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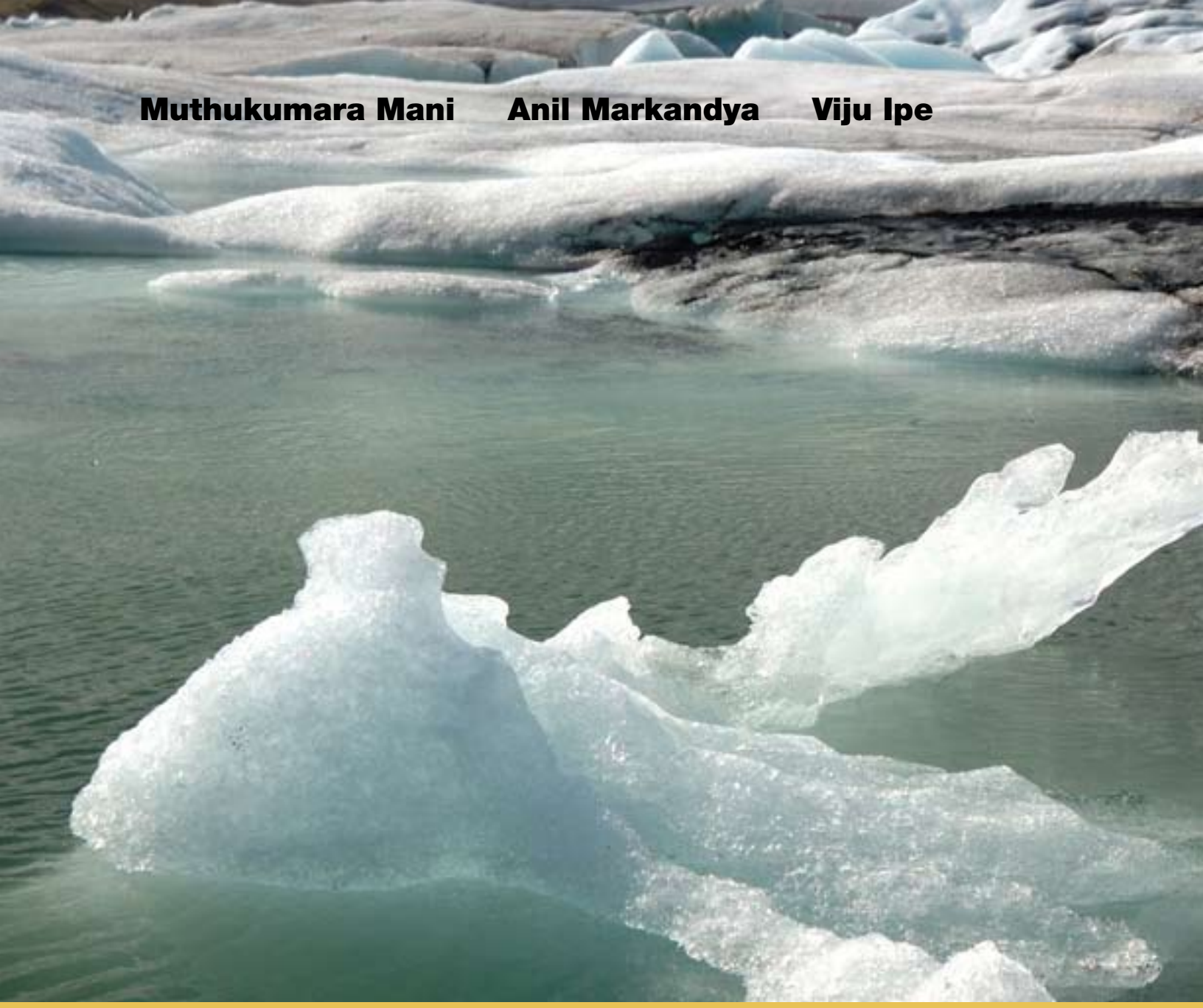

POLICY AND INSTITUTIONAL REFORMS TO SUPPORT

climate change

ADAPTATION AND MITIGATION IN DEVELOPMENT PROGRAMS

A PRACTICAL GUIDE

Environment Department Sustainable Development Network The World Bank

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Contents

List of Acronyms

CDG	Carbon delivery guarantee
CDM	Clean Development Mechanism
CEA	Country Environmental Analysis
CEIF	Clean Energy for Development Investment Framework
CER	Certified emission reduction
CFL	Compact fluorescent lamp
CFU	Carbon finance unit
CPF	Carbon Partnership Facility
CPIA	Country Policy and Institutional Assessment
EIA	Environmental impact assessment
EPI	Environment Performance Index
ERC	Emission reduction credits
GHG	Greenhouse gases
FCPF	Forest Carbon Partnership Facility
GDP	Gross domestic product
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goals
NAFTA	North American Free Trade Agreement
NAPA	National adaptation programs of action
PRSC	Poverty reduction strategy credit
RAF	Resource allocation framework
REDFD	Reducing emissions from deforestation and forest degradation
SEA	Strategic environmental analysis
SFCCD	Strategic Framework for Climate Change and Development
TTL	Task team leader
UNFCCC	United Nations Framework Convention on Climate Change
WBG	World Bank Group

***Notes*:**

1. Unless otherwise noted, all dollars = U.S. dollars.

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Preface

The need to “mainstream” climate policy into development goals is well-recognized within the World Bank, as well as at the national level and among other donor agencies. Individually and collectively, international multilateral and bilateral organizations have responded to the increasing challenge of climate change with an agenda for action to integrate climate concerns into the mainstream of developmental policy making and poverty-reduction initiatives. All have defined major new initiatives designed to help their clients mitigate the impact of past and future development programs on climate change. In addition, they have intensified joint efforts on both climate change mitigation and adaptation.

Actions needed to adapt to climate change and to limit GHGs cover many sectors of the economy (agriculture, water, coastal areas, forests, biodiversity and ecosystems, health, transport and infrastructure investment). Since all of these are affected by most development programs, one can expect the choice of policies for development to have implications for adaptation policy. More widely, macroeconomic and sectoral policies also have potential impacts on emissions of GHGs and on the nature of development in a country, which in turn has implications on the costs of adaptation. It is important for donors and their country partners to be aware of these linkages.

The purpose of this study is to draw on all available material in order to provide targeted guidance on the linkages between the design of development programs and the objectives of adapting to climate change and limiting emissions of greenhouse gases (GHGs). The report should be useful to practitioners in development organizations (multilateral and bilateral institutions) and countries for a better understanding of the implications of development programs and policies on climate change, as well as the implications of climate policies on budgetary and related operations.

Acknowledgments

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The authors are solely responsible for the views expressed here, which do not necessarily represent the opinion of the World Bank, its Executive Directors, or the countries they represent. The generous support received from the Bank Netherlands Partnership Program (BNPP) is gratefully acknowledged.

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Introduction

There is now a strong consensus that climate change presents an urgent challenge to the well-being of all countries, particularly the poorest countries and the poorest people in them. Even if efforts to reduce greenhouse gas emissions (GHGs) are successful, it is no longer possible to avoid some degree of global warming and climate change. The primary direct effects of climate change are an increase in droughts and floods, more seasonal peaks in river flow, and a higher probability of stronger tropical storms. The poorest countries and communities are likely to suffer the most because of their geographical location, low incomes, and low institutional capacity, as well as their greater reliance on climate-sensitive sectors like agriculture.

Climate action regarding adaptation is therefore increasingly important in most developing countries. Adaptation is understood to include efforts to adjust to ongoing and potential effects of climate change. Building up resilience to increasing climate variability is the most significant climate challenge facing these countries. Although poor developing countries contribute the least to GHG emissions, some development programs—such as expanding access to clean energy (including through regional projects), as well as financing improved land management and forest management programs—can offer true win-win opportunities in terms of both supporting good development and reducing global GHG emissions.

