insights
DEVELOPMENT RESEARCH

Securing development in the face of climate change

Climate change poses a potentially major challenge to social and economic development in all countries. It is widely accepted that at least part of the earth's 0.6°C warming during the last 100 years is due to emissions of greenhouse gases, such as carbon dioxide, caused by human activities. During this century, the world is expected to continue warming, by between 1.4 and 5.8°C. Other predicted impacts are a rise in global sea levels of between 0.09 and 0.88 metres by 2100, and changes in weather patterns, including an increased frequency and severity of extreme events such as hurricanes, floods and droughts. How can developing countries and development policies ensure progress in a changing climate?

Climate change means 'global warming' or the 'greenhouse effect'. This is caused by the emission of greenhouse gases (GHGs) into the atmosphere through human activities, particularly the burning of fossil fuels. In this issue of *insights* we consider the challenge of climate change from a development perspective in terms of adaptation: how can developing countries anticipate and respond to the threats and opportunities brought by climate change?

During the last few years, scientific consensus and many people's own perceptions have moved to an acceptance that climate change is 'real' and that we are now experiencing its early stages. In 2001, the Intergovernmental Panel on Climate Change (IPCC), which represents the international scientific consensus of governments and independent scientists, stated that 'most of the observed warming over the last 50 years is attributable to human activities'. Perceptions are also changing across the world. Examples of this are found in a recent book by Mark Lynas which draws on peoples' experiences of changing climate, including Alaskan Eskimos, South Sea islanders, and Chinese sheep-herders.

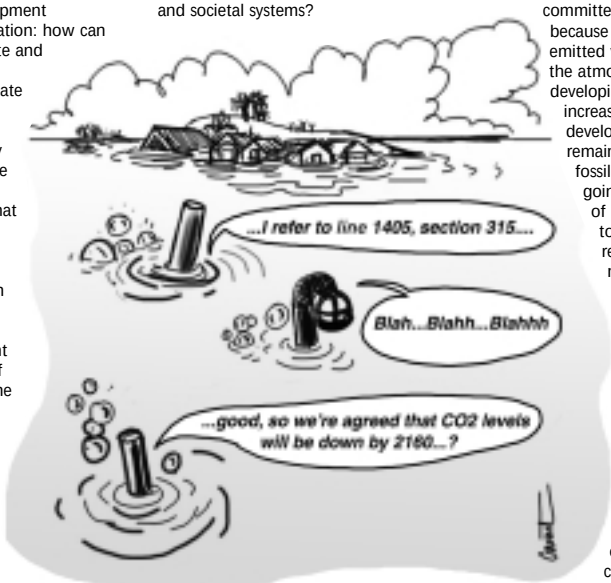
Scientific and policy debates about climate change focus on the following questions:

- How fast and to what extent will climate change occur?
- What will the implications be for natural and societal systems?
- How much can we do to prevent it (and at what cost)?
- How can we adapt to the changes it brings?
- What are the limits to adaptation?

From a development perspective, we are interested in these questions, but others are also important. These include:

- How will climate change interact with other factors driving change in society, such as population growth?
- How will climate change interact with social and economic vulnerability?
- How can efforts to reduce vulnerability be coordinated with activities to adapt to climate change?

Major challenges also surround the equity issues of climate change, particularly between developed and developing countries, in terms of historically unequal emissions of GHGs, constraints on future emissions and unequal exposure and capacity to adapt to the effects of climate change. These are questions to which the developing world and the development community can bring considerable insights.



Welcome to the Maldives Climate Conference

Mitigation and adaptation

Mitigation of climate change tackles the problem by reducing GHG emissions at source or 'locking them up' into ocean and terrestrial stores, through measures such as afforestation programmes. Adaptation refers to the ability of human and ecological systems to manage or cope with a changing climate. We are now committed to some climate change because industrial nations have already emitted vast amounts of GHGs into the atmosphere, and emissions by developing countries are also increasing. Furthermore, economic development in many countries remains fundamentally based on fossil fuels. This means societies are going to experience some degree of climate change and will have to implement a combination of reactive and anticipatory measures to adapt.

There is still much uncertainty about how the climate is likely to change, at both regional and national levels. In this issue of *insights*, **Stainforth** explains how climate models are used to predict future climate and where the key uncertainties lie. These include our understanding of the climate system and its response to GHGs, the ability of models to represent the climate system and at what rate GHG emissions will increase. Policy makers and ▶

planners often require information about climate change at scales which have high levels of uncertainty. Responses to extreme weather and anticipatory planning for climate change therefore need be flexible and resilient to a much wider range of climate conditions than are currently experienced. They must also do this on the basis of limited knowledge.

For various reasons, more attention in climate change research and policy has been given to mitigation than adaptation. **Tompkins** and **Adger** explain the differences between mitigation and adaptation, noting that they share the same underlying factors and are not substitutes for each other, but are essentially complementary. The authors highlight that adaptation is place and context-specific, i.e. it may be difficult to generalise about how it occurs and how strategies can be used. Adaptation may be in response to or in anticipation of events, and implemented through the actions of individuals, governments or other groups.

International policies on climate change

There are growing international efforts to fund and facilitate adaptation in developing countries, as explained by **Huq**. These are primarily through the United Nations Framework Convention on Climate Change (UNFCCC) and the Global Environment Facility (GEF). However, important questions still need to be resolved about the funding of the incremental costs of adaptation to climate change, how much responsibility developed countries will bear and whether and how assistance will be allocated among and between vulnerable groups.

It is unclear how or whether there will be coordination between funding and activities through international polices on climate change and normal development assistance. This question is considered by **Agrawala** in a discussion of mainstreaming climate change responses within development organisations. Some aid organisations have begun the process of considering how climate change may affect their activities and how they in turn could address the issue. However, much remains to be done. For example, results from an Organisation for Economic Co-operation and Development (OECD) review of donor programmes in six developing countries show that a significant amount of funding goes to sectors potentially exposed to climatic hazards but there are few examples where climate change is given clear consideration.

Vulnerable people, vulnerable places

Uncertainty about the details of climate change, such as whether rainfall will increase or decrease and the timescales over which climate change will occur, are likely to influence decision-making about funding priorities and target activities. There is, however, close agreement between development agendas and the effects of climate change in areas with high climate variability and extremes of weather. It is in these situations that climate change will most directly affect vulnerable people, such as those living in small island states or low-lying coastal areas, subsistence farmers, flood-prone communities and urban dwellers exposed to extreme temperatures and potential increases in disease transmission.

Development work can provide valuable insights into the context-specific and socially mediated links between vulnerability and extremes of weather. Cause and effect between hazard and disaster occurs through human agency and it is here that development research has much to offer our understanding of climate-society interactions. **Devereux** and **Edwards** consider these issues in relation to drought and food security. Whilst climate change globally may lead to increases in staple crop yields, there will be considerable local variations. Many tropical regions and developing countries are expected to experience lower yields, due to reduced water availability, smaller fertilisation effects from carbon dioxide and interactions with non-climate factors, such as reduced capacity to adapt to climate change. The context-specific exposure to climate-related risk and activities currently in place to address adaptation are outlined in two short country examples, South Africa and Pacific Islands, by **Vogel** and **Lefale** and **McFadzien**. Together, the articles in this issue highlight some of the key cross-cutting themes in international development and climate change ■

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See also

'Summary for policymakers', A report of working group 1 of the Intergovernmental Panel on Climate Change, IPCC, 2001
www.ipcc.ch/pub/spm22-01.pdf

'High Tide: News from a Warming World', Flamingo Press, M. Lynas, 2004

Synergies and trade-offs in climate change responses

Beyond the climate change community and the United Nations Framework Convention on Climate Change (UNFCCC), how much awareness of climate change is there amongst development organisations? What steps have they taken in response to climate change? The development community and sectoral planners in several governments are increasingly asking how the future impacts of climate change can be included within development activities.

