20 Adaptation in the developing world

Key Messages

Adaptation to mute the impact of climate change will be essential in the poorer parts of the world. The poorest countries will be especially hard hit by climate change, with millions potentially pushed deeper into poverty.

Development itself is key to adaptation. Much adaptation should be an extension of good development practice and reduce vulnerability by:

- Promoting growth and diversification of economic activity;
- Investing in health and education;
- Enhancing resilience to disasters and improving disaster management;
- Promoting risk-pooling, including social safety nets for the poorest.

Putting the right policy frameworks in place will encourage and facilitate effective adaptation by households, communities and firms. Poverty and development constraints will present obstacles to adaptation but focused development policies can reduce these obstacles.

Adaptation actions should be integrated into development policy and planning at every level. This will incur incremental adaptation costs relative to plans that ignore climate change. But ignoring climate change is not a viable option – inaction will be far more costly than adaptation.

Adaptation costs are hard to estimate, because of uncertainty about the precise impacts of climate change and its multiple effects. But they are likely to run into tens of billions of dollars. This makes is still more important for developed countries to honour both their existing commitments to increase aid sharply and help the world's poorest countries adapt to climate change. More work is needed to determine the costs of adaptation.

Without global action to mitigate climate change, both the impacts and adaptation costs will be much larger, and so will be the need for richer countries to help the poorer and most exposed countries. The costs of climate change can be reduced through both adaptation and mitigation, but adaptation is the only way to cope with impacts of climate change over the next few decades.

20.1 Introduction

It is the countries with fewest resources which are most likely to bear the greatest burden of climate change in terms of loss of life, adverse effect on income and growth, and damage to living standards generally. Developing countries - and especially the low-income countries in tropical and sub-tropical regions - are expected to suffer most, and soonest, from climate change. They are especially vulnerable to the effects of climate change, because of their existing exposure to an already fragile environment and their economic and social sensitivity to climate change. And their poverty reduces their capacity to adapt (discussed in Chapter 4).

As in developed countries, much adaptation will be a local response by individuals to a changing climate. Households, communities, and firms respond autonomously to climate change and extreme variability in ways that help to reduce its harmful effects. Yet these autonomous responses will be likely to fall far short of what is necessary, given current vulnerabilities and the scale of future impacts. Sections 20.2 and 20.3 set out the essential role that governments will have to play in reducing this vulnerability through good development practice, including better disaster risk management and use of social safety nets to protect the most vulnerable.

Governments will also have a specific role in establishing the policy frameworks to encourage adaptation by private individuals and firms – in particular to address information uncertainties,

ensure transparency of transactions, and tackle financial/non-financial constraints that will reduce the capacity for autonomous adaptation (as discussed in Chapters 18 and 19). Three aspects will be especially important for governments:

- Providing high quality information;
- Effective land-use planning and performance standards; and
- Ensuring that major planning and public sector investment decisions take account of climate change.

The application of these principles is context specific and will vary from country to country. Developing countries face additional constraints and obstacles that will require even greater effort by governments, as discussed in Section 20.4. Section 20.5 sets out a range of estimated costs of adaptation in developing countries. The chapter concludes with a preview of the necessity of international assistance for adaptation (discussed in detail in Chapter 26).

20.2 Adaptation prospects in the developing world

Individuals, firms and civil society will respond to a changing climate as far as their knowledge and resources allow. But they will require support from their government to overcome barriers and increase adaptive capacity.

Individuals, firms, and civil society will have a central role in responding to climate change. People and local companies will typically have better information than governments about their own specific situations, as well as stronger incentives to act. This is testified by examples of autonomous action taken in response to extreme weather events. For example:

- In parts of the Mahanadi floodplains in India's Orissa state, farmers usually cultivate a local variety of paddy (Champeswar) that is tolerant to water stagnation to reduce agricultural output loss;[1] and
- In the Sahel, a drought in the 1980s was greater than one in the 1970s but the losses associated with the later drought were far less as people effectively adapted and increased their resilience to the impacts of a hostile climate.[2]

However, many poor people face a plethora of constraints – linked mainly to low-income levels and poverty – which limit their ability to react autonomously to climate change, as set out in Chapter 4. Unless action is taken, these constraints will be compounded as developing countries are exposed to more frequent and intense extreme weather events. As in developed countries, individuals and firms will naturally react in response to market signals. For example, if climate-induced water scarcity results in higher prices, firms and households are likely to become more efficient in their use of water. But in many developing countries public water utilities do not provide water services to poor people but only to firms and better-off consumers – and at artificially low, subsidised prices. In such cases, existing structures and price systems limit autonomous adaptation and actually increase the burden on the poorest.

Government capacity is also a major issue in most developing countries where human and other resources are already strained. But governments have an important potential role in helping people to build their adaptive capacity through good development practice. In addition, developing-country governments - as with developed - have an essential role in supplying information and ensuring that markets provide appropriate signals. This is in addition to providing necessary infrastructure and public services. But already stretched local and national administrations face additional burdens with the need to adapt governmental activities to climate change, and ensure that both public and private sectors exploit whatever comparative advantages they have in adapting to the stresses of climate change. Box 20.1 sets out a summary of the various measures that governments should take to strengthen adaptation, discussed in more detail below.

[1] Roy et al (2006). Champeswar can sustain almost seven days submergence

[2] Nkomo et al (2006) This resilience can be broadly attributed to a) reliance on local networks and groups, b) local savings schemes, many of them based on regular membership fees, c) a changing role of the state and linkages between countries and to global aid systems, and d) regional co-operation, such as the CILSS grouping (the Permanent Interstate Committee for the Fight against Drought in Sahelian countries founded in 1973 in the aftermath of the 1970s drought).

Box 20.1 Measures to strengthen adaptation

As discussed above, development itself is the most effective way to promote adaptation to climate change, because development increases resilience and reduces vulnerabilities. Beyond that broad development focus, fully integrating climate change will require ensuring that adaptation concerns are reflected across many aspects of government policy. Some of the required measures for strengthening adaptation include:

- **Ensuring access to high-quality information about the impacts of climate change and carrying out vulnerability assessment**. Early warning systems and information distribution systems help to anticipate and prevent disasters.
- **Increasing the resilience of livelihoods and infrastructure** using existing knowledge and coping strategies.
- **Improving governance,** including a transparent and accountable policy and decision-making process and an active civil society.
- **Empowering communities** so that they participate in assessments and feed their knowledge into the process at crucial points.
- **Integrating climate change impacts** in issues in all national, sub-national and sectoral planning processes and macro-economic projections. The national budget process is key here.
- **Encouraging a core ministry** with a broad mandate, such as finance, economics or planning, to be fully involved in mainstreaming adaptation.

Source: Adapted from Sperling (2003)

20.3 The foundations of the policy response: building on good development practice

Much of what governments should do in relation to adaptation is what they should be doing anyway - that is, implementing good development practice. This is key to reducing the vulnerability of developing countries to climate change and raising their capacity to adapt. Climate change concerns simply lend greater urgency to these core tasks of government and, as discussed in Chapter 26, the role of the international community in supporting adaptation in developing countries. This was noted in Chapter 4 where rapid growth, as being experienced in China and India for example, will equip these countries with the economic resources to invest in appropriate policies and tools to better manage the effects of climate change. In some circumstances, there may be additional costs, which the international community will have a role in helping to finance (see Chapter 26), bearing in mind the differences in income and historical responsibility for the bulk of past emissions.

If individuals and communities are empowered by development and rendered less vulnerable overall, they will be better able to adapt to climate change.

By empowering individuals with the tools to shape and improve their own lives and livelihoods - in other words, by promoting development broadly - governments will also strengthen individuals' ability to respond autonomously to climate change. Economic diversification, for example, is typically a core feature of development *and* is one of the best defences against economic shocks. It typically reduces the dependence of households, and the economy more broadly, on climate-sensitive sectors such as agriculture. It also increases the flexibility of the economy and individuals to adjust to sudden or gradual changes in the climate. Broad development measures will improve the lives of millions today and reduce individuals' vulnerability to climate change. In some cases it will also reduce the risks of these impacts occurring in the first place. For example:

- The control of malaria benefits millions of people today *and* will reduce the extent to which climate change will expose people to greater risk of malaria infection in the future;

- Greater access to education and reproductive health care for women will improve their lives and opportunities today *and* help control the rapid rate of population growth in developing countries, reducing pressures on existing resources.[3]

Good development practice will also serve to better equip people through building and developing their resilience. This is demonstrated in the case of Bangladesh where vulnerability to extreme weather events has been reduced in part through good development (Box 20.2).

Box 20.2 Reducing vulnerability in Bangladesh

Bangladesh has been identified as the "most disaster-prone" of all countries, having suffered 170 large-scale disasters between 1970 and 1998.[4] Substantial investments have been made in recent years to reduce vulnerability to extreme climate variability (with the recovery following the 1998 floods more rapid than predicted) including: a structural change in agriculture, with an increase in the planting of much lower risk dry season irrigated rice; better internal market integration; and increased private food imports. Bangladesh's dependence on agriculture has also been reduced by an increase in export-oriented garment manufacturing. These developments were aided by higher credit penetration, including micro credit, increased remittances from abroad, and increased donor assistance. General development support has contributed to reducing the economy's sensitivity to extreme climate variability.

Source: ODI (2005)

Key areas for development action that will help to reduce vulnerability to the effects of climate change include:

- Progress on achieving income and food security and on overcoming the structural causes of famine/insecurity;
- Building robust education and health systems, including eradication of malaria, cholera, and other diseases associated with water;
- Better urban planning and provision of public services and infrastructure; and
- Better gender equality.

Improving access to micro-finance to help create assets and income will also be important as much of the funding for autonomous adaptation in developing countries will have to come from domestic sources and much of the action will be by households and small firms. Access to insurance and reinsurance services, savings and credit facilities, and flows such as financing for disaster preparedness measures and remittances will also be important to help protect the most vulnerable from climate change (discussed in Chapter 26).

It is important to note, however, that not all development policies and practice will be beneficial from a climate change perspective, and in some cases will actually increase vulnerability to the impacts of climate change. This is known as maladaptation.[5] Maladaptation is commonly caused by a lack of information on the potential external effects of policies and practices on other sectors, or a lack of consideration given to these effects. The destruction of coastal mangroves is a prime example. Mangroves provide a wide range of services, including protecting against floods, coastal erosion and storm surges. Despite their importance, mangroves are being cleared in countries such as Bangladesh and Fiji to make way for agriculture, urbanisation and tourism. Shrimp-farming, for example, took-off in Bangladesh as an export industry in the mid 1980s. While this provided incomes it also encouraged the deliberate inundation of land with brackish water during periods of low salinity to increase shrimp production. As these fragile ecosystems are destroyed, so vulnerability to climate change is increased. More integrated planning and management is widely recognised

[3] For example, evidence suggests that educated women are more likely to seek medical care, improve sanitation practices and choose to have fewer children. For example, econometric studies have found that an extra year of female schooling reduces female fertility by between 5 to 10%. World Bank (2001); Summers (1992).
[4] World Bank's recent Water Resources Assistance Strategy report for Bangladesh
[5] Burton (1996, 1997)

as an effective mechanism for strengthening sustainable development, as discussed in Section 20.4 below.

Improving disaster preparedness and management saves lives, but it also promotes early and cost-effective adaptation to climate-change risks.

Natural disasters exact far greater economic costs in developing countries than developed countries, in relative terms, and can cause setbacks to economic and social development in developing countries. As a result, private, public and international resources and assistance is increasingly being diverted through humanitarian responses and reconstruction needs to deal with natural disasters, as discussed in Chapter 4. For example, OECD estimates, show that "emergency and distress assistance" from donors has risen from an average of 4.8% of total Official Development Assistance (ODA) in 1990 to 1994 to 7.2% in 1999 to 2003, reaching 7.8% of ODA (more than $6 billion) in 2003.[6]

It will typically be more effective - in terms of both lives saved and finances - to invest in better disaster preparedness and management. Macro-level assessments show that disaster risk reduction (DRR) measures have a high benefit-to-cost ratio. The US Geological Survey and the World Bank estimated that an investment of $40billion would have prevented losses of $280billion in the 1990s.[7] And the savings are not just hypothetical:

- *China*: the $3.15billion spent on flood control between 1960 and 2000 is estimated to have averted losses of some $12billion;[8]
- *Brazil*: the Rio flood reconstruction and prevention project yielded an internal rate of return exceeding 50%;[9]
- *India*: disaster mitigation and preparedness programmes in Andhra Pradesh yielded a benefit/cost ratio of 13.38;[10]
- *Vietnam*: a mangrove-planting project aimed at protecting coastal populations from typhoons and storms yielded an estimated benefit/cost ratio of 52 over the period 1994 to 2001.[11]

Thus a focus on climate change reinforces an earlier development lesson: not only do disaster preparedness and emergency planning save lives and property, they are also highly cost-effective. DRR measures can also bring significant developmental benefits in normal times. Raised flood shelters in Bangladesh are used on a day-to-day basis as schools or clinics, for example, and boreholes drilled to protect against drought provide water that is cleaner and easier to access than alternative sources.[12]

At the margin, it will be important to ensure that disaster risk assessments take new climate-change risks into account. Otherwise, mal-adaptation can be the result (as discussed above and in Chapter 18). This was the case in Bangladesh where flood defences had been designed for lower levels of floods. Because those defences were poorly maintained and were in any event inadequate for the higher flood levels of recent years, they became counter-productive, eventually trapping and prolonging the floods of 1999.[13]

Governments should also promote risk-sharing approaches, through insurance and pooling of disaster risks.

Insurance is another area - closely related to disaster preparedness - in which climate-change considerations reinforce what governments should already be doing on developmental grounds.[14] Well-functioning insurance markets share risk across individuals, regions, and

[6] OECD (2004) cited in ERM (2006). Note that a part of the increase in damages may be due to improved monitoring and reporting and increases in income.
[7] Cited in Environmental Resources Management (2006); Benson (1998). Figures are indicative as consistent methodologies were not used to prepare estimates.
[8] Benson (1998) cited in ERM (2006).
[9] ProVention (2005) cited in ERM (2006).
[10] Venton and Venton (2004), cited in ERM (2006).
[11] IFRC (2002) cited in ERM (2006).
[12] ERM (2006)
[13] Bangladesh is now integrating long-term climate risks into disaster management.
[14] A lot of work has been done on this by UNEP Finance Initiative (http://www.unepfi.org/).

countries, reducing the welfare effects of negative shocks of all types, whether climate-related or not. Risk-based insurance schemes can also reduce the costs of climate change by encouraging good risk-management behaviours, as discussed in Chapter 19. For example, by providing the incentives to meet standards on building design and construction, they encourage action to reduce risk. In addition, insurance may also act as a catalyst for autonomous adaptation by providing information through its measurement and pricing of climate risks. With the expected increase in climate-related shocks, governments now have even more reason to promote well-functioning insurance markets, as described in Chapter 18 and 19. Low-cost micro-insurance options, particularly weather derivatives, could be a mechanism for sharing risk in the poorest countries. Promoting private-sector involvement and investment in disaster risk management in developing countries should be high on the agenda for governments.[15] Box 20.3 provides examples of innovative programmes in this area.

Box 20.3 Pilot risk-sharing ventures in the developing world

A number of recent initiatives have pioneered micro-insurance and weather derivative instruments in the developing world:

- A weather insurance initiative was launched in 2003 in India by a group of companies called BASIX. It has already grown from 230 farmers in one state to 6,703 customers across six states for 2005, and it has generated much broader interest in weather-related insurance in India, with other insurance companies now beginning to offer the product;[16]
- The World Food Programme has a pilot drought insurance project in Ethiopia. The WFP secured contingency funding through a Paris-based reinsurer to set this up, and ensured data availability through capacity-building at the National Meteorological Agency. A drought index now tracks agricultural seasonal development through 26 weather stations reporting daily;[17]
- DFID is launching two pilot projects in Bangladesh to offer weather-based index insurance at the community level. These projects illustrate the possible convergence of micro-finance and complementary community-based programmes with more sophisticated market-based financial instruments;
- In Malawi, an index-based weather derivative is offered to groundnut farmers as part of a loan package organised by the National Smallholder Farmers Association (with technical assistance from the World Bank and Swiss development cooperation);
- In the coastal Andhra Pradesh region of India, micro-insurance services have been provided as part of the voluntary Disaster Preparedness Programme to groups of women with a minimum size of 250 members. The Oriental Insurance Company offers affordable cover to poor communities through cross-subsidy with the wider insurance market. In addition, Oxfam pays half the premium.

However, as noted in Chapter 4, these insurance markets will often fail to emerge autonomously in developing countries through poorly developed financial markets, low income levels with which to purchase the insurance and lack of robust information. While approximately a third of natural-disaster losses are insured in high-income countries, for example, less than 3% of such losses to households and businesses are insured in developing countries.[18] And only a small number of schemes offering weather derivatives or micro-insurance for disaster risks have been implemented in developing countries to date.[19] For insurance markets to work effectively, insurance companies need access to accurate forecasts of climate change effect and the damage it may cause. This is currently a major constraint in developing countries that will have to be addressed if insurance provision is to play an important role in disaster risk management. There is also a limit to the ability of insurance companies to spread risk as they will be unwilling or unable to insure against an event with a very high probability of occurring. In some cases the price of individual premiums will become unaffordable because of the high risks. At the same time, if risks increase in

[15] Mechler et al (2006)
[16] World Bank (2005b)
[17] WFP (2006)
[18] Munich Re (2005)
[19] The ProVention Consortium (http://www.proventionconsortium.org/) is actively pursuing this agenda.

several insurance markets at once, then insurance companies may find it harder to spread risks and therefore be less willing to provide insurance at affordable rates.

In addition, effective social safety nets will be important to protect those who are most vulnerable and cannot afford protection. One example is the set of safety net programmes that were announced in Indonesia in response to the economic, natural and political crisis between 1997-98. The employment creation programmes - which relied on self-selection targeting - were found to be far more effective in reaching the most vulnerable households than programmes based on health subsidies and subsidised rice sales.[20] Equally, the Employment Guarantee Scheme (EPG) in the Indian state of Maharashtra has provided wage labour opportunities since the 1970s that help buffer households from the effects of poor harvests and other negative shocks.[21]

20.4 New policies focused on climate change

Investing in climate resilience has implications for each country's investments in natural, physical, human, technological, and social capital.

While many of the policies that promote adaptation will already form part of national governments' priorities, others may not. Beyond reducing vulnerability through a broad suite of development activities, effective adaptation may also require governments to address specific market failures and barriers that limit effective adaptation.[22] Box 20.4 highlights a range of issues to consider. However, as the impacts of climate change are difficult to predict accurately, any adaptation strategy should be as flexible as possible, able to respond to new information, and robust enough to be cost-effective across a range of possible future scenarios.

Box 20.4 Investing in adaptation

- **By encouraging technology transfer and supporting flows of knowledge:** governments can deliver better climate forecasts, and spread information about climate-resilient crop varieties and irrigation schemes. Regional Climate Outlook Forums for example, provide guidance on the probabilities of rainfall to farmers in Africa and South America;
- **Human capital:** Investing in health and education raises the effectiveness of explaining to communities and individuals how their climate is changing, and why and how they should adapt in ways which effectively integrate climate risks into the development process;
- **Physical capital:** governments can make long-term infrastructure more climate resilient, for example through building codes and regulations, land-use zoning, river management, and warning systems. [23] Without increased climate resilience, people face shorter lives and will have to live with less reliable infrastructure. Some adaptation may require higher maintenance costs for basic infrastructure such as re-building or diverting dirt roads. Additional protective investments such as flood barriers and sea walls will also be required;
- **Social capital:** Supporting social networks, institutions and governance arrangements, to strengthen safety nets for poor people in response to natural disasters. Many traditional risk-sharing mechanisms based on social capital, such as asset pooling and kinship networks, are less likely to be effective when climate change simultaneously damages families and households in an entire region. The same is true of traditional coping mechanisms like selling assets;[24]

[20] Pritchett et al (2002)
[21] A problem with scaling up an EPG scheme is the lack of 'high value' works from local plans to provide employment. Sen (2004:11) discusses these challenges in the case of India and noted that "for any commitment of expenditure, the opportunity costs have to be scrutinised, and employment guarantee is no exception to this".
[22] Berkhout (2005)
[23] Climate norms including climate variability and extreme events should already be taken into account in infrastructure development. Climate is a factor in, for example, the design of domestic, industrial and commercial buildings, roads, bridges, drainage systems, water supply and sanitation systems, irrigation and hydroelectric power installations. Improving climate resilience will go a step beyond this. Burton and van Aalst (1999)
[24] In the jargon this is known as 'covariate risks' or 'correlated risks', as discussed in Chapters 5 and 19, Sections 5.5 and 19.6 respectively.

- **Natural capital:** governments can help protect the resilience of natural systems to support the livelihoods of poor people, for example by planting mangrove belts to buffer the coastal erosion impacts of sea level rise.

Source: DFID (2003); Sperling et al (2003)

Many of the interventions required in developed countries, as set out in Chapter 18 and 19, will also be needed by developing countries including:

- Better information on climate change and more accurate weather forecasting;
- Regulation to overcome market barriers to adaptation; and
- Incorporating climate change into long-term policies.

Whilst the principles may be similar, their application may be different. Development constraints – including high levels of illiteracy and poor governance – will present obstacles to the effectiveness of these policies. The significance of these constraints will vary from country to country, with low-income countries likely to face the greatest challenge. And additional adaptation measures will be required by developing countries that face acute threats of rising sea levels or desertification. Developed countries can play a strong leadership role on adaptation but these wide-ranging constraints have to be addressed to ensure early and effective adaptation in developing countries.

Governments have an important role to play in raising awareness. But there are barriers that should be addressed.

Individuals, firms, and civil society cannot adapt autonomously without reliable information and projections, especially since they should make some of their investment choices well before the effects of climate change are fully visible. A core responsibility of governments will be to see that it has access to, and disseminates domestically, good information on climate change. This will range from forecasts on the likely timing, extent and effects of climate change, to knowledge of drought and flood resistant crops and new crop planting techniques. Governments should provide these services given the public good nature of high quality climate information, noted in Chapters 18 and 19. The important role attributed to climate information is widely recognised. Tanzania's 1997 National Action Plan on Climate Change provides an example of a government focusing its efforts on raising awareness in the first two years of implementation.

Better information is a priority in many developing countries given the very low level of climate information currently available. The density of weather watch stations in Africa, for example, is eight times lower than the minimum level recommended by the World Meteorological Organisation, and reporting rates are the lowest in the world.[25] This low starting point indicates the size of the challenge compared to developed countries where government funded research programmes are already in place, such as UKCIP discussed in Chapter 19. Developing the necessary information is beyond the current capacity of many developing country governments. Many are not even able to monitor the climate, let alone forecast changes. Developing country governments will require international support in this area, as discussed in Chapter 26.

Effective communication of this information is also critical. Poor countries face barriers to free and easy communication such as:

- High illiteracy rates: in South Asia the female literacy rate is 46.3% and 53.2% in Sub-Saharan Africa, compared to 98.7% in developed countries;[26]
- Restricted access to electronic communication: while 70% of the population in North America are internet users, only 3.6% of Africans are, and only 10.8% of the population in Asia;[27]
- Inaccessibility of rural areas due to poor transport and road infrastructure.

[25] Washington et al (2004)
[26] UNESCO Institute for Statistics (2006) based on adult (15+) literacy rates on a regional basis, September 2006.
[27] Internet World Stats (2006)

Good development can go a long way in helping to overcome such barriers to effective information dissemination. However, it is important that governments take these issues into consideration in planning their communication strategies.

Government regulation can encourage private investment to take account of climate change. But its effectiveness will depend on the commitment and credibility of the government.

Land-use planning and performance standards can be important tools in encouraging private investment to consider the future risks and implications of climate change on their investment, as discussed in Chapters 18 and 19. However, the value of these interventions will be largely dictated by the commitment and credibility of the government. Poor governance is a problem in many developing countries, and indeed some developed countries, as demonstrated by the Corruption Perception Index.[28] This can lead to weak regulatory practices and poor enforcement of building standards. For example, while Iran adopted a seismic building code in 1989, legislation was not always enforced. As reported in the IFRC (2004), new buildings were sometimes certified as conforming to earthquake norms without thorough inspections being conducted, and laws were not in place to tackle municipalities that failed to retrofit infrastructure. Addressing problems with governance and weak enforcement will be crucial if regulation is to be fully effective.

Unclear property rights and the illegality of much slum housing also pose major problems which need to be overcome by changes to ownership and property laws and stronger law enforcement. Without property rights and civil protection householders put off making necessary home improvements since authorities would then have an incentive to evict the occupants once the work was done and rent out the dwellings to others willing to pay for protection.[29] Development itself can help to overcome these constraints, by educating civil society, promoting transparency and institutional checks on power, and encouraging accountability. Governments can then help by providing better technical guidance on building standards and encouragement of monitoring and enforcement.

Governments should integrate adaptation into their development projects but may require support to overcome technical capacity constraints.

Developing countries should integrate adaptation into development policy, budgets, and planning.[30] This cannot be an add-on or an afterthought, since some degree of continuous adaptation will be required across many sectors and regions. Governments - working alongside donors, the private sector, and civil society - should ensure national policies, programmes and projects take account of climate change and the options for adaptation.

National planning and policies

The importance of integrating adaptation into development policy and process through national economic planning and budgetary processes is an important first step towards effective adaptation. The budget is an important process for identifying and funding development priorities. Adaptive activities should be integrated into the budget framework and relevant sectoral priorities to help ensure necessary actions receive adequate funding over the long term and are balanced against other competing priorities.[31] Yet there is little evidence of progress on this score so far. Recent (draft) analysis by the World Bank found that while most of the Poverty Reduction Strategy papers (PRSPs) reviewed established linkages to climate change, such as by highlighting vulnerabilities to climate risk factors and impacts on economic productivity, further in-depth discussion of the issue was rare. They found a similar story with the Country Assistance Strategies (CAS).[32] Developing countries face two key constraints in integrating climate change into broader national development planning:

[28] This is produced by Transparency International. This Index ranks more than 150 countries by their perceived levels of corruption, as determined by expert assessments and opinion surveys. http://www.transparency.org/policy_research/surveys_indices/cpi/2005
[29] IFRC (2004)
[30] Burton (2006)
[31] Sperling (2003)
[32] Jiminez (2006)

- Institutional constraints: Governments face numerous constraints, including competing demands on scarce public resources. At present the adaptation process is generally channelled through the UNFCCC focal points, which are normally based in Ministries of the Environment. Such ministries usually have limited influence with other line ministries and with the Ministry of Finance. An integrated response requires activities led by a strong core ministry with overall responsibility such as Finance, Planning, Economic Affairs, and other line ministries. Climate change faces the same challenges that other crosscutting issues, such as gender, HIV/AIDS, and rural livelihoods, have faced in the past. Given the importance of risk management in relation to climate change – and the potential impact on public sector investments – there are sound reasons for Finance and Economy Ministry engagement.

- Technical capacity: Many developing countries – particularly the poorest – have only recently begun preparing longer-term national development plans and budget frameworks. This planning capacity is essential for broader development, as well as for enabling the integration of climate issues, and is already being supported by many development programmes. This should also be supported by the process of preparing National Adaptation Plans of Action (NAPAs) in Least Developed Countries.[33] While NAPAs could help to fill this planning gap, it is essential that they be integrated within overall national planning. Otherwise they could become yet another issue without a strong championship ministry and therefore be ignored when budgets are prepared. So far, only five NAPAs have been completed, and there is no indication that any implementation has begun as a consequence of preparing a NAPA, so their effectiveness or otherwise is as yet untested.

Programmes and projects

At the programme and project level, climate change may reduce the efficiency with which development resources are invested and worsen outcomes. Hence the risks of climate change should be integrated into development programmes. This means, for example, using information related to climate-change risks in the design and construction of infrastructure and buildings. In addition to building the resilience of development programmes, integrating climate-change risks will also help to ensure action to achieve adaptation to climate change is consistent with action to reduce poverty. Several commentators have suggested how to incorporate climate change risks into their plans and programmes. Burton and van Aalst (2004), for example, have proposed a climate risk-screening tool for World Bank projects,[34] while the UNDP has compiled a series of technical papers to guide projects towards identification of appropriate adaptation strategies.[35] One crucial task will be for governments to manage public goods that may be sensitive to climate change through finance and investment decisions, for example by improving flood defences, public health and safety, and emergency planning and response. Some examples of adaptation in practice are given in Box 20.5 below.

Box 20.5 Adaptation in practice

(a) Climate resilience in the Pacific Islands

Several Pacific Islands are implementing climate risk management programmes:

- *Samoa*: community grants to strengthen coastal resilience and reconstruction of roads and bridges to cyclone-resilient standards. Such local initiatives may well be a fruitful approach since local people are usually able to identify more accurately points of vulnerability;
- *Tonga:* national programme to construct cyclone-resistant housing units and retrofit buildings to improved hazard standards;

[33] The Least Developed Countries have received funding from the Least Developed Countries Fund (discussed in Chapter 26), implemented by the Global Environment Facility (GEF), to assist them in preparing these documents.

[34] This includes (i) a web-based knowledge tool that sets out the nature, magnitude and distribution of climate risks by country and region; and (ii) a routine project risk-screening tool modelled on the widespread practice of environmental impact assessment, where high-risk "hotspots" undergo a full risk assessment, while low and medium-risk projects undergo a vulnerability appraisal.

[35] The UNDP Adaptation policy framework is designed to be flexible so that those at an early stage of understanding can begin to assess vulnerability to climate variability and change, and those at a more advanced stage can begin to implement adaptation in practice. The overall approach embeds adaptation into key policies for development and places substantial emphasis on stakeholder engagement.

- *Kiribati*: climate-proofing of major public infrastructure and promote effective water management;
- *Niue:* strengthening of early-warning system for cyclones, including satellite-phone back-up, solar-powered radios for isolated villages and email facilities. In addition, the government is promoting vanilla as a more resilient cash crop than taro that typically suffers heavy damage during cyclones.

Source: Bettencourt et al. (2006)

(b) Qinghai-Tibet Railway

The Qinghai-Tibet Railway crosses the Tibetan plateau with some 550 km of the railway resting on permafrost. About half of this permafrost is only 1°C to 2°C below freezing, and is therefore highly vulnerable to even moderate warming. Permafrost thawing could significantly affect the stability of the railway. To reduce these risks, design engineers have put in place a permafrost cooling system using crushed rocks. In the winter, the colder denser air above the rock layer will circulate downwards through the spaces between the rocks, forcing warmer air out and away from the ground. In the summer, the air will be warmer and lighter outside the rock layer, and the air within the rocks will cease to circulate, thus minimising the amount of heat absorbed by the permafrost. The technique could be applied to many types of infrastructure projects in permafrost zones around the world.

Source: Brown (2005)

(c) Adaptation of hydropower sector in Nepal

Glacier retreat and ice melt are adding to the size of Nepal's glacier lakes and increasing the risk of 'glacial lake outburst floods' (GLOFs), catastrophic discharges of large volumes of water following the breach of the natural dams that contain glacial lakes. The most significant flood occurred in 1985 when a surge of water and debris up to 15 metres high flooded down the Bhote Koshi and Dudh Koshi rivers for 90km. The flood destroyed the almost-complete Namche Small Hydro Project, which had cost over $1 million. Much more attention is now being paid to the GLOF risks in Nepal and the likelihood that such risks will increase as a result of rising temperatures. Some adaptation options being considered include:

- Siting of hydropower facilities at low-risk locations (although this may only be feasible for new facilities);
- Early warning systems that can save lives far downstream (likely to cost around $1 million per basin);
- Design of hydropower infrastructure to limit vulnerability, such as powerhouse placed under ground;
- Direct reduction of risk through (i) siphoning or pumping water out of dangerous lakes, (ii) cutting a drainage channel, and (iii) taking flood control measures downstream.

Source: Agrawala (2005)

(d) Shanghai Heatwave Warning Systems

With a population of over 17 million, Shanghai is vulnerable to the effects of dangerous heat waves. The original heat wave warning system was triggered whenever temperatures in the city reached an arbitrary threshold of 35°C. The new system monitors a range of weather variables known to affect human susceptibility to the heat. For example, 'moist tropical' conditions are associated with the highest average temperatures and humidity and lead to the greatest increase in daily average mortality (35-63 excess deaths on top of a baseline of 222). The system can predict dangerous conditions up to two days in advance. Such a forecast triggers a series of activities by the Shanghai Municipal Health Bureau to reduce the population's vulnerability – media announcements on TV and radio, preparation of hospitals and public services, visits to the elderly in the city centre, and measures to ensure an adequate supply of water.

Source: Acclimatise (2006)

In factoring climate-change risks into investment decisions, it will be important to make good use of information on the costs and benefits of various alternative investments in terms of the damages avoided through adaptation and the benefits gained. An example is given in Box 20.6. These can mostly be at the project level, as in the case of retro-fitting buildings and flood defences. A key element determining the appropriate response will be the lifespan of the project and the options, for example, to retro-fit buildings and flood defences – noting that designing in adaptation at the beginning of the project can reduce the cost of retro-fitting.

Box 20.6 Case-study of cost-benefit analysis for adaptation

Water supply in the Berg River Basin in South Africa

Runoff from the Berg River Basin provides a major source of water for Cape Town and the surrounding agricultural land. In the last 30 years, water consumption in Cape Town has increased three-fold, and is expected to continue to grow in the future, as a result of population growth (migration of households to the city from rural communities) and economic development. At the same time, climate models show that average annual run-off in the catchment could decrease by as much as 25% during the period 2010 - 2040 due to climate change. A dam for the basin was approved in 2004 to deal with these competing pressures, but the possible impacts of climate change were not taken into account. Similarly, arrangements for liberalising the market for water supply are also being discussed in order to provide an economically efficient and more resilient distribution of water.

A recent study has compared the net benefits of adjusting to development pressures and, additionally, adjusting to climate change under two strategies:

Strategy A: Constructing a storage reservoir to cope with development pressures and then adding capacity to cope with climate change.
Strategy B: Implementing water markets to cope with development pressures and then building a dam to cope with climate change.

Table showing present value estimates for costs and benefits of adjustments for increasing development pressures and climate change in the 2080s

Estimated benefit or cost measure	Strategy A	Strategy B
Development action (no climate change)	Construct dam, no water markets	Water markets, no dam
Net benefits of development action	15 billion	17 billion
Additional adaptation action (development + climate change)	Increase dam capacity, no water markets	Construct dam + water markets
Net benefits of adaptation (reduction in damages from adaptation minus costs of adapting)	0.2 billion	7 billion
Cost of not planning for climate change that does occur	-0.2 billion	-7 billion
Cost of planning for climate change that does not occur	-0.2 billion	-1 billion

Note: All monetary estimates are expressed in present values for constant Rand for the year 2000, discounting over 30 years at a real discount rate of 6%.

Both the dam and water market options individually have similarly large projected net present values, but adding the possibility of adaptation to climate change shows the benefits of adopting both simultaneously. Increasing the water storage capacity of the Berg Dam could have a significant benefit for welfare. The effect is particularly strong if efficient water markets are introduced (net benefit of 7 billion, discounted over 30 years). Under this flexible and economically efficient approach, the costs of not adapting to climate change that does occur are much greater than the costs of adapting to climate change that does not occur (-7 billion vs. –1 billion in the case of efficient markets).

Source: Callaway et al. (2006)

20.5 Adaptation costs in the developing world

Adaptation is projected to cost developing countries many billions of dollars a year, increasing pressure on development budgets.

Only a few credible estimates are now available of the costs of adaptation in developing countries, and these are highly speculative. In a world of rapid climate change, it is increasingly difficult to extrapolate future impacts from past patterns, so historical records are no longer reliable guides. Furthermore, the discussion above has shown that conceptually this is a difficult calculation to solve: adaptation is so broad and cross-cutting - affecting economic, social and environmental conditions, and vice versa - that it is difficult to attribute costs clearly and separately from those of general development finance. Adaptation should be undertaken at many levels at the same time, including at the household/community level, and many of these initiatives will be self-funded.

With these very important caveats, one can consider the range of estimates that is available. The most recent estimates come from the World Bank that show the additional costs of adaptation alone as $4-37 billion each year.[36] This includes only the cost of adapting investments to protect them from climate-change risks, and it is important to remember that there will be major impacts that are sure to occur even with adaptation.[37] The World Bank estimate is based on an examination of the current core flows of development finance, combined with very rough estimates of the proportion of those investments that is sensitive to climate risk and the additional cost to reduce that risk to account for climate change (5-20% as a very rough estimate).[38] See Table 20.1. Whilst there is considerable debate as to the value of these figures, they provide a useful order-of-magnitude estimate and reinforce the importance of further research in this area.

Table 20.1 World Bank preliminary estimates of the added costs necessary to adapt investments to climate-change risks

This table, based on World Bank analysis, examines the core flows of development finance and estimates the proportion of the investment that is sensitive to climate risk. An estimate of the additional cost to reduce that risk to account for climate change is given. The percentage figures relating to the estimated costs of adaptation require further research and revision.

Item	Amount per year	Estimated portion climate sensitive	Estimated costs of adaptation	Total per year (US$ 2000)
ODA and Concessional Finance	$100bn	20%	5 – 20%	$1 – 4bn
Foreign Direct Investment	$160bn	10%	5 – 20%	$1 – 3bn
Gross Domestic Investment	$1500bn	2 – 10%	5 – 20%	$2 – 30bn
Total International finance				**$2 – 7bn**
Total Adaptation finance				**$4 – 37bn**
Costs of additional impacts				**$40bn (range $10 – 100 bn)**

Source: World Bank (2006a), updated through discussions with the World Bank

Another source of information is the NAPAs, which five countries have completed so far. On the basis of these it is possible to get a preliminary indication of the funding required. The total estimated cost for these NAPAs is $133million, averaging $25million per country.

[36] World Bank (2006a) and subsequent revisions.
[37] As explained in chapter 18, adaptation will not fully insulate people or economies from climate change, rather it is a way of dampening the impacts. As such, there will still be residual costs.
[38] These estimates exclude flood risk and other categories for which no costs are available so can be considered an underestimate from this perspective

Extrapolating up to the 50 Least Developed Countries suggests adaptation costs of $1.3billion for these (mostly small) countries alone, and for only the 'urgent and immediate' action that is required.

Information and knowledge about the additional costs of adaptation is very limited. This knowledge is essential in facilitating countries to integrate climate change risks and adaptation needs into their longer-term plans and budgets. More work is needed to arrive at more precise measures.

20.6 International assistance for adaptation

Just as individuals, communities, and firms in developing countries will require help from their governments to adapt efficiently to climate change, so these governments may need support form the international community. Chapter 26 will discuss how the international community can help to promote adaptation in developing countries. Nonetheless, it should be clear from the discussion above that adaptation will require coordinated efforts on many fronts. Donors and other international development partners should reorient their strategies to match national efforts. Development assistance should aim to reorient current practices and remove barriers to interventions that prove cost-effective once climate risk management is integrated into development programmes. This would also help to mainstream adaptation into national development and planning processes and so promote sustainable development.

Equally, given that the most affected countries are often among the poorest, there is a real need for the international community to fully honour the commitments, made at Monterrey in 2002, the EU in June 2005, and at the G8 summit in Gleneagles in July 2005, to increase sharply the flows of aid to developing countries, with the EU confirming and setting a timetable to 0.7% of GDP for ODA. Chapter 26 explores in detail the question of international support for countries facing the challenge of adaptation.

20.7 Conclusion

The climate will continue to change over the next few decades, whatever the world manages to achieve on the mitigation side. But the costs of adaptation will rise exponentially if efforts to mitigate emissions are not successful. It is an unfortunate twist of fate that those affected most immediately and hardest are often the countries that contributed little to the problem and that are least able to afford the costs of adaptation. They can afford even less *not* to adapt, however. Adaptation efforts are already underway, but they must be accelerated. Much of the adaptation is and will have to be autonomous, driven by market forces and by the needs and devices of households and firms. Governments should assist this process.

This chapter argued that a first set of actions consists of policies that should already be high on each government's agenda, even in the absence of climate change. The first and best way for governments to accelerate adaptation is to promote development successfully. If individuals and communities are empowered by development and rendered less vulnerable overall, they will be better able to adapt to changes in their environment. Second, improving disaster preparedness and management saves lives, but it also promotes early and cost-effective adaptation to climate-change risks.

But, in addition, governments should adopt new policies targeted at the climate-change threat. One important new task for governments will be to provide firms and communities with high-quality information and tools for dealing with climate change. Governments will also have an important role in encouraging effective adaptation through the use of regulation. More generally, in light of the far-reaching implications of climate change, governments should integrate adaptation into their development projects and plans across the board. Investing in climate resilience has implications for each country's investments in natural, physical, human, technological, and social capital. There will be barriers and obstacles to these climate policies that will have to be taken into consideration – but development progress will help to address and overcome these constraints.

With all of these needs, the incremental investment costs of adaptation are projected to run into many billions of dollars a year for developing countries, including very poor countries that

are already hard pressed to meet development goals. On top of those costs, these countries will have to bear the costs of the climate-change impacts that remain even after adaptation. Chapter 26 will return to the question of how the international community can best help developing countries adapt.

References

Acclimatise (2006): 'Review of adaptation to climate risks by cities', London: London Climate Chamge Partnership, available from http://www.london.gov.uk/climatechangepartnership/adapting-jul06.jsp

Agrawala, S. (ed.) (2005): 'Bridge over troubled waters: Linking climate change and development', Paris: OECD.

Baer, P. (2006): 'Adaptation: who pays whom?', in pp. 131-153, W.N. Adger, J. Paavola, S. Huq, M.J. Mace (eds.), Fairness in Adaptation to Climate Change, Cambridge: MIT Press.

Benson, C. (1998): 'The cost of disasters. Development at risk?', in Natural disasters and the third world. J. Twigg (ed.) Oxford: Oxford Centre for Disaster Studies

Benson, C. and Clay, E. Understanding the economic and financial impacts of natural disasters, World Bank, Disaster Risk Management Series No. 4, 2004, Washington DC: World Bank.

Berkhout, F. (2005): 'Rationales for adaptation in EU climate change policies', Climate Policy **5**: 377 – 391

Bettencourt, S., R. Croad, P. Freeman, et al. (2006): 'Not if but when: adapting to natural hazards in the Pacific Islands region', Washington DC: World Bank.

Brown, J.L. (2005): 'High-altitude railway designed to survive climate change', Civil Engineering **75**: 28 – 38

Burton, I., (1996): 'The growth of adaptation capacity: practice and policy, in Adapting to Climate Change: An International Perspective J.B. Smith, N. Bhatti, G.V. Menzhulin, et al. (eds.)] New York: Springer-Verlag, pp. 55–67.

Burton, I., (1997): 'Vulnerability and adaptive response in the context of climate and climate change'. Climatic Change, **36**(1-2): 185–196.

Burton, I. (2006): 'Adapt and Thrive: Options for reducing the climate change adaptation deficit', Policy Options issue December 2005-January 2006 Global Warming - A Perfect Storm.

Burton, I. and van Aalst, M. (1999): 'Come hell or high water – integrating climate change vulnerability and adaptation into bank work', World Bank Environment Department Paper No 72, Washington DC: World Bank.

Callaway, J. M., D.B. Louw, J.C. Nkomo, J. C., et al. (2006): 'The Berg River dynamic spatial equilibrium model: A New Tool for Assessing the Benefits and Costs of Alternatives for Coping With Water Demand Growth, Climate Variability, and Climate Change in the Western Cape'. AIACC Working Paper No. 31. International START Secretariat, Washington, DC: AICC available from www.aiaccproject.org

Environmental Resources Management (2006): 'Natural disaster and disaster risk reduction measures- a desk review of costs and benefits', London: DIFID.

Hanemann, W. M. (2000): 'Adaptation and its measurement', Climatic Change **13**: 571 – 581

Haughton, J. (2004): Global Warming - The Complete Briefing, third edition, available from http://www.london.gov.uk/climatechangepartnership/docs/adapting_to_climate_change.pdf

International Federation of the Red Cross and Red Crescent Societies (2002): 'World Disasters Report 2002'. Geneva: IFRC.

International Federation of the Red Cross and Red Crescent Societies (2004): 'World Disasters Report 2004'. Geneva: IFRC.

International Federation of the Red Cross and Red Crescent Societies (2003): 'World Disasters Report 2004'. Geneva: IFRC.

IMF Working Paper (2003a) Dealing with increased risk of natural disasters: Challenges and options, [Freeman, P.K., M. Keen and M. Mani], Washington: DC, IMF.

IMF (2003b): 'Fund Assistance for Countries Facing Exogenous Shocks'. Prepared by the Policy Development and Review Department (In consultation with the Area, Finance, and Fiscal Affairs Departments), Washington: DC, IMF.

Internet World Stats (2006): available from http://www.internetworldstats.com/stats.htm

Intergovernmental Panel on Climate Change (2001): 'Climate Change 2001: Working Group 1: Scientific Basis - Summary for Policymakers', Cambridge: Cambridge University Press.

Jimenez, R. (2006): How climate change is being addressed in strategic documents including CASs, PRSPs and Environmental Analytical Work. Consultant report prepared for the World Bank.

Jones, R. and R. Boer (2003): 'Assessing current climate risks', Adaptation Policy Framework: A Guide for Policies to Facilitate Adaptation to Climate Change, UNDP, in review, available from
http://www.undp.org/cc/apf-outline.htm

Jones, R. and L. Mearns (2003): 'Assessing future climate risks', Adaptation Policy Framework: A Guide for Policies to Facilitate Adaptation to Climate Change, UNDP, in review, available from
http://www.undp.org/cc/apf-outline.htm

Kleindorfer, P. R., and H. Kunreuther (2000): 'Managing catastrophe risk', Regulation, **23**: 26 – 31, available from http://www.cato.org/pubs/regulation/regv23n4/kleindorfer.pdf

London Climate Change Partnership (2005): 'Adapting to climate change: a checklist for development'.

Mechler, R., J. Linnerooth-Bayer, and D. Peppiatt (2006): 'Micro insurance for natural disaster risks in developing countries: benefits, limitations and viability', ProVention/IIASA study, Geneva: Provention Consortium.

Mendelsohn, R. (2000) Efficient adaptation to climate change, Climatic Change **45**: 583 – 600

Munich Re (2005): 'Topics Geo Annual review: Natural catastrophes 2005', Munich: Munich Re Group.

Nkomo, J.C., A. Nyong and K. Kulindwa (2006): 'The impacts of climate change in Africa', Commissioned by the Stern Review.

Overseas Development Institute (2005)`Aftershocks: natural disaster risk and economic development policy', ODI Briefing Paper November 2005

OECD (2004): 'Statistical Annex of the 2003 Development Cooperation Report', Paris: OECD.

OECD (2004b): 'Natural Disasters and Adaptive Capacity' [J. Dayton-Johnson] Working Paper No 237, DEV/DOC(2004)06, Paris: OECD.

Pritchett, L., S. Sumarto, and A. Suryahai (2002): Targeted programmes in an economic crisis: Empirical findings from the experience of Indonesia. SMERU Working paper

ProVention Consortium (2005): 'Successful disaster prevention in LAC', available from http://www.proventionconsortium.org/goodpractices/

Roy, J. (2006): 'The Economics of Climate Change: A review of studies in the context of South Asia with a special focus on India'. Jadavpur University.

Schelling, T.C. (1992): 'Some Economics of Global Warming', the American Economic Review **82**(1): 1

Sen, A. (2004): 'A lecture on India: large and small', Public Lecture, December, 2004, India Habitat Centre, New Delhi

Sperling F. (ed). (2003): 'Poverty & climate change: reducing the vulnerability of the poor through adaptation', Washington, DC: AfDB, AsDB, DFID, Netherlands, EC, Germany, OECD, UNDP, UNEP and the World Bank (VARG).

Summers, L. H. (1992): 'Investing in all the people – educating women in developing countries', Vol. 45. Washington, DC: World Bank.

Tompkins, E. L. (2005): 'Planning for climate change in small islands: Insights from national hurricane preparedness in the Cayman Islands', Global Environmental Change, **15.**

Tompkins, E. L., & Adger, N. W. (2005): 'Defining a response capacity to enhance climate change policy', Environmental Science & Policy, **8.**

UNDP Reducing Disaster Risk (2004): A challenge for development

UNEP Global Environment Outlook 2003.

UNESCO Institute for Statistics (2006): 'Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change', 2005, UNFCCC Secretariat, available from http://stats.uis.unesco.org/tableviewer/document.aspx?FileId=220

Venton, C and Venton, P. (2004). Disaster preparedness programmes in India. A cost benefit analysis. Humanitarian Practice Network, London: ODI.

Washington, R., M. Harrison, and D. Conway, (2004): 'African Climate Report: A report commissioned by the UK Government to review African climate science, policy and options for action', December 2004.

World Food Programme (2006): Progress Report on the Ethiopia Drought Insurance Pilot Project, WFP Executive Board Annual Session, :WFP

World Bank (2001): 'Engendering development through gender equality in rights, resources, and voice', volume 1. [King, E. M., and Mason, A. D], Washington, DC: World Bank.

World Bank (2004): 'Natural disasters: counting the cost'. Feature story 2nd March 2004, Washington, DC: World Bank.

World Bank (2005a): 'Natural disaster hotspots: A Global Risk Analysis', IBRD, and Columbia University, Washington, DC: World Bank.

World Bank (2005b): 'Scaling up micro insurance: the case of weather insurance for smallholders in India', Washington, DC: World Bank.

World Bank (2006a): 'Clean Energy & Development: Towards an Investment Framework' Annex K, Washington, DC: World Bank.

World Bank (2006b): 'Not if, but when: adapting to natural hazards in the Pacific Islands Region', a policy note, Washington, DC: World Bank.

World Bank (2006c, draft): 'How climate change is being addressed in Bank's strategic documents including CASs, PRSPs and Environment Analytical Work'. Prepared by Ricardo Jimenez (Consultant) for the Environment Department of the World Bank, Washington, DC: World Bank.