Given the inherent costs involved, adaptation should be pursued not as an end in itself, but as a means to meet the development objectives of countries. Countries will need to factor climate risks into their development planning and consider the range of interventions that will increase their resilience to climate change. In low-income countries, a primary focus on growth and poverty reduction can increase climate resilience by helping these countries diversify their economies.

In 2007 the World Bank undertook a review of how climate change impacts poor developing countries. The review highlighted the strong links between poverty and climate vulnerability and emphasized the need for increased resources to assist countries (a) with the higher costs of climate risk management and asset rehabilitation due to more frequent and severe natural disasters, and (b) to adapt within their core development strategies.[1]

Lessons from Bank experience also demonstrate that mitigation of and adaptation to climate change can have significant synergies with local development priorities and development of new business opportunities. In an address at the United Nations Conference in Bali in December 2007, World Bank President Robert Zoellick noted that climate change is a "development, economic and investment challenge. It offers an opportunity for social and economic transformation that can lead to an inclusive sustainable globalization. That is why climate change is a critical pillar of the development agenda."[2]

In 2008 the Bank issued the Strategic Framework for Climate Change and Development. The framework seeks to integrate climate change and development challenges without compromising growth and poverty reduction efforts through its country operations, including policy dialogue, lending, and analytical work in client countries, and through its regional and global operations.

The purpose of this report is to draw on all available material in order to provide targeted guidance on the linkages between the design of development programs and the objectives of adapting to climate change and limiting emissions of greenhouse gases (GHGs).

Donor-supported poverty reduction strategy credits (PRSCs) are already playing an increasing role in

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1 World Bank. 2007. *IDA and Climate Change: Making Climate Action Work For Development.* Other important contributions that have come out recently include the IPCC Fourth Assessment report (2007), the UNFCCC report on investment flows (2007), the International Energy Agency's (IEA) *World Energy Outlook 2007*, and the forthcoming Organisation for Economic Co-operation and Development's (OECD) *Environmental Outlook 2008*.

2 Robert Zoellick, United Nations Climate Change Conference in Bali, Indonesia, December 2007.

supporting prioritized policy actions in implementing the agenda of social and structural policy and institutional reform in a number of countries. Mainstreaming of the climate agenda is still in the early stages and is mainly driven by the UNFCCC through preparation of National Adaptation Programs of Action (NAPA) and associated prioritization of adaptation projects.[3] The countries are also increasingly integrating climate change adaptation strategies into the development and implementation of PRSCs.

The financial implications of actions to address climate change in developing countries remain highly uncertain. The estimated total cost of adaptation range from $4 to $109 billion a year, with a significant portion coming from public funds. Such high levels of expenditure cannot be made outside a macroeconomic framework that recognizes their importance, evaluates them appropriately, and includes them in the medium-term expenditure framework.

Objective and Audience

The report provides practical guidance to development practitioners on systematically analyzing the direct and indirect effects of development policy reforms on climate change, as well as how climate change affects the choice of instruments used to promote sustainable development. The specific objectives are to:

- Offer guidance on general measures that need to be taken in each country to ensure that climate change considerations are mainstreamed into development policies and programs.
- Offer guidance on how macroeconomic and sectoral development policies impact on the objectives of mitigating GHGs and on adapting to climate change.
- Provide examples of important pathways by which climate change can impact on the effectiveness of development policy lending and what these pathways imply for the design of such policy.
- Provide examples of policy making at the national level that successfully mainstreams climate considerations.

The report should be useful to practitioners in development organizations (multilateral and bilateral institutions) and countries for a better understanding of the implications of development programs and policies on climate change, as well as the implications of climate policies on budgetary and related operations.

Key Policies and Programs Addressed

Development programs are associated with a whole array of policies such as macroeconomic policy reforms, fiscal policies, and specific policies in key sectors such as agriculture, energy, transport, health, and education. In some cases, the operation may deal directly with reforms in certain climate sensitive sectors such as energy, transport, water and sanitation, agriculture, and forestry. In such cases, there is an obvious need for a careful analysis of impacts of these policies on emissions of GHGs, as well as on the effectiveness of measures taken to adapt to climate change. In other cases, such as public sector reform and governance, the potential for likely significant impacts on the environment and natural resources is much less, but even here there may be a need to include a climate "overlay" on the reforms being proposed.

From an analytical standpoint, more difficult cases are those where the effect is indirect. Trade, public expenditure management, and privatization reforms could have a significant bearing on GHG emissions on natural resources, with implications for the climate impacts of these changes on individuals. For example, reducing export tariffs on agriculture products may increase exports of certain crops with a high demand for water and low drought tolerance. As climate impacts start to bite, farmers who have adopted these crops will be negatively affected. Switching to other crops, which is what the climate adaptation policy is promoting, will become more costly. These examples underscore the need for the two programs to work in harmony.

3 For further details see http://unfccc.int/national_reports/napa/items/2719.php. Accessed 9th November 2008.

Structure of the Report

The report organizes the different tools available for analysis of the effects of each policy, identifies the environmental priorities, and then provides guidance on selection and use of the tools given the time and resource constraints. The report is designed to be concise and user-friendly. It consists of three specific modules.

The ***first module*** looks at the main climate impacts that can be expected in developing countries. It briefly describes the measures being taken to adapt to the expected impacts and provides some estimates of the costs of these measures. The data and information are drawn from the latest IPCC report, as well as from reports and publications of national governments.[4]

The second module identifies relevant transmission channels through which development programs could have an effect on GHG emissions and on the impacts of impending climate change on individuals. The development programs are divided into two groups: (1) macroeconomic reforms, including macroeconomic stability, the investment climate, governance, social protection, and competition; and (2) sectoral reforms, including agriculture, forestry, and mining. The analysis identifies two classes of possible actions to respond to these linkages: (1) actions that need to be taken to minimize any negative impact of the development programs; and (2) actions that can be taken to enhance the impact of the program. The first is based on the principle of doing as little harm as possible to climate adaptation and mitigation,[5] **and the second on the principle of being pro-active and using the development program framework to make mitigation and adaptation polices more effective.**

The ***third module*** describes the measures being introduced to reduce GHGs and to adapt to climate change in developing countries. They should be borne in mind when deciding what new policies or measures should be introduced or what existing polices strengthened to ensure that climate policy and development policies are reinforcing. The aim is to inform those preparing the programs of what is going on in the climate arena, how it may affect the measures they wish to implement and specific policies that may be implemented.

4 IPCC. 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Intergovernmental Panel on Climate Change"*. **Bonn: Intergovernmental Panel on Climate Change.**

5 In the climate literature the term mitigation is used to refer to measures to reduce the emissions of GHGs.

Module I

This module provides some background information on the likely impacts of climate change in developing countries and on possible measures that need to be taken to address the ongoing and forthcoming changes.

As the 4th IPCC report notes,

> "Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases."

The main impacts of climate change are summarized in this report. This module provides a brief description of these impacts and of the measures that can be taken to adapt to them. It also reviews measures by which developing countries can reduce their GHG emissions in a cost-effective way.

Impacts of Climate Change in Developing Countries

The IPCC report identifies a large number of areas of impact. Summarized below are those where there are likely to be significant consequences for the development of a country:

Freshwater resources

- Average river runoff and water availability are projected to increase by 10–40 percent at high latitudes and in some wet tropical areas, but decrease by 10–30 percent over some dry areas at mid-latitudes and in the dry tropics.

- Drought-affected areas will likely increase in extent. At the same time, heavy precipitation events, which are very likely to increase in frequency, will augment flood risk.

- Over the course of the century, water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by meltwater from major mountain ranges, where more than one-sixth of the world's people currently live.

Ecosystems

- The resilience of many ecosystems is likely to be exceeded in this century by an unprecedented combination of climate change, associated disturbances (such as flooding, drought, wildfire, insects, and ocean acidification), and other global change drivers (such as land use change, pollution, and overexploitation of resources).

- Due to increases in global average temperature exceeding 1.5 to 2.5° C and concomitant atmospheric carbon dioxide concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions, and species' geographic ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services such as water and food supply.

Food, fiber, and forest products

- Crop productivity is projected to increase slightly at mid- to high latitudes for local mean temperature increases of up to 1–3° C depending on the crop, and then decrease beyond that in some regions. At lower latitudes, especially seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increases (1–2° C), which would increase the risk of hunger.

- Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1–3° C, but above this it is projected to decrease.

- Increases in the frequency of droughts and floods are projected to affect local crop production negatively, especially in subsistence sectors at low latitudes. However, at all latitudes

adaptations such as altered cultivars and planting times allow cereal yields to be maintained at or above baseline yields for modest warming.

- Globally, commercial timber productivity rises modestly with climate change in the short- to-medium term, with large regional variability around the global trend.

- Regional changes in the distribution and production of particular fish species are expected due to continued warming, with adverse effects projected for aquaculture and fisheries.

Coastal systems and low-lying areas

- Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas.

- Corals are vulnerable to thermal stress and have low adaptive capacity. Increases in sea surface temperature of about 1–3° C are projected to result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatization by corals.

- Coastal wetlands, including salt marshes and mangroves, are projected to be negatively affected by sea-level rise, especially where they are constrained on their landward side or starved of sediment.

- By the 2080s, many millions more people are projected to be flooded every year due to sea-level rise. Those densely populated and low-lying areas where adaptive capacity is relatively low, and which already face other challenges such as tropical storms or local coastal subsidence, are especially at risk. The numbers affected will be largest in the mega-deltas of Asia and Africa. Small islands are especially vulnerable.

Industry, settlements, and society

- The most vulnerable industries, settlements, and societies are generally those in coastal and river flood plains, those whose economies are closely linked with climate-sensitive resources, and those in areas prone to extreme weather events, especially where rapid urbanization is occurring.

- Where extreme weather events become more intense and/or more frequent, the economic and social costs of those events will increase. These increases will be substantial in the areas most directly affected. Climate change impacts spread from directly impacted areas and sectors to other areas and sectors through extensive and complex linkages.

Health

- Projected climate-change-related exposures are likely to affect the health status of millions of people, particularly those with low adaptive capacity, through:

    - Increases in malnutrition and consequent disorders, with implications for child growth and development

    - Increased deaths, disease, and injury due to heat waves, floods, storms, fires, and droughts

    - An increased burden of diarrheal disease

    - Increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone related to climate change

    - Altered spatial distribution of some infectious disease vectors.

- Climate change is expected to have some mixed effects, such as a decrease or increase in the range and transmission potential of malaria in Africa.

- Studies in temperate areas have shown that climate change is projected to bring some benefits, such as fewer deaths from cold exposure. Overall, it is expected that these benefits will be outweighed by the negative health effects of rising temperatures worldwide, especially in developing countries.

There are four observations about these impacts.

The first is that the impacts in the low latitudes, where most of the developing countries are located, are largely negative.

Second, while the balance of positive and negative health impacts will vary from one location to another and will alter over time as temperatures continue to rise, poor communities will be especially vulnerable, particularly those concentrated in high-risk areas. They tend to have more limited adaptive capacities and are more dependent on climate-sensitive resources such as local water and food supplies. It follows from this that a reduction in poverty will reduce the vulnerability to climate change. Thus development and adaptation go hand in hand.

Third, the observations clearly note an increase in negative impacts as GHG concentrations increase and as global mean temperatures rise. Whereas for small increases in temperatures of around 1 to 2° C there are even some positive effects, these disappear once temperature increases reach 4 to 5° C and above.

Fourth, there remains a great deal of uncertainty about these impacts, especially at the local level. The IPCC report is at pains to reflect this by stating varying degrees of confidence in its statements. From a policy perspective, this uncertainty translates into the need to avoid extreme events through the adoption of measures that reflect an aversion to risk.

Africa and South Asia are the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity. Some adaptation to current climate variability is already taking place; however, this may be insufficient for future changes in climate.

The report estimates that between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change by 2020. Coupled with increased demand, this will adversely affect livelihoods and exacerbate water-related problems. Agricultural production, including access to food in many African countries and regions, is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons, and yield potential—particularly along the margins of semi-arid and arid areas—are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent. In some countries, yields from rainfed agriculture could be reduced by up to 50 percent by 2020.

Local food supplies are also projected to be negatively affected by decreasing fisheries resources in large lakes due to rising water temperatures, which may be exacerbated by continued overfishing. Toward the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to10 percent of gross domestic product (GDP). Mangroves and coral reefs are projected to be further degraded, with additional consequences for fisheries and tourism.

Adaptation Measures to the Impacts of Climate Change

The IPCC refers to adaptation practices as actual adjustments, or changes in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate. Investment in coastal protection infrastructure to reduce vulnerability to storm surges and anticipated sea-level rise is an example of actual adjustments. The development of climate risk-screening guidelines, which might make downstream development projects more resilient to climate risks, is an example of changes in the policy environment.

Another important classification of measures is with respect to the time dimension. Adaptation to climate risks can be viewed at three levels: (1) responses to current variability (which also reflect learning from past adaptations to historical climates); (2) observed

medium and long-term trends in climate; and (3) anticipatory planning in response to model-based scenarios of long-term climate change.

In the context of development programs, the cases of greatest interest are when there is a conflict between policies that promote development and those that protect individuals against the impacts of climate change. For example, activities such as shrimp farming and conversion of coastal mangroves may promote rural livelihoods, but they could also exacerbate vulnerability to sea-level rise.

Adaptation measures can be further classified into *proactive* and *reactive or ex-post*. Examples of proactive measures include crop and livelihood diversification, seasonal climate forecasting, community-based disaster risk reduction, famine early warning systems, insurance, water storage, supplementary irrigation and so on. Examples of *reactive* or *ex-post* measures include emergency response, disaster recovery, and migration. Recent reviews indicate that a "wait-and see" or reactive approach is often inefficient and could be particularly unsuccessful in addressing irreversible damages—such as species extinction or unrecoverable ecosystem damages—that may result from climate change.

Table 1.1 provides examples of some adaptation measures implemented by a range of actors, including individuals, communities, governments, and the private sector. Such measures involve a mix of institutional and behavioral responses, the use of technologies, and the design of climate-resilient infrastructure. They are typically undertaken in response to multiple risks, and often as part of existing processes or programs, such as livelihood enhancement, water resource management, and drought relief. Public expenditures are an important part of the adaptation strategy, although they are by no means the only part of the strategy. While climate change has generated a great deal of discussion, relatively few adaptation measure have been implemented to date.

In addition to the examples in Table 1.1, which are largely though not entirely reactive, there are now measures being taken to adapt infrastructure investment to account for future climate change. This is particularly the case for long-lived infrastructure that may be exposed to climate change impacts over its lifespan, or where business-as-usual activities would irreversibly constrain future adaptation to the impacts of climate change. Examples are mostly from developed countries and include investments in roads, railway lines (to account for subsidence from climate change), bridges (to account for sea-level rise), and the like. More of this should be done, however, in developing countries.

An example from the developing world, the Qinghai-Tibet Railway, is an exception. The railway crosses the Tibetan Plateau, including about 1,000 kilometers that is at least 13,000 feet (4,000 meters) above sea level. Five-hundred kilometers of the railway rests on permafrost, with roughly half of it "high-temperature permafrost," which is only 1 to 2° C below freezing. The railway line would affect the permafrost layer, which will thaw as a result of rising temperatures, in turn affecting the stability of the line. To reduce these risks, design engineers have put in place a combination of insulation and cooling systems to minimize the amount of heat absorbed by the permafrost.

In addition to specific infrastructure projects, there are now also examples where climate change scenarios are being considered in more comprehensive risk management policies and plans. Efforts are under way to integrate adaptation to current and future climate within the environmental impact assessment (EIA) procedures of several countries in the Caribbean. Within OECD countries, a number of other policy initiatives have also been put in place that account for future climate change, particularly sea-level rise. In the Netherlands, for example, the Technical Advisory Committee on Water Defence recommended the design of new engineering works with a long lifetime, such as storm surge barriers and dams, to take a 50-cm sea-level rise into account. Such examples from developing countries are rare, although there are exceptions (see the case of Bangladesh in Table 1.1).

There are also examples of consideration of climate change as part of comprehensive risk-management

strategies at the city, regional, and national levels. France, Finland, and the United Kingdom have developed national strategies and frameworks to adapt to climate change. At the city level, meanwhile, climate change scenarios are being considered in a number of developed countries. Again, there are fewer examples from the developing world of this kind of risk management strategy.

In deciding on which adaptation policies to introduce, policy makers need to look at their costs and benefits. This is difficult, given the major uncertainties referred to above, and implies the need to adopt the precautionary principle of taking action to prevent serious negative effects from climate change.

Most work has been done on sea-level rise, where the estimates are relatively straightforward. Studies

Table 1.1 Adaptation initiatives in selected developing countries

Region/ Country	Climate Stress	Adaptation Practices
Africa		
Egypt	Sea-level rise	Adoption of National Climate Change Action Plan integrating climate change concerns into national policies; adoption of law 4/94 requiring EIA for project approval and regulating setback distances for coastal infrastructure; installation of hard structures in areas vulnerable to coastal erosion
Sudan	Drought	Expanded use of traditional rainwater harvesting and water conserving techniques; building of shelter belts and wind breaks to improve resilience of rangelands; monitoring of the number of grazing animals and trees cut; set-up of revolving credit funds
Botswana	Drought	National government programs to re-create employment options after drought; capacity building of local authorities; assistance to small subsistence farmers to increase crop production
Asia		
Bangladesh	Sea-level rise, saltwater intrusion	Consideration of climate change in the National Water Management Plan; building of flow regulators in coastal embankments; use of alternative crops and low-tech water filters
Philippines	Drought, floods	Adjustment of silvicultural treatment schedules to suit climate variations; shift to drought-resistant crops; use of shallow tubewells; rotation method of irrigation during water shortages; construction of water impounding basins; construction of fire lines and controlled burning; adoption of soil and water conservation measures for upland farming
Nepal	Glacial lake expansion	The Tsho Rolpa risk reduction project in Nepal is an example of adaptation measures being implemented to address the creeping threat of glacial lake outburst flooding as a result of rising temperatures, potentially causing serious damage to a dam and to livelihoods downstream.
Small Islands (Somoa, Tonga, Cook Islands)	Sea-level rise	Capacity building for shoreline defense system design; introduction of participatory risk assessment; provision of grants to strengthen coastal resilience and rehabilitation of infrastructures; construction of cyclone-resistant housing units; retrofit of buildings to improved hazard standards; review of building codes; reforestation of mangroves
	Drought, saltwater intrusion	Rainwater harvesting; leakage reduction; hydroponic farming; bank loans allowing for purchase of rainwater storage tanks

Source: from IPCC WGII Fourth Assessment Report – Final Draft for Government Review Chapter 17: Assessment of Adaptation Practices, Options, Constraints and Capacity.

indicate that, based on such a benefit-cost assessment, almost all the cities in the OECD countries and about 50 to 80 percent of beaches and open coasts should be protected. In the case of developing countries, an analysis for some selected Asian states shows the costs of coastal protection as a percentage of GDP. In general the figures are low, amounting to 1 to 2 percent of GDP, depending on which climate scenario considered. In the case of a couple of island states, however, the percentage rises to more than 13 (IPCC WGII, 2007).[7] These cost-benefit calculations are sensitive to the assumed values of the land and structures that would be affected.

There are a few studies of the costs and benefits of agricultural adaptation for developing countries.[8] The available results indicate that there are large inter and intra-regional variations. Here are some examples:

- In the case of Gambia, Njie and others (2006) found that yields of millet would increase and inter-annual variability decrease through adaptation measures such as improving cultivars, irrigation, and improved crop fertilization. The net benefits of these measures, however (that is, the benefits less the costs), were not always positive. In general, the net benefits were higher for crop fertilization than for the other measures. The authors note the high level of uncertainty, especially as one goes further out in time.

- In Mali, Butt and others (2005) estimate that adaptation through trade, through changes in crop mix, and through the development of heat-resistant cultivars could offset 90 to 107 percent of the welfare losses arising from climate change. Thus the benefits can exceed the costs or come close to it.

- For many countries located in tropical regions, the potential benefits of low-cost adaptation measures such as changes in planting dates, crop mixes, and cultivars do not turn out to be sufficient to offset the significant climate change damages (Rosenzweig and Parry, 1994; Butt and others 2005).

These analyses need to be interpreted with some caution. First, there is a high level of uncertainty about the "business-as-usual" scenario. In particular, not taking action could result in high "socially contingent" costs, such as when populations migrate and social changes lead to conflict. By and large, these have not been accounted for. Including them would turn the calculations more in favor of some adaptation action, although that action may not best take the form of maintaining agriculture in the affected regions.

Second, where there are risks, the benefits should include a premium associated with any actions that reduce this risk. In general, such a premium has not been added.

Third, most of the benefits of adaptation go to poor households, while the costs are incurred to individuals with a higher average income. This transfer, although not generally accounted for, should also be considered.

In addition to the national-level studies, there are overall estimates of the costs of adaptation to climate change at the global level. Table 1.2 summarizes the main studies, which range from $4 billion to $109 billion a year for developing countries and $44 billion to $166 billion for all countries. The breakdown between public and private sectors is not provided. Notwithstanding the uncertainty over costs, it is clear these costs could be a significant share of the budget of developing countries in the years to come and hence deserve to be taken seriously.

Overall, IPCC AR4 summarized the situation by noting that the literature on adaptation costs and benefits remains "quite limited and fragmented" (Adger and others 2007, in IPCC WGII 2007). It reported that there

7 The countries covered in the study were Micronesia, Palau, Tuvalu, Marshall Islands, Mozambique, French Polynesia, Guinea-Bissau, Nauru, Guyana, New Caledonia, Papua New Guinea, Kiribati, Maldives, Vietnam, and Cambodia.

8 There is virtually nothing on the costs of adapting energy systems at the country level.

is only a small methodological literature on the adaptation cost-benefit assessment, much of this at a macro-scale associated with global assessment, and there remains very limited real practical application.

Other aspects of adaptation that are relevant from the broader perspective of development policy are the following:

Adaptive capacity and development

Although development does in general make it easier to adapt, new studies show that adaptive capacity is influenced not only by economic development and technology, but also by social factors such as human capital and governance structures. Furthermore, recent analysis argues that adaptive capacity is not a concern unique to regions with low levels of economic activity. Although economic development may provide greater access to technology and resources to invest in adaptation, high per-capita income is considered neither a necessary nor a sufficient indicator of the capacity to adapt to climate change. Some elements of adaptive capacity actually are not substitutable: an economy will be as vulnerable as the "weakest link" in its resources and adaptive capacity (for example, with respect to natural disasters). Within both developed and developing countries, some regions, localities, or social groups have a lower adaptive capacity.

Determinants of adaptive capacity

The specific determinants of adaptive capacity at the national level represent an area of contested knowledge. Some studies relate adaptive capacity to levels of national development, including political stability, economic well-being, human and social capital, and institutions. National-level adaptive

Table 1.2 Global studies of adaptation costs

Study	Cost of Adaptation	Regional coverage	Time frame	Sectors	Comments
World Bank (2006)	$9 billion to $41 billion/year	Developing countries	Present	Unspecified	Based on OECD and WB analysis of flow exposed to CC. Costs of reducing climate risks (climate proofing)
Stern Review (2006)	$4 billion to $37 billion/year	Developing countries	Present	Unspecified	Update with modification of WB study
Oxfam (2007)	At least $50 billion/ year	Developing countries	Present	Unspecified	WB study plus extrapolation from NAPA's and NGO estimates
UNDP (2007)	$86 billion to $109 billion/year	Developing countries	2015	Unspecified	WB study, plus costing of targets for adapting poverty reduction programs and strengthening of disaster response
UNFCCC (2007)	$28 billion to $67 billion/year	Developing countries	2030	Agriculture, forestry, fisheries, water supply, health, coastal zones, infrastructure	Analysis of specific adaptations
UNFCCC (2007)	$44 billion to $166 billion/year	Global	2030	Agriculture, forestry, fisheries, water supply, health, coastal zones, infrastructure	

Source: Agrawala and others. 2008. Presented at the OECD workshop on Economic Aspects of Adaptation.

capacity has also been represented by proxy indicators such as economic capacity, human and civic resources, and environmental capacity. From the Bank's perspective, a country-level assessment of adaptive capacity should include an assessment of the institutional capacity in the government structures that deal with adaptation measures, as well as an assessment of the capacity of the private sector and civil society to make behavioral changes in the light of new pressures from climate-related events. In all this, vulnerability assessments of key affected groups should also play a part, but they are not the whole story. In addition, there could be major differences between regions of the country and between different communities and groups, which also need to be recognized.

Finally, the capacity to adapt is influenced by economic policies. For instance, measures that improve non-farm employment opportunities and reduce peoples' dependence on the land make rural households less vulnerable to changes in yields. Likewise, a policy that allows prices of primary products to become volatile makes it more difficult for farmers to survive if low prices coincide with periods of drought in the region. Trade measures can also affect adaptation. In the case of India, many farmers no longer plant traditional, drought-tolerant oilseed crops because there are no markets due to an influx of cheap imports from abroad (O'Brien and others 2004). It is also argued that the globalization of fisheries has decreased the resilience of marine ecosystems (Berkes and others 2006) and made them less able to adapt to climate change.

Measures to enhance adaptation capacity

Measures that have been identified as important in enhancing adaptation capacity include:

- Reducing vulnerability of people and infrastructure
- Providing information on risks for private and public investments and decision making
- Protecting public goods such as habitats, species, and culturally important resources.

The process of providing international finance to developing countries to support these measures is through a National Adaptation Program of Action (NAPA). In completing a NAPA, a country identifies priority activities that must be implemented in the immediate future in order to address urgent national climate change adaptation needs. Although only six countries had completed their national NAPA reports as of mid-2006, a number of specific projects were identified in these reports for priority action. For instance, lessons from the Bangladesh NAPA suggest that the country should (a) adopt a livelihood rather than a sectoral approach, (b) focus on near- and medium-term impacts of climate variability as well as long-term impacts, (c) ensure integration of indigenous and traditional knowledge, and (d) ensure procedural fairness through interactive participation and self-mobilization.

NAPA as an instrument needs to recognize the importance of mainstreaming adaptation into macro policies as well as policies across all sectors affecting water management, disaster preparedness, land use planning, and energy planning. By ensuring the mainstreaming of adaptation measures, we ensure that this area of policy will become part of and consistent with other well-established programs.

Like the World Bank, other agencies are also seeking to integrate climate change adaptation into their grant and loan activities. They want to screen out those loans or grants that make adaptation more difficult or less effective and that create new vulnerabilities. So far, however, they have not fully examined how their activities affect vulnerability to climate change and have not encompassed a set of measures to reduce vulnerability.

Adaptation is constrained by ecological, technical, economic, and financial factors. In some cases it may be impossible from an ecological viewpoint to adapt, at least locally, to the changes. In such cases more major action may be needed, such as complete relocation of populations and abandonment of ongoing activities. Then there are technological limits regarding how much one can restore the situation *ex ante*. These go together with economic factors,

which determine how much one can justify, in terms of costs and benefits, to adapt to a given set of impacts. Finally, even if an action is ecologically and technically feasible, and it is justified on cost-benefit grounds, it may not be undertaken if the agents involved cannot afford to make the necessary outlays. Without external support, many of the justifiable actions will not be implemented.

Mitigation Measures to the Impacts of Climate Change

Mitigating climate change is central to the development and poverty reduction agenda. Early mitigation of greenhouse gas emissions will significantly reduce the need for future adaptation, especially the burden on the poor. Few major studies—such as IPCC *Fourth Assessment* report (2007), the UNFCC report on investment flows (2007), the International Energy Agency's (IEA) *World Energy Outlook 2007*, and the upcoming Organisation for Economic Co-operation and Development's (OECD) *Environmental Outlook 2008*—have improved the understanding of the feasibility and costs of curbing GHG emissions. Stabilization of GHG concentrations within the levels that keep the impacts of climate change manageable would require limiting GHG emissions through multilateral action involving policy incentives and the deployment on a global scale of a portfolio of currently available and future low-carbon technologies in a range of sectors, including energy supply, transport, buildings, industry, agriculture, forestry, and waste management.

Since GHG mitigation is a global public good, measures for abatement require international cooperation if they are to provide effective incentives. International coordination to deal with climate change has been organized under the UN Framework Convention on Climate Change (UNFCCC), which was signed in Rio de Janeiro in 1992 and ratified in 1994 by 190 countries. The climate policy framework of the UNFCCC has four critical elements: (1) a long-term goal of stabilizing GHG concentrations in the atmosphere; (2) a short-term goal for the developed countries to stabilize their emissions at 1990 levels by 2000; (3) a principle of "common but differentiated responsibilities," suggesting that developing countries should not be expected to undertake the same obligations as developed countries; and (4) opportunities for realizing more cost-effective reductions in GHG emissions through joint implementation. The Kyoto Protocol, which came into force in 2005, committed most industrial countries and some transition economies (Annex B countries) to specific GHG emission targets (see Box 1.1). Beyond Kyoto, international agreements to deal with climate change will be more efficient if they provide incentives to reduce GHG emissions and institutions to collect and verify information on emissions so that progress toward mitigation can be monitored. Such incentives could be through a carbon tax, permit market, or some combination of the two.

The UNFCCC has been implementing the Clean Development Mechanism (CDM) as one of its sources of carbon finance. Under the CDM, parties to the Kyoto Protocol could meet their obligations to reduce GHG emissions by purchasing emission reduction credits (ERCs) from projects in developing countries. An ERC is generated if a project reduces its carbon emissions below what would have occurred without the CDM. The credits need to be certified by the UNFCCC before they can be used to meet obligations under the Kyoto Protocol. The CDM market is growing; as of January 2008, the UNFCCC had registered 901 projects with ERCs totaling 1.15 billion tons of CO_2 equivalent.[9] Land-use projects eligible under the CDM are limited to afforestation and reforestation under the Marrakesh Accords. A new carbon credit program that is being negotiated with in the UNFCCC is Reducing Emissions in Deforestation and Forest Degradation (REDD). This program would compensate countries with carbon credits for their efforts in reducing CO_2 emissions through forest conservation and by controlling forest degradation.

9 Most of these projects have originated in Asia or Latin America, with fewer than 3 percent originating in Africa. China was the largest seller of ERCs between January 2005 and September 2006; most transactions involved energy and manufacturing projects.

Box 1.1 The Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) entered into force on February 16, 2005, following ratification by Russia. As of May 11, 2007, 172 countries and the regional economic integration organization (EEC) have ratified, accepted, approved, or acceded to the Kyoto Protocol. The UNFCCC includes the principle of "common but differentiated responsibilities." Under the principle, as stipulated in Article 3, Paragraph 1 of the UNFCCC, the Parties agreed that (1) the largest share of historical and current global emissions of greenhouse gases has originated in developed countries; (2) per capita emissions in developing countries are still relatively low; and (3) the share of global emissions originating in developing countries will grow to meet their social and development needs.

Under the Kyoto Protocol, industrialized countries (called Annex I countries) have to reduce their combined emissions to 5 percent below 1990 levels in the first commitment period of 2008–12. Annex I countries include the industrialized countries that were members of the Organisation for Economic Co-operation and Development (OECD) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic states, and several Central and Eastern European states. Countries that have accepted greenhouse gas emissions reduction obligations must submit an annual greenhouse gas inventory. Non-Annex I countries (developing countries) that have ratified the protocol do not have to commit to specific targets as they face potential technical and economic constraints. Nevertheless, they have to report their emissions levels and develop national climate change mitigation programs.

While the average emissions reduction is 5 percent, each country agreed to its own specific target. Within the Annex I countries, differentiated national targets range from 8 percent reductions for the European Union (EU) to a 10 percent allowable increase in emissions for Iceland.

Further, while Annex I countries must put in place domestic policies and measures to achieve their targets, the Protocol does not oblige governments to implement any particular policy, allowing countries to seek optimal ways to achieve greenhouse gas emission reduction and to adjust their climate change strategies to the circumstances of their economies. The Protocol defines three flexibility mechanisms—known as joint implementation (JI), the Clean Development Mechanism (CDM), and emissions trading—to help Annex I Parties lower the overall costs of achieving emissions targets by allowing them to reduce emissions, or increase greenhouse gas removals more cheaply in other countries than at home.

Source: 1. European Environment Agency. 2006. "Greenhouse Gas Emission Trends and Projections in Europe 2006." 2. United Nations Framework Convention on Climate Change. "Good Practices in Policies and Measures Under the Kyoto Protocol."

Although there is a broad agreement that GHGs must be reduced over the coming decades, there are differences of opinion on the stabilization targets and the means of achieving them. Estimates of GHG emissions in 2000 by sector show that about 65 percent of the total emissions are from energy consumption and industrial processes, 18 percent from land use change (primarily deforestation), and the rest (17 percent) from agriculture and waste. In 2004, the average per capita emissions were 13.3 tons of CO_2 per person in high-income countries, 4.0 in middle-income countries, and only 0.9 ton in low-income countries. Carbon emissions from both high-income (Annex 1 countries that agreed to limit GHG emissions under UNFCC) and developing countries (non-Annex 1 countries) have continued to increase. They are predicted to increase by over 60 percent by 2035 (from 2004 levels) under the IPCC AIFI[10] scenario.

Although historically the annual CO_2 emissions from developing countries remained below those from the developed countries, they will soon be equal and emissions from developing countries are projected to surpass the developed-country emissions under the AIFI scenario (Wheeler and Ummel 2007). Similarly, following the AIFI trajectory, the cumulative emissions from developing countries will equal those of high-income countries by 2035. However, this does not imply that emissions from developing countries should immediately be reduced, thus compromising their growth prospects, but does indicate that the magnitude of emissions need to be considered as well. The non-Annex 1 countries have not yet made any commitments and or responsibilities to reduce their emissions.

The World Bank and climate change

The World Bank Group has accumulated substantial experience in addressing climate change in the context of development and poverty reduction, most recently through the Clean Energy for Development Investment Framework (CEIF) together with the action plan in 2006–07. The Bank has recently issued a draft comprehensive Strategic Framework on Climate Change and Development (SFCCD) (Box 1.2).

The Bank has been a pioneer in the carbon market, and a facilitator of energy sector reforms that provide incentives for efficiency, energy savings, and better environmental practices. The CEIF focuses on three areas: (a) energy for growth, with particular emphasis on access to energy in sub-Saharan Africa; (b) the transition to a low-carbon development trajectory; and (c) adaptation to the effects of climate change. The World Bank engagement in low-carbon growth technologies has now expanded beyond energy to other sectors such as urban, transport, industry (primarily by the IFC), agriculture, and forestry. The CEIF further envisages enhancement of cooperation and harmonization with other development partners and catalyzing substantial additional resources from both the public and private sources.

The Bank Group is optimizing the use of available non-lending sources such as GEF and carbon finance for mitigation. The Bank has committed about 22 percent of its notional GEF allocation to mitigation during the GEF 2006–10 replenishment period. In addition, the Bank's carbon finance (CF) emission reduction purchase agreements totaled $195 million in fiscal 2007, of which $144 million is for energy. The CF purchase agreements are expected to reach $300 million in fiscal 2008. MIGA is also exploring opportunities to expand guarantee operations in the form of carbon credits for carbon finance projects. A carbon delivery guarantee (CDG) is IFC's flagship program. It aims to further support climate-friendly products in emerging markets. The CDG is the only product in the market that (a) improves market access for sellers of project-based carbon credits in developing countries, (b) provides sellers with enhanced counterparty quality, and (c) helps maximize the value of future credits by providing a triple-A credit enhancement and a transparent link to prices in secondary compliance markets like Europe.

10 For an explanation of AIFI scenario, refer to IPCC Special Report on Emissions Scenarios, IPCC http://www.grida.no/climate/ipcc/emission/index.htm

Box 1.2 Strategic Framework on Climate Change and Development

The World Bank's Strategic Framework on Climate Change and Development (SFCCD) is a means to articulate the WBG's vision on how to integrate climate change and development challenges, without compromising growth and poverty reduction efforts through its country operations, including policy dialogue, lending, and analytical work in client countries, and through its regional and global operations. Scaling up WBG action on climate change rests on (a) a continued priority for economic growth, poverty reduction, and achieving MDGs in developing countries; (b) an understanding that access to energy services and increased energy use by developing countries are fundamental to these goals; and (c) a recognition that adaptation to climate variability and change is critical to sustaining and furthering development gains in the majority of developing countries.

Reflecting the multisectoral and multidimensional nature of the challenge, the SFCCD will encompass activities in many sectors, covering energy, transport, urban development, water, agriculture, forestry, industry, economic policy, and social and human development. The SFCCD also acknowledges and will address multiple dimensions through which changing climate affects development: economic, financial, social, gender, and environmental, including impacts on other global environmental goods such as biodiversity.

Given that knowledge about climate change, particularly the economic and social aspects, is continuously evolving and uncertainties remain, the design of the SFCCD will be flexible so as to incorporate new knowledge and support actions, whose benefits are robust under any future scenarios of climate change negotiations and impacts.

The development of the SFCCD is also guided by the principles of (a) supporting the UNFCCC process; (b) being neutral to any negotiating party position; (c) helping developing countries manage the challenges of climate change and realize opportunities of climate action; (d) considering climate change as an overarching development and economic issue—not only an environmental issue—that requires involvement and leadership by the ministries of development and finance, in addition to environment ministries; (e) recognizing the importance of partnerships, given the many actors on the international arena with different mandates on the issue; and (f) building the SFCCD as an integral part of the Bank's strategy on inclusive and sustainable globalization.

Source: World Bank. 2008. *Toward A Strategic Framework on Climate Change and Development for the World Bank Group: Concept and Issues Paper*. Washington, DC: World Bank.

Although CEIF has focused mainly on the power sector, work has extended to other sectors such as transport, where there are opportunities to tackle development and mitigation together. Two new carbon facilities, the Carbon Partnership Facility (CPF) and Forest Carbon Partnership Facility (FCPF), were approved by the Bank Board in September 2007 to expand the scale and scope of carbon finance. The CPF is designed to (1) scale up carbon finance through programmatic and sector-based approaches, and (2) support long-term low-carbon investments by purchasing emission reductions beyond 2012. Its aim is to use carbon markets to promote GHG mitigation enhancing the value of carbon finance to leverage investment for clean energy and the use of lower-carbon technology. The CPF will provide continuity and sustain capacity in the carbon market, both in developing and developed countries.

FCPF is designed to test and pilot activities for reducing emissions from deforestation and forest degradation (REDD). It aims to build country capacity, including a national accounting framework for REDD in interested countries. FCPF's Carbon Fund will offer positive incentives for reducing emissions from tropical forests, which can improve the livelihoods of poor people who depend on natural resources, while protecting natural assets. These natural assets typically promote the maintenance of local environmental benefits such as protection of watersheds, the clearing and degradation of which represents about 30 percent of GHG emissions from developing countries. FCPF has been developed in response to numerous requests from both developing and industrialized countries, including interest from 34 IBRD and IDA member countries, with a target capitalization of $300 million. The Bank group is also developing strategies to overcome the barriers to accelerated development and deployment of clean energy technologies in developing countries.

Module 2

Transmission Channels

In this module, the different transmission channels are evaluated with respect to their possible links to climate change.

The purpose of this module is to identify the main channels through which development programs could affect the capacity of a country to adapt to climate change and to reduce its GHGs in a cost-effective way.

The pathways by which macroeconomic and sectoral reforms can influence climate policy are complex and depend on the existing institutional framework. With appropriate institutions, one can ensure a high degree of consistency between development policy and climate policy, whereas in the absence of such institutional support there can be considerable dissonance. From a broad environmental viewpoint, a country's environmental management capacity can be assessed through the CIESIN's Environment Performance Index (EPI),[11] the World Bank's CPIA index,[12] or the GEF Resource Allocation Framework (RAF).[13] For climate policy, that assessment is important but it is not enough. In addition, an assessment should be made of the country's institutional capacity to address climate issues and the extent to which these have been mainstreamed into the government policy-making framework.

Since the capacity of the country to integrate development and climate policy are crucial to the effective design of development policy, we would recommend that all countries have such an assessment carried out and any gaps in the present arrangement noted. The aim should then be to help the countries to fill these gaps as part of present and future development policy lending programs. In the meantime, where capacity is weak, special measures may need to be taken to ensure that the development programs do not have any significant negative effects on the climate side. In the analysis of the transmission channels, we have attempted to indicate what these measures might be.

For each policy we divide the linkages into those related to adaptation and those related to mitigation. For each of the two we identify actions that should be taken to reduce any negative impacts, as well as actions that could be taken to enhance the positive impacts. Thus each development policy has four sets of linkages to climate policy. Of course, not all are equally important. To give an idea of their relative importance, we have used a color coding. A red color indicates that action is very important and should be given priority. Yellow is used to indicate that action is of moderate importance and green to indicate that there are no significant linkages and could indeed be positive effects on climate adaptation and mitigation.

The policies are divided as follows: Items 1-8 are macroeconomic or economy-wide reforms and 9-19 are sectoral reforms:

1. Ensuring macroeconomic stability
2. Improving the investment climate
3. Improving public financial management
4. Governance reforms
5. Social protection
6. Decentralization

11 An Initiative of the Yale Center for Environmental Law and Policy (YCELP) and the Center for International Earth Science Information Network (CIESIN) of Columbia University, EPI measures country-scale performance on a core set of environmental policy goals for which every government can be made accountable.

12 The Country Policy and Institutional Assessment (CPIA) rates countries against a set of 16 criteria grouped in four clusters: (a) economic management; (b) structural policies; (c) policies for social inclusion and equity; and (d) public sector management and institutions. The environmental criterion assesses the extent to which environmental policies foster the protection and sustainable use of natural resources and the management of pollution. Assessment of environmental sustainability requires multidimensional criteria (i.e. for air, water, waste, conservation management, coastal zones management, and natural resources management). To ensure balanced assessments, World Bank staff members assess country policies and institutions by filling out a specific questionnaire.

13 Under the RAF, GEF resources are being allocated to countries based on their potential to generate global environmental benefits and their capacity, policies, and practices to successfully implement GEF projects.

7. Increasing competition and entrenching property rights
8. Modernizing the rural economy
9. Agricultural sector reforms
10. Forestry sector reforms
11. Mining sector reforms
12. Fisheries sector reforms
13. Environmental management reforms
14. Education sector reforms
15. Health sector reforms
16. Infrastructure reforms covering water, transport, and urban sectors
17. Energy sector reforms
18. Financial sector reforms
19. Tourism sector reforms

Climate Institutional Assessment

As noted above, each country should have made an assessment of the effectiveness of current arrangements to formulate and implement climate policy in an integrated way. Since the Bank has not yet carried out such an assessment, a rapid appraisal may be necessary. The key questions that need to be addressed in such a survey are given below (Table 2.1). These are divided into two groups: (1) the Key questions, and (2) a supplementary list provided for additional guidance.

Macroeconomic, Fiscal, and Public Sector Reforms

Policies designed to ensure macroeconomic stability, improve the investment climate, improve public financial management, improve governance, social protection decentralization, increase competition and entrench property rights and modernization of the rural economy are included in the general class of macroeconomic, fiscal, and public sector reforms**.**

Ensuring macroeconomic stability

The broad objectives here are to improve fiscal performance and fiscal sustainability, reduce government debt and improve debt management, and expand and deepen international trade. The specific policies to ensure macroeconomic stability and their impacts are given in Table 2.2. The following comments should be noted:

a. Positive impacts on the environment are possible with a number of policies. In terms of mitigation, the countries should look at measures that promote energy efficiency and provide adequate resources for adaptation programs. Although much of the funding for such programs will come from donors, counterpart funds are crucial. A list of such measures is given in module 3. In defining priority spending, the relatively weak state of benefit-cost analysis for adaptation programs should not imply that they get summarily rejected. Rather, an effort should be made to strengthen capacity to estimate the benefits of such programs in a credible way. Generally, since environmental budgets (and a part of adaptation budgets probably come under this category) are often at risk, it is important to make a fair valuation of the expenditures in this area. Ministries of Finance often see the expenditures on the environment as a luxury, which they are not. But the capacity of the environment ministries to quantify the benefits and make the case can be weak. Ideally these adaptation programs should be integrated into traditional sectoral programs, where their benefits to the economy are properly quantified and accounted for.

b. In the area of fiscal reform, countries should be encouraged to explore the potential for energy taxes that provide incentives for low-carbon options. Examples of such taxes are given in module 3.

c. With fiscal devolution, there is a risk that support for mitigation and adaptation programs will fall, especially where the benefits of such programs are at the national level rather than regional. Measures should be included to prevent this.

d. The most risky area is with respect to trade reforms. Cases where deforestation has resulted from trade liberalization have been documented.

Table 2.1 Climate Institutional Assessment

Key Questions
How strong is the country's environmental capacity as measured by its EPI/CPIA/RAF Score for the environment?
How well does the national focal point for climate function? Are all communications with the UNFCCC and other bodies on time and are other reporting obligations fulfilled?
Has the country prepared a NAPA and how well is this rated in terms of completeness, analytical rigor, etc.? How complete are the assumptions and methodology used in the GHG inventories reported in the NAPA?
Are the inventories of GHGs reported in NAPA internally consistent in all its elements, with inventories of other years?
Has the country prepared a climate mitigation strategy and how well is this rated in terms of completeness, analytical rigor, etc.?
Additional Issues to be addressed
Are the estimates of emissions and removals reported in the national reports comparable across parties?
Is the inventory complete in that it covers all sources and sinks as well as all gases as in the IPCC guidelines for national GHG inventories?
Does the country have a vulnerability assessment of the impact of climate change and how well is the assessment done in terms of completeness and rigor?
Does the country possess infrastructure and institutional systems for meteorological, oceanographic and atmospheric/space based systems for proper reporting of climate variables?
In which ministries other than environment is there a person with some responsibility for integrating climate policy?
Has the country an active program for mitigation of GHGs that is being monitored and how many tons of GHGs have been reduced as a result of CDM and other projects and programs?
Has the plan for disaster and emergency preparedness been modified to incorporate climate change related events?
Does the country have a national program for systematic development and implementation of a climate change action program?
Are the responsibilities of the key stakeholders in developing and implementing climate change policies well defined?
Do the key stakeholders, the participating ministries and committees, have well-defined institutional linkages and coordination mechanisms to fulfill the climate agenda?
Do the public and industry have sufficient awareness of climate change issues? Are there enough mechanisms to better inform the public and industry about the climate change challenges and opportunities?
Does the climate change policy team have enough human resources to implement the action agenda?
Are the institutions supported by enough public resources?
Do the institutions have enough technical resources such as data access and management systems, information networks and means of communication?
How well the activities are coordinated at the national and regional levels?
Does the central agency command enough political power to develop and implement sound policies and programs?
Are there options available in the country for insurance against risk from climate change and natural disasters? (See Box 2).

This acts to reduce carbon sequestration capacity. On the adaptation side, some export incentives can increase vulnerability to climate change. An analysis of the potential for such exports should be carried out and appropriate measures to prevent such exploitation should be introduced.

e. Regional trade agreements can have negative environmental consequences. Major agreements such as NAFTA have been subject to SEAs, which have identified the potentially damaging impacts of such agreements. It would be desirable to have some upstream work that has identified the problem areas.

Improving the investment climate

The broad objectives here are to improve investment procedures, promote privatization reform and liquidation of state-owned enterprises, promote private sector development generally, and facilitate trade. The specific policies and their impacts are given in Table 2.3. The following comments should be noted:

a. There have been problems with the speeding up of business start-up times and licensing procedures. Where the primary investment sectors and/or operations are likely to have major impacts in terms of energy use and adaptation measures, it is not appropriate to require these to be done hastily. This applies especially to areas such as mining and forestry and areas where change in land use is an integral part of the program. Proper procedures in these sectors will take time (as they do in industrialized countries); countries should not follow shorter processing times in such cases.

b. The promotion of FDI should also not be at the expense of energy efficiency standards and should be screened with respect to national adaptation plans. In general, foreign investors are only too willing to ensure compliance but they need to be well-informed about the requirements in these areas. Furthermore, it is not always the case that FDI seeks to be compliant. There can be an incentive for national authorities to accept lower performance standards or turn a blind eye to adaptation measures not complied with if it means getting a major job creation investment.

c. Privatization can be beneficial to energy efficiency, as often it is the state industries that are the least compliant with environmental standards. The new, more private-sector-oriented industrial structure will, however, need a larger and a different regulatory capacity with regard to the GHG and energy efficiency targets. The macroeconomic reform program should therefore be complemented with an environmental capacity enhancing program, as has been the case in a number of countries.

d. Policies to strengthen small businesses should include measures to help them to be more energy efficient and better able to comply with the requirements imposed by any adaptation plan.

e. Improving access to capital markets and raising funds through international bonds can help increase energy efficiency, as these markets now include standards of good practice in this area. They are also becoming more aware of the need to respect adaptation guidelines.

f. Reforms to land markets should recognize the need to restrict development in certain areas as a measure to address climate change

Improving public financial management

The broad objectives here are to strengthen budgeting and financial management, improve procurement, and initiate civil service reform. The specific policies and their impacts are given in Table 2.4. The following comments should be noted:

a. It is important that costs of adaptation measures be prepared as soon as possible and fed into the medium-term expenditure framework.

b. In improving control of government revenues the Bank and the Fund look to establish a

consolidated set of budgetary accounts. This includes revenues from taxes that are earmarked. Sometimes the two institutions also ask for the taxes not to be earmarked. In the case of mitigation and adaptation measures, however, some earmarked taxes can be justified (e.g. a carbon tax that is allocated for an energy efficiency program or a land development fee that is used to finance expenditures on adaptation). Where this is the case, they should be allowed to remain as such, although the consolidation can still go ahead.

c. A number of countries also operate with environmental funds. Some of these have played an important role in financing environmental investments. Where the Bank engages in strengthening non-bank financial institutions, it should look to ensure that these are also operating under "good practice" rules (for example, the "St. Petersburg Principles" developed by the OECD[14]).

d. Government can provide strong incentives for energy efficiency through giving positive points in procurement evaluations for energy-efficient suppliers.

Governance reforms

The broad objectives here are to improve public administration, raise fiduciary standards, and implement judiciary and civil service reforms. The specific policies and their impacts are given in Table 2.5.

In general, policies that reduce corruption and make the judiciary and civil service more accountable and transparent should help ensure that the goals of mitigation and adaptation are implemented more effectively.

One can draw attention in the awareness programs to the importance of carbon footprints of different lifestyles and of the measures needed to adapt to climate change more effectively. Such programs have been important drivers of a range of environmental reforms in many industrialized countries and economies in transition, as well as some developing ones.

It is also important to ensure society's participation in the adaptation programs that are being drawn up.

Finally, when introducing measures to increase equity in decentralized resource allocation, it is important to ensure that differences in adaptation costs of different zones are taken into account.

Social protection

The broad objectives here are to target policies for the poor, implement pension reforms, and bring in policies to encourage growth and development of small and medium enterprises. The specific policies and their impacts are given in Table 2.6.

In general, measures that directly act to reduce poverty should benefit the environment. There are some cases, however, where the measures may need to be looked at carefully—for example, removal of some subsidies to the poor, where these subsidies provide an incentive to use energy more efficiently. Most countries have some such measures, and a list is provided in module 3. Furthermore, some subsidies may be needed to promote adaptation (for example, cultivation of drought-resistant crops, or increased use of renewable energy). These should be evaluated carefully; if targeted payments are effective, they should be retained.

Decentralization of poverty reduction programs should take account of the differential access of individuals to noncommercial resources, including energy.

Credit supply to small and medium enterprises should be used to promote energy efficiency and to implement critical adaptation measures that have been identified in works carried out by the government.

Decentralization

The broad objectives here are to promote fiscal decentralization and to strengthen the capacity of local

14 OECD. 1995. "The St. Petersburgh Guidelines on Environmental Funds in the Transition to a Market Economy." OECD/GD(95) 108. Paris: OECD.

communities to deliver public services. The specific policies and their impacts are given in Table 2.7.

It is frequently the experience that local authorities are less well-equipped and less well-qualified in managing environmental resources than central governments. Any program of decentralization must therefore take account of the need to build capacity at that level. In the case of climate change, this applies to programs to promote energy efficiency and renewable energy use, as well as to programs to implement adaptation measures. It may be better to have some of these programs managed at the national level, or at least with strong central government support. Without adequate capacity, a serious risk exists of damage being done to the environment.

It is also important to ensure that enough resources are made available for adaptation programs once decentralization has been introduced.

Increasing competition and entrenching property rights

The broad objectives here are to liberalize the provision of key services, entrench property rights and secured transactions, and reform state-owned utilities. The specific policies and their impacts are given in Table 2.8.

Privatization of the railway and civil aviation industries should be supported by guidance on how future investments and operations will be affected by climate. Guidelines on taking account of climate impacts should be provided to the private sector.

It is important in drawing up privatization plans for energy-intensive industries to prepare at the same time a plan to meet certain carbon reduction or energy efficiency targets. Where appropriate, plans to adapt to climate impacts should also be prepared by the private enterprises. This will require the private sector to work with the government to ensure the targets are credible and in keeping with government indicative improvements in carbon efficiency.

In general, the involvement of the private sector should improve energy efficiency, but it will need some encouragement and monitoring to ensure that the full potential of the reforms is realized.

Sectoral Reforms

Sectoral reