many nations face the prospect of total inundation. Tuvalu and islands in Vanuatu, Kiribati, the Marshall Islands, the Federated States of Micronesia and Papua New Guinea are already impacted by rising sea levels.¹⁹⁸

With 17,000 kilometres of coastline and 600 islands, many of which are low lying, sea-level rise is a key issue for Papua New Guinea. Some low-lying islands will eventually

Why are small island states so vulnerable?¹⁹⁹

According to the IPCC, small island states are especially vulnerable to climate change, sea-level rise and extreme events because:

- “Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, which is expected to affect local resources, e.g., fisheries, and reduce the value of these destinations for tourism.
- Sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihoods of island communities.
- Climate change is projected by the mid-century to reduce water resources in many small islands in the Pacific, to the point where they become insufficient to meet demand during low rainfall periods.”

become completely submerged as is already happening on the islands of Mortlock, Tasman and the Duke of York Islands. A one metre rise could affect up to 50 per cent of the coastline.²⁰⁰ Natural barriers to storm surges and coastal erosion, such as, mangroves and swampy forest ecosystems, will become less effective.

Sea-level rise is also threatening important mangrove forests in many Pacific island states.²⁰¹ Many commercially important fish species breed and raise their young among mangrove roots. Mangroves are also sources of timber and medicines for local communities, and they protect shorelines from storms and tidal surges. The UNEP estimates that some of the region's islands could lose half of their mangroves by 2100.²⁰²

Water is an extremely limited resource in most Pacific island states and many rely on a single water source. Any changes to the recharging of this source or contamination by saltwater can, therefore, have catastrophic consequences. Changing rainfall patterns could lead to droughts. Atoll countries in particular depend on fresh-water lenses for water (for drinking and irrigation). Rising sea levels and leakage from storm surges could contaminate these fresh-water supplies.

Pacific churches and climate change²⁰³

'Here on the small island atoll of Kiribati, the impacts of human-induced climate change are already visible. The sea level is rising. People's homes are vulnerable to the increasingly high tides and storm surges. Shores are eroding and the coral reefs are becoming bleached. The water supplies and soil fertility are being threatened by the intrusion of saltwater. Weather patterns are less predictable, posing risks to fisher-folk and farmers.'

These words introduced the Otin Taai declaration, produced by the Pacific Churches' Consultation on Climate change, which met on Kiribati in 2004. The consultation involved 50 representatives of the Pacific Conference of Churches from Kiribati, Nauru, French Polynesia, Niue, Marshall Islands, Solomon Islands, Fiji, Tuvalu, Vanuatu, Tonga, Samoa, American Samoa, New Caledonia, Papua New Guinea, and the Cook Islands. The signatories promised to engage Christian churches internationally in education and action on the issue. Specialised church-related ministries for emergency response, development and advocacy were called on to integrate climate change and adaptation projects into their work. Churches were also asked to encourage companies that produce or consume large amounts of fossil fuels to move towards cleaner, renewable energy sources.

In 2005, Caritas Oceania presented guidelines on Environmental Justice to Caritas Internationalis, the international confederation of 162 Catholic relief, development and social service organisations. Its key proposal was that climate change should become the major focus of environmental justice activity within the confederation for the following five years. The Pacific members of the confederation also pushed for the 2007 General Assembly to focus on climate change as a major discussion topic.

The bleaching of reefs, caused by increases in sea-surface temperatures, is another concern. Reefs are important for many atoll states as they protect communities from extreme weather events and coastal erosion. They also protect fish stocks enabling them to feed and reproduce. Tuvalu's inner reef areas and lagoon provide much of its food. While reefs may have been able to keep pace with changing sea levels, the additional stress of coral bleaching may prevent their survival.²⁰⁴

Planning for climate change in the city of Apia, Samoa²⁰⁵

The UNFCCC acknowledges the 49 LDCs as amongst the most vulnerable to climate change. They therefore receive support to identify their 'urgent and immediate adaptation needs' in National Adaptation Plans of Action (NAPAs).²⁰⁶ The steps for the preparation of NAPAs include identifying key adaptation measures and selecting prioritised project activities.

NAPA assessments submitted to date cover priority sectors such as health, agriculture, water resources, and forests. They place more emphasis on the rural poor²⁰⁷ despite the fact that urban centres in low- and middle-income nations already have three-quarters of the world's urban population, and also a large and growing proportion of the world's population most at risk from storms, floods and other climate change-related impacts.²⁰⁸ Some NAPA projects, however, have an urban focus.

Samoa has identified the 'Zoning and Strategic Management Planning Project' in Apia, its capital, as a key adaptation need. Apia is the centre of all utility services and operations and houses 22 per cent of the population. Its coastal location makes it vulnerable to the storm tides and strong winds that characterise tropical cyclones. Urban growth in Apia and its adjoining areas is predicted to continue to rise, but environmental problems are already apparent. Such problems include waste disposal, overcrowding, flooding caused by building on flood-prone and poorly drained lands, dead animals, mangrove destruction, septic-tank effluent flowing into groundwater and coastal ecosystems, and reduced water quality. Centralising services in Apia and increasing coastal population levels will place more infrastructure and people in areas vulnerable to sea-level rise and extreme weather events. The NAPA project aims to integrate climate change policies and methods into all management plans at national, regional, district and site-specific levels, and mainstream climate change issues into urban planning processes.

Raising youth awareness in Fiji²⁰⁹

The University of the South Pacific's Institute of Applied Science and the Pacific Centre for Sustainable Development are organising workshops for Fiji's youth, training them on the use of songs and traditional dances to raise awareness about climate change, biodiversity, sustainable development, and the need to understand how these issues are connected. Drama consultant, Sukulu Rupeni, said this year youth capacity-building workshops had been conducted in three village communities – Naboutini in Cakaudrove, Muaivuso in Rewa, and Univanua in Tailevu. The workshops involved about 65 young people from 15 villages who were given role-play exercises after each topic had been taught. The exercises reinforced the messages.

Youths learnt how climate change affects coastal areas, the agriculture, water and health sectors, and marine and terrestrial biodiversity in small island countries. They learnt how climate change will devastate coral reefs and how changing rain patterns threaten land-based biodiversity. Participants also gained understanding on the impacts of climate change on food sources, traditions, culture and livelihoods. Tourism is a major source of income for Fiji, with Fiji's marine biodiversity attracting many visitors. The workshops also raised awareness about the significance of village marine-protected areas as food sources.

The two-year project will include Vanuatu, the Solomons and Tuvalu where lessons learnt in Fiji will be replicated. The next step is for community drama troupes to work with their provincial council offices to coordinate village community theatre performances. Community theatre groups will also help other NGOs and government departments working to raise awareness on similar issues in other provinces.

Extreme events on the increase

Climate change is projected to shift rainfall patterns causing prolonged droughts in some areas, placing additional pressure on already limited water resources, and excessive rainfall in others, resulting in flooding.²¹⁰ The World Bank predicts that Kiribati could experience flooding of its landmass of up to 80 per cent in some areas due to rising sea waters. Fiji could also experience a 100 per cent increase in cyclone damage, an increase in dengue fever cases of between 20 and 30 per cent, and a decline in crop yields of up to 15 per cent.²¹¹

El Niño weather patterns have become more frequent since 1977 and each El Niño event has led to drought and water shortages in nations such as Papua New Guinea, the Marshall Islands, Federated States of Micronesia, American Samoa, Samoa, Tonga,

Kiribati, and Fiji. More frequent El Niño events also bring an increased risk of tropical cyclones, particularly for Tuvalu, Samoa, Tonga, Cook Islands, and French Polynesia. El Niño events have already caused large decreases in rainfall in the western Pacific. For example, in 1998, 40 atolls of Micronesia ran out of water during an El Niño event, resulting in the declaration of a national emergency.²¹² Outbreaks of cholera have been associated with inadequate water supplies during El Niño events in various Pacific island states.²¹³

Deaths from weather-related disasters have already increased in the region by 21 per cent since the mid-1970s. Cyclone wind speeds could increase by 10 to 20 per cent over the next few years, and tropical storms are likely to increase in strength and frequency.²¹⁴

'We live in constant fear of the adverse impacts of climate change. For a coral atoll nation, sea-level rise and more severe weather events loom as a growing threat to our entire population. The threat is real and serious, and is of no difference to a slow and insidious form of terrorism against us.'

Saufatu Sopoanga, Prime Minister of Tuvalu, September 2003

Migration – the most extreme form of adaptation

In time, one or more Pacific island countries will probably have to be completely evacuated because of flooding or saltwater contamination. The Carteret Islands (Papua New Guinea) and Tuvalu are likely to be the first nations to be evacuated due to climate change, but Kiribati, the Marshall Islands and many other parts of the Pacific may also have to face this catastrophe. Internal relocation due to shoreline erosion and rising sea levels has already occurred in Vanuatu, Kiribati and Tuvalu.

Migration is the most extreme form of adaptation to climate change and the last option that should be considered. Like many peoples across the world facing the devastating impacts of climate change, Tuvaluan's stress that becoming 'climate refugees' is not their primary goal.²¹⁵

'Taking us as environmental refugees, is not what Tuvalu is after in the long run. We want the islands of Tuvalu and our nation to remain permanently and not be submerged as a result of greed and uncontrolled consumption of industrialised countries. We want our children to grow up the way we grew up in our own islands and in our own culture.'

Tuvaluan Governor-General Sir Tomasi Puapua's, September 2002

Energy generation and access

Neighbouring countries, such as Australia, produce most of their excessive per capita greenhouse gas emissions by generating electricity from coal. Australia's per capita greenhouse gas footprint is currently 27 tonnes each year. Pacific islanders have comparably insignificant greenhouse gas footprints: The Marshall Islands has an

Forced migration from Tuvalu

Tuvalu is one of the most vulnerable places to the impacts of global warming on earth. Most of Tuvalu is just two metres above sea level, with its highest point a mere 4.6 metres above sea level. Sea-level rise could spell complete disaster to the 11,000 Tuvaluans currently residing on nine low-lying coral atolls. Its entire population could have to relocate to other countries over the next few decades. Currently, the population of Tuvalu lives by fishing, receiving financial support from Tuvaluan workers overseas and accessing an international trust fund set up in 1987. The rising sea levels are taking their toll on infrastructure and the remaining population. Assistant Secretary for Foreign Affairs in Tuvalu, Paani Laupepa made it clear that they 'feel threatened, [their] whole culture would have to be transplanted'. Tuvalu has twice approached the Australian Government for assistance with accepting climate change refugees. So far, the Australian Government has refused.²¹⁶

Climate refugees – the case of Tegua, Vanuatu

A small community living in the Pacific island chain of Vanuatu has become one of the first to be formally moved as a result of climate change. The community has been relocated higher into the interior of Tegua Island after coastal homes were repeatedly swamped by storm surges and waves. The relocation occurred under a project called 'Capacity Building for the Development of Adaptation in Pacific Island Countries', a project of the Secretariat of the Pacific Regional Environment Programme (SPREP).

In recent years, more and more flooding has triggered an escalating variety of problems including malaria and skin diseases among children. A one-metre-high coral reef – previously a line of defence against high tides and waves – is increasingly being swamped. According to Taito Nakalevu, climate change adaptation officer with SPREP, 'people are being forced to build sea walls and other defences, not just to defend their homes but to defend agricultural land'. Under the project, water tanks able to collect rainwater have been supplied and installed in the interior enabling the community to move.

annual footprint of 0.05 tonnes per capita; Nauru 1.46 tons; Samoa 2.53 tons; and, Solomon Islands 0.81 tonnes per person.²¹⁷ Electricity generation from renewable sources and adoption of energy efficiency and conservation measures is indisputably the primary obligation of industrialised countries.

The Carterets, Papua New Guinea

Citizens of the Carteret Islands are also being moved because of sea-level rise. The Carterets are six small islands that surround an atoll about 25 kilometres wide. The islands are approximately one metre above high tide and made of sand. The communities occupying them are losing access to fresh water, with consequent health effects, and the advancing saltwater is destroying crops.

According to Bernard Tunim, Chief of Piul Island and community spokesperson 'we are frustrated, and we are angry at the same time. We are victims of something that we are not responsible for. We believe that these islands are ours, and that our future generations should not go away from these islands. I think it's about time these industrialised countries realised that these island countries in the Pacific are taking the toll. We are bearing the brunt of all these gas emissions.'

It is a sad irony that the people of the Carterets, with a carbon footprint amongst the lowest in the world, are amongst the first to have to abandon their islands because of rising seas attributable to emissions from nations elsewhere.

Some 80 per cent of Pacific islanders have no access to electricity. This inhibits opportunities to diversify economic activity, self-sufficiently produce goods (which are otherwise imported great distances) and provide health and education services. Most electricity is produced by diesel generators. Some Pacific countries, such as Niue, have historically spent most of their gross domestic income on diesel imports. But reduced diesel production and increasing prices could mean Pacific islanders will soon be unable to source diesel, thus further exacerbating their vulnerability to climate change. There is a growing interest in renewable energy generation in the Pacific, but this trend must build on past experiences of renewable energy projects that were designed without consulting local communities and without considering the unique cultural and physical context of the Pacific.

The way forward

Industrialised nations must take the first steps to reduce greenhouse gas emissions but also to help vulnerable nations deal with current and expected climate change impacts. Much of the historical responsibility for climate change lies with these industrialised nations and their use of fossil fuels over the last 150 years. Australia and New Zealand, as wealthy industrialised Pacific nations, have a moral and ethical obligation to help their Pacific neighbours. Australia and New Zealand also have international obligations under the UNFCCC to help Pacific island countries and other developing nations 'that are particularly vulnerable to the adverse effects of climate change in meeting the costs of adaptation to those adverse effects' and to 'formulate

100 per cent renewable energy for Niue

In 2004, Niue, the smallest nation on earth, had 70 per cent of its infrastructure destroyed by cyclone Heta. Once the immediate needs of the population were met, Greenpeace began helping the Government to make Niue the first nation on earth to meet all its energy requirements from renewable sources.

Niue is the largest uplifted coral island in the world. It is an independent country in free association with New Zealand and has a population of 1,700. Niue has one of the highest wind-energy intensities in the South Pacific and ample solar resources, more than sufficient to meet all its energy needs. Electricity prices in Niue are currently six times higher than the typical Australian consumer price, which means renewables should be commercially viable.

Currently most Pacific island countries depend on increasingly expensive imported diesel, oil and bottled gas to produce power for electricity, transport and cooking. This trend will only continue unless steps are taken to reverse this development path. The 100 per cent Niue Greenpeace Renewable Energy Project will reduce Niue's dependence on imported fossil fuels, while also creating jobs because people will be trained to maintain and operate the cleaner technologies. The project will also draw new investment into the economy, and help promote local businesses.

and implement national and, where appropriate, regional mitigation and adaptation programs'.²¹⁸ Australia should also help each Pacific country develop a national adaptation strategy. This would include a regional plan for emergency responses for climate-related disasters.

The options for the Pacific islands, other than continuing to berate the industrial nations on their lack of concerted action, include migration, developing renewable energy sources, foreshore stabilisation, resettlement and decentralisation to adapt to the impacts of climate and sea level changes. Pacific nations need help with planning and taking these options forward. Other efforts include protecting fresh water sources from saltwater contamination, adapting to land losses and dealing with coastal infrastructure affected by erosion. Working with local communities is essential to ensure that they understand climate change and are helped to adapt.

Although the overall carbon footprint of the Pacific is small, renewable energy could reduce greenhouse gas emissions and help address many of the other issues related to energy use and demand in the Pacific. Most Pacific island countries do not have their own petroleum resources and the limited size and remoteness of island markets

Climate adaptation in the South Pacific follows community leads²¹⁹

In response to observed climate change impacts, WWF-South Pacific has developed adaptation projects by taking cues from the communities living in the region. The programme started on Fiji's Kabara Island with a series of workshops attended by many islanders. At the workshops community members were asked what climate-related impacts they were experiencing, what the root problem was, and what the solutions might be. WWF scientists correlated these community observations with known regional climate changes. The workshop report laid out how the adaptation strategies put forward by the community could be implemented, and a second visit to Kabara sought community endorsement. The endorsed action plan was published in the local vernacular and the WWF team continued to work with local authorities on implementation.

One community adaptation strategy involved improving village use of water tanks and maintenance of wells. External grants allowed the villagers to buy guttering and pipes, build more tanks in the village and obtain materials to fix older tanks. Many of the adaptation strategies proposed by the community were also good conservation practices. For example, to increase the resilience of the Kabara marine environment against climate change impacts, the community decided to ban non-sustainable fishing practices and pollution from ships dumping in the lagoon. The project also helped with forest conservation, providing incentives for protecting natural resources, and establishing a small forest reserve.

Critically, the project fostered the support and collaboration of several national government agencies by sharing materials and inviting participation throughout. Previously, the local government had no involvement in climate change issues; now it is a key implementation partner. Following this programme, WWF-South Pacific has been invited to help develop Fiji's national climate change strategy and to work with the governments of Tuvalu and the Cook Islands.

cannot guarantee the security of fuel supplies. High and fluctuating fuel prices, which are beyond the control of regional States, add to this problem, and to the vulnerability of Pacific islanders.

The development of renewable energy resources is still limited by the availability of appropriate technologies, poor institutional mechanisms, and the challenges of developing systems for small remote markets at reasonable prices. Yet technologies such as solar, wind and mini hydro are clean, affordable and better suited to the local environment than imported fossil fuels. Solar energy, in particular, has immense



Workshop in Kabara, Fiji: villagers undertaking an exercise to map the most vulnerable areas in their village. Photo: WWF SPP 2004

potential. Renewable energy can also create new jobs and investment, and if supported by the international community in the short-term, local renewable energy resources can be cheaper, more secure, more reliable and healthier than fossil fuels in the long-term. In addition, lower fuel bills would allow regional governments and

rural communities to spend money elsewhere. Using renewable energy would improve water, sanitation and living conditions, provide better health services, elevate the status of women and create an environment that encourages learning.

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Contributing organisations

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Act Central Asia	Masipag Farmers, Philippines
ActionAid – India	Oxfam – Australia
Bangladesh Centre for Advanced Studies	Oxfam – Great Britain
Caritas – Bangladesh	Oxfam – Hong Kong
Caritas – India	Oxfam – Novib (Netherlands)
Catholic Earthcare Australia	Philippine Indigenous People's Link – Philippines/UK
Citizens' Nuclear Information Centre, Japan	PhilNet, Philippines
Columban Centre for Peace, Ecology and Justice, Australia	Preda Foundation – Philippines
Development Alternatives – India	PRODIPAN, Bangladesh
Development Partnership in Action, Cambodia	Pro Public/Friends of the Earth Nepal
Dhaka Ahsania Mission (DAM), Bangladesh	RDI Leyte, Philippines
Diversity Photos	Sahabat Alam Malaysia/Friends of the Earth Malaysia
Down to Earth Indonesia	Social Action Centre Infanta, Philippines
ECOWEB Philippines	Social Action Centre Pagadian
Edmund Rice Centre, Australia	TERI – India
Friends of the Earth Australia	The Allachy Trust
Greenpeace – Australia Pacific	The Ashden Awards for Sustainable Energy
Greenpeace – China	The Climate Change and Development Roundtable, Australia
Greenpeace – India	World Council of Churches climate change programme
Greenpeace – Southeast Asia	WWF – India
Indiadisasters.org	WWF – Japan
Josefina Parish Integrated Programme (JPIP), Philippines	Youth EcoCentre, Tajikistan
Korea Green Foundation – Korea	
Li Bird – Nepal	



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



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