Recent reports commissioned by the World Bank and German and Norwegian aid organisations have looked at links between development assistance measures and climate change adaptation. Furthermore, ten international development agencies recently highlighted the importance of adaptation to climate change in achieving poverty alleviation.

In 2002, the Organisation for Economic Co-operation and Development (OECD) began the Development and Climate Change Project. The main objective was to explore possible synergies and trade-offs in 'mainstreaming' responses to climate change. Mainstreaming in this context means integrating responses to climate change within normal development activities and plans. Case studies were conducted in Bangladesh, Egypt, Fiji, Nepal, Tanzania, and Uruguay. Each case study followed a framework designed to identify the links between adaptation to climate change and development activities. These included:

- a country-level overview of principal climate change impacts and vulnerabilities
- analyses of national plans and development assistance measures that affect vulnerable sectors and regions
- analyses at a regional/sectoral level of how climate change adaptation responses can be mainstreamed in particular development policies and projects.

Several findings emerged from this work. An analysis of official development assistance and loans to the six countries indicates that a significant amount of funding goes to sectors potentially affected by climatic risks. Between 1998 and 2000, the estimates range from several hundred million US dollars for Nepal and Tanzania to between one and two billion dollars for Egypt and Bangladesh. It is evident, therefore, that consideration of climatic risks (including climate change) should be central to development investments and projects.

Consideration of climatic risks should be central to development investments and projects

Analysis of various national development plans and strategy papers for the six countries indicates that these documents generally give little consideration to the impacts of climate change. Furthermore, they often pay limited attention to current weather and climatic risks. In all cases, climate experts, sectoral planners and other stakeholders need to discuss different approaches to including adaptation to climate change in future development plans.

The discussion on mainstreaming responses to climate change is slowly changing. More emphasis is being given to whether and how adaptation to climate change should be included in development efforts. The significance of climate change, relative to other factors that affect development, will need to be evaluated on a case-by-case basis. In some cases, climate change impacts might only warrant attention over the medium to long term, and not be immediate priorities for development. However, there is likely to be a growing number of countries where climate change is of immediate concern ■

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Glossary

GEF
Global Environment Facility. This was established in 1991 to provide grants to help developing countries fund projects and programs that protect the global environment.

GHGs
Greenhouse Gases. These are one of the main causes of climate change. The six harmful GHGs listed by the Kyoto Protocol are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), HFC gases, PFC gases and SF6 gases.

IPCC
The Intergovernmental Panel on Climate Change. This was established to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation.

Kyoto Protocol
In early December 1997, more than 160 nations met in Kyoto, Japan, to negotiate binding limitations on greenhouse gases for the developed nations. The outcome was the Kyoto Protocol, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990.

NAPAs
National Adaptation Programmes of Action. These are documents specifying a list of priority activities that will communicate the urgent needs of Less Developed Countries, considering their high vulnerability and low adaptive capacity to climate change.

UNFCCC
United Nations Framework Convention on Climate Change. Many countries joined this international treaty over a decade ago to consider what can be done to reduce global warming and to cope with inevitable temperature increases.

International policy in supporting adaptation

The world is committed to a certain amount of human-induced climate change over the next few decades. Some negative impacts of climate change are inevitable. These impacts are likely to affect developing countries most severely. Developed countries and wealthier people in less developed countries may be able to cope with, or adapt to, these impacts. However, poor people across the world may require assistance to adapt to climate change and to offset its potentially unequal effects.

The United Nations Framework Convention on Climate Change (UNFCCC) came into effect in 1994 with the objective of reducing the rate of human-induced climate change through mitigation and adaptation. The 'rich' countries, listed by the UNFCCC, have all accepted their obligation to assist poor countries to adapt to climate change, particularly small island states and least developed countries (LDCs). The Seventh Conference of Parties of the UNFCCC, held in Marrakech, Morocco, in 2001, created several new funds specifically for this purpose. The LDCs also developed guidelines for carrying out National Adaptation Plans of Action (NAPAs) to identify and prioritise adaptation actions in each country. These new funds include:

- the Least Developed Countries Fund to support LDCs in carrying out their respective NAPAs
- the Special Climate Change Fund to assist all developing countries in adaptation and mitigation
- the Adaptation Fund under the Kyoto Protocol to assist all developing countries in carrying out adaptation measures.

So far, only the Least Developed Countries Fund is operational. In addition to these 'Marrakech Funds', the Global Environment Facility (GEF) also provides funding for climate change activities, as part of the UNFCCC. While most funding for climate change over the last decade has been for mitigation, the GEF has recently set up a special fund for adaptation in developing countries, worth US$ 50 million over three years. However, one barrier to using these funds is the GEF rules, which state that they can only be used for the 'incremental costs of global benefits'. While it is relatively easy to calculate the costs of global benefits arising from mitigation projects, it is more difficult to do so for adaptation projects (as benefits are usually local rather than global).

UNFCCC funds are likely to form a relatively small part of the financial assistance that developing countries will need to adapt to climate change. It is therefore useful to distinguish between adaptation actions and international funding support. Adaptation will have to be done by the vulnerable communities, sectors and countries themselves, with whatever resources they can provide. International funding support for adaptation in developing countries is the responsibility of the UNFCCC and its associated funds.

Most adaptation in developing countries will need to be done as part of normal development activities. These will probably come out of existing development assistance funding, including official development assistance. Other funding may be available through bilateral and multilateral funding agencies and through non-governmental organisations, both national and international, as illustrated in the diagram (left).

A key challenge will be to find ways in which overseas development assistance and UNFCCC funds can be complementary, rather than repeating each other's activities. This process has only just begun and needs to be accelerated if developing countries (and their poorest communities) are to be assisted effectively in adapting to climate change in the near future ■

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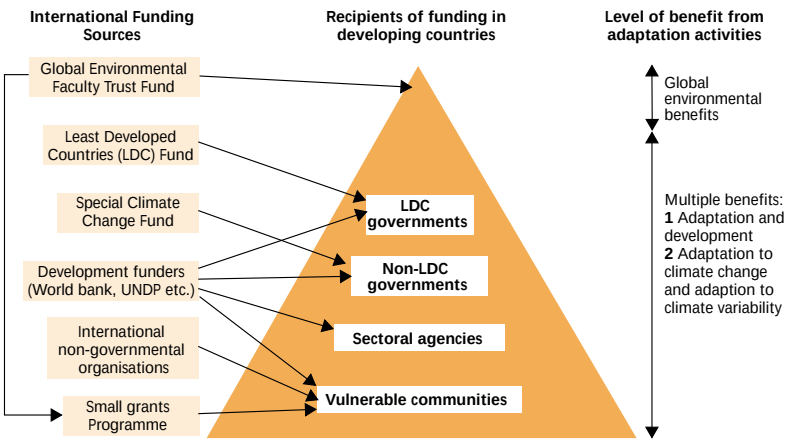
Adaptation: who benefits from international funding sources



Responding to drought and food insecurity

Science cannot predict with certainty how future climate change will affect food security. Around 800 million people are currently undernourished, and this number will probably grow as our climate changes. How will the most vulnerable households and countries cope, when they are likely to be the most seriously affected and have the least resources to adapt?

Climate change is not necessarily all bad. The consensus of scientific opinion suggests that agricultural land may be gained in higher latitudes that are presently too cold for cultivation, if relatively small temperature increases are experienced. Overall, world food production may even increase because of global warming. However, this growth is likely to benefit large surplus producers in North America and northern Europe the most.

These potential benefits will also mask the severe problems poorer regions are likely to experience. Africa may be worst affected with losses of arable land and declines in rainfall reducing the length of growing seasons. This will intensify food insecurity in a region where crop production per capita is already declining and population growth will double the demand for food within the next 30 years. It may also create further dependency on overseas food supplies.

Climate change is not only about global warming but also changes in the frequency and magnitude of extreme weather events. Changes may occur in the frequency and severity of El Niño Southern Oscillation events, such as prolonged droughts and heavier monsoons; these have been fairly closely correlated with weather-related famines in the Horn of Africa (Djibouti, Eritrea, Ethiopia, Somalia including Somaliland, Sudan) for at least the past 200 years. There is also uncertainty about interactions between gradual and abrupt changes. A combination of slow climatic changes and increasing frequency of sudden shocks could trigger much larger and more frequent harvest collapses than countries can cope with.

Climate change and increasing frequency of sudden shocks could trigger much larger and more frequent harvest collapses

Projections from increasingly sophisticated climate models for the global number of undernourished people by 2060 vary widely, ranging from 641 million to as many as 2.1 billion. The uncertainty associated with predicting the impacts of climate change on food security are increased by:

- future technological, adaptive or political responses to global warming
- contrasting models for economic growth rates
- trends in urbanisation
- developments in global governance.

What can be done? Advances in technology – including, controversially, biotechnology – could transform agriculture. Alternatively, rural-urban migration or livelihood diversification within rural areas could reduce dependence on rain-fed agriculture, which is extremely sensitive to climate change. Adaptation strategies can offset some of the consequences of climate change, and are already being used by people living in marginal regions. Examples include crop and livelihood diversification. Many risk management measures could have an immediate positive effect on hunger, regardless of climate change. A simulation model for Mali, where temperatures are projected to rise by 1°C – 2.75°C by 2030, anticipates cereal harvests falling by up to 19%. As a consequence, this will result in doubling the incidence of undernutrition from 34% to 64-70%. However, this simulation also demonstrated that, if appropriate policy and agricultural adaptations were implemented now, hunger could decline from 34% to 21% of the population. This would require strong governance and considerable finance.

Action is needed at all levels to strengthen coping systems and reduce exposure to risk. Disaster planning will be needed to cope with the aftermath of unpredictable extreme weather events, but slower changes to weather patterns offer more opportunities to introduce risk reduction and risk management strategies. The economic cost of adaptation is high and those most affected by climate change can least afford it – the poorest and most vulnerable countries urgently need technical and financial support. But climate change could also affect international relationships. We have seen how the events of September 11th 2001 changed political alliances in unforeseeable ways. Will climate change generate a fraction of the resources allocated to the 'war on terror'? If not, the losers could find themselves abandoned by the wealthier winners ■

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See also

'Climate change and food security', IDS Bulletin 35 (3), by S. Devereux and J. Edwards, 2004

'Food Security Implication of Climate Change in Developing Countries: Findings from a Case Study in Mali', Department of Agricultural Economics, Texas A&M University, by T. Butt, B. McCarl, J. Angerer, P. Dyke and J. Stuth, J, 2003

Living with variable climate in southern Africa

Southern Africa has experienced severe food shortages over the past few years. These have been caused by several factors, including climate change and variability, problems with governance (including poor risk-management, and inadequate early warning systems) and wider structural issues (such as globalisation). Many parts of the region are also vulnerable to the impacts of large-scale environmental change, including land degradation and biodiversity loss.

Science and policy efforts have focused on improved understanding of the changing climate and potential impacts, improved risk reduction at various levels and concerns around climate change mitigation. Despite these efforts, there is a growing need to better understand climate change and climate variability adaptation and mitigation within the context of wider issues in the region. Focussing only on the climate ignores the importance of these other stresses and changes. In the agricultural sector, for example, changes in agriculture practices and policies have major impacts that are exacerbated by variable climate. Coping with and adapting to such changes therefore requires a comprehensive approach.

Communities may manage climate variability more effectively if they had access to assets such as climatic information

Communities may manage climate variability more effectively if they had access to a variety of assets and capabilities. When these resources are constrained, communities struggle to adapt. In the Limpopo Province, which straddles parts of South Africa, Botswana, Zimbabwe and Mozambique, several studies show that improved access to various types of information, including climate information, may help communities manage various risks. Farmers who diversify and depend on a range of livelihood sources (including off-farm employment, pensions and social welfare) can improve their ability to manage risks such as drought and floods.

Coping strategies to improve the management of climate change could be combined with development activities and other long-term activities, including improved social welfare. The recent National Disaster Management Act in South Africa calls for both emergency response and longer-term risk reduction to a variety of stresses, including climate risk. Poverty reduction programmes also need careful planning and implementation to ensure continued resilience to climate change and other stresses. The challenge for scientists and policy makers is daunting but critical.

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Responding to climate change

The impacts of climate change are already being observed around the world, from retreating glaciers to changing seasons and rainfall patterns. Climate change is likely to be evident in the future through more frequent storms, droughts, heat waves, floods and other extreme events. Each of these may affect the security and sustainability of development throughout the world. Developing countries, particularly least developed countries, are likely to be exposed to the greatest impacts. However, climate change is caused by current and past emissions from industrialised countries that have more resources to cope with the impacts.

There are two responses to climate change: mitigation and adaptation. Mitigation means reducing emissions of greenhouse gases, the main cause of human-induced climate change. Without serious mitigation there will be no 'stabilisation' of carbon dioxide concentrations in the atmosphere, the climate will continue to change in unpredictable ways and impacts may increase exponentially. Any serious efforts to mitigate must address the global dependence on fossil fuels and the politics that surround this dependence. For developing countries, efforts to curb greenhouse gas emissions will also have significant consequences for energy-intensive development and the affordability of energy for the poor.

Adaptation means adjusting to any new climatic conditions caused by natural and human-induced change. Many parts of the world have had to cope with previous climate variability and have developed strategies to do so. Adaptation can be undertaken in anticipation of impacts or after these have occurred. These can be initiated by individuals through market exchanges and social interactions, or through coordinated measures by government or other groups. The mix of anticipatory or reactive adaptation action actually introduced will depend on the existing vulnerabilities of each community or individual, as well as institutional processes, regulatory frameworks, property rights, access to resources and social conditions.

Adaptation is place-specific and context-specific: there is no single plan for how adaptation should occur. However, lessons learned from responding to past hazards may be useful for planning for future climate change. For example, government agencies and individuals in the Cayman Islands have learned from hurricane events over the past 20 years, including Hurricane Ivan in 2004.

A strategy to prepare for climate change should involve:

- compiling clear and concise information about climate change, including uncertainties
- integrating current and future climate information into physical planning processes to build robust infrastructure to mitigate future impacts
- focussing on the buffering capacity of managed natural systems, for example wetlands, the coastal zone and rain-fed agriculture, when investing in new projects.

The Cayman Islands show how government institutions can respond to environmental hazards. Societies benefit from operating as a 'learning system' and by recognising that experimentation and adaptive management allow procedures and response capacity to develop. Participation and ownership of responses by wide sections of society is essential.

Investments in adaptation and mitigation are necessary but these are not substitutes for each other. In fact, the ability of societies to reduce their emissions and to adapt are determined and constrained by the same underlying factors. The resilience of institutions and of resources sensitive to changes in the climate is central to meeting the challenge. These issues are often magnified in developing countries, which are coping with economic globalisation and other challenges simultaneously ■

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See also
www.tyndall.ac.uk/research/theme3/

'Planning for climate change in small islands: insights from national hurricane preparedness in the Cayman Islands', Global Environmental Change 15(2), E.L. Tompkins (forthcoming 2005, copies available from the author)

Knowledge about our future climate

Whilst there is evidence that our climate is changing as a result of human activities, forecasting future changes remains a significant challenge. Despite the use of complex computer models, there is a high degree of uncertainty in forecasts for the next 10 to 100 years. This uncertainty tends to be greater for small spatial scales but government planners, the private sector and non-governmental organisations need detailed regional or local information. Providing this information is perhaps the biggest challenge to climate science today.

To predict future climate change, computer based models are used to summarise our understanding of the way the climate behaves. These range from simple 'energy balance' models to complex, three-dimensional global circulation models that calculate the changing weather at over 100,000 points around the earth, every 15 to 30 minutes. The results from these models are often compared with observations of climate change over the last 50 years. However, even if a model can simulate the past reasonably well, this does not mean that it can correctly forecast the future.

There are three major sources of uncertainty in climate forecasting. The first source is natural variability, which is studied using identical models with slightly different starting conditions. This accounts for the chaotic 'butterfly effect'. A consequence of this is that a system is sensitive to the precise details of its starting conditions. Second is model uncertainty – do different models give different forecasts? This can be addressed by slightly changing the way the model represents the physics of the climate. Third is uncertainty in the levels of future greenhouse gas concentrations. This depends on natural factors (such as volcanoes) and on anthropogenic factors (such as how society responds to climate change).

In 2001, experts from the Intergovernmental Panel on Climate Change (IPCC) reported on the state of climate science at the time. They predicted a rise in average global temperatures of between 1.4 and 5.8°C by 2100, and a sea level rise of between 0.09 and 0.88 metres. Alongside these, they anticipated changes in extreme weather and climate events including:

- higher maximum and minimum temperatures and more hot days over land areas (very likely)
- more intense rainfall events (very likely, over many areas)
- increase in tropical cyclone peak wind and rainfall intensities (likely, over some areas)

More recently, the **climateprediction.net** project has developed a method for creating very large numbers of different models. This enables a more comprehensive exploration of possible future climate changes and therefore analysis of the uncertainty in climate forecasts. There are currently over 70,000 participants from over 130 countries. Initial results support the conclusions of other recent studies in suggesting that there is a possibility of a much greater increase in global temperature than considered by the IPCC. Future collaborations with developing country scientists could help develop the project further, with the possibility of providing climate forecasts related to probability for specific countries or sectors e.g. crop yields, flooding risks.

The problem of assessing uncertainty in how the climate will respond to current and future greenhouse gas emissions is not yet solved. However, experiments such as **climateprediction.net** and developments in climate models will improve our understanding of the sources of uncertainty. The need for mitigation is clear but for the present, planners and policy-makers need to adopt flexible responses to the adaptation problem. Useful, regional climate forecasts related to probability are nevertheless on the horizon and a real possibility during the next decade or so.

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See also
www.climateprediction.net

'Climate change 2001: the scientific basis', contribution of Working Group 1 to the Third Assessment Report of the IPCC, Cambridge University Press, IPCC, 2001
www.ipcc.ch/pub/spm22-01.pdf

Focus on the Pacific Islands

Many Pacific islands are extremely vulnerable to the impacts of climate change such as sea level rise. The Intergovernmental Panel on Climate Change predicts that sea levels will rise by between 0.09 and 0.88 metres by 2100 and continue rising after this. Higher sea levels will cause coastal flooding and have adverse effects on biodiversity, soils and water supplies. Pacific Islanders will be among the first people forced to adapt or ultimately relocate. The impacts will be felt for many generations because of the low adaptive capacity in these islands and high vulnerability to climate-related natural disasters.

Concerns about climatic change were first raised during the South Pacific Forum Leaders meeting in 1988. In 2000, the Pacific Framework on Climate Variability, Climate Change and Sea Level Rise was adopted. Local public pressure is now mounting for action on adaptation on many islands. There is growing community and government concern about the need to reduce vulnerability and manage the risks posed by extreme events and long-term change.

The Pacific Framework aims to promote action and strengthen partnerships at all levels. This will enable islanders to understand and respond to climate change and sea level rise. People and partnerships are at the centre of the process. This is reflected in the range of climate change programmes now underway. An example of this is a workshop held in 2004, organised by the Fiji Department of Environment in partnership with the World Wildlife Fund-Fiji climate change. This initiative aims to develop strategies that reduce the risks of climate change for people, such as building freshwater storage facilities. This is part of a regional initiative organised by the Canadian International Development Agency.

There are several critical research and information needs in Pacific Islands. These include:

- providing access to and maintaining fresh water supplies, which are threatened by contamination by rising sea levels
- protecting public health
- ensuring public safety in extreme events and protecting community infrastructure
- sustaining agriculture, by adapting to changing rainfall patterns and increasing salt content in soils
- sustaining tourism
- promoting wise use of marine and coastal resources, such as mangroves, coral reefs and fish stocks.

Although several adaptation programmes are in place, there remain considerable difficulties. Experience over the last two decades shows that while Pacific Islanders are receptive to assistance from outside, they know that they are responsible for designing impact and adaptation programmes within their communities. These must consider local cultures, traditions, and identify the factors likely to hold back the success of these programmes.

Adapted by **Tim Woods** from the following:

'Case Study: Pacific Islands', by P. Lefale, National Institute of Water & Atmospheric Research, New Zealand (unpublished) **p.lefale@niwa.co.nz**

'South Pacific Currents', WWF South Pacific Programme Number 23, D. McFadzien, 2004 **dmcfadzien@wwfpacific.org.fj www.wwfpacific.org.fj**

Earth Policy Updates **www.earth-policy.org/Updates/Update2.htm**

South Pacific Regional Environment Programme, Climate Change **www.sprep.org.ws/topic/climate.htm**

SITES FOR SORE EYES

There are several websites looking at the many issues linking climate change and development. The Science and Development Network have a climate change dossier with three sub-topics, including adaptation to climate change www.scidev.net/dossiers/index.cfm?fuseaction=dossierItem&Dossier=4&CFID=4042064&CFTOKEN=905db86117985a0b-C389F645-B0D0-F03F-73B8B632F884BED0 The UNFCCC website unfccc.int/2860.php contains reports, guidelines and general information about what provisions there are for Less Developed Countries on adapting to climate change.

The Assessments of Impacts and Adaptation to Climate Change in Multiple Regions and Sectors is a project that aims to increase scientific understanding of climate change vulnerabilities and adaptation options in developing countries. The website www.aiaccproject.org/aiacc.html contains reports and information about the project, as well as links to relevant research elsewhere. Another source of information about research on climate change and development is hosted by the School of Development Studies at the University of East Anglia www.uea.ac.uk/dev/climate The Institute of Development Studies also has several sources of information www.ids.ac.uk/ClimateChange

The OECD Development and Climate Change Project is described at www.oecd.org/document/14/0,2340,en_2649_34359_1933710_1_1_1_1,00.html This site includes country case studies and further information on the project itself. The Intergovernmental Panel on Climate Change also has information relevant to understanding climate change, its potential impacts and options for adaptation and mitigation www.ipcc.ch/

Further regional information is available on the Small Island Developing States Network website www.sidsnet.org/1f.html This contains articles and news on climate change and small islands. The South Pacific Regional Environment Programme www.sprep.org.ws/climate/index.asp hosts a climate change portal for providing information and links on climate change that are of specific interest to the Pacific region.

The Center for Earth Science Information Network at Columbia University provides access to research on climate change and food security in the Thematic Guide to Agriculture and Global Environmental Change ciesin.columbia.edu/TG/AG/AG-home.html The website also provides information on the potential impacts of climate change on world food supply, based on data sets from a crop modelling study sedac.ciesin.columbia.edu/giss_crop_study/index.html Another interesting website contains information about a project on climate change and agriculture in India www.teriin.org/coping/index.htm

On predicting climate change impacts, the website climateprediction.net/ represents an experiment to try and produce a forecast of the climate in the 21st century.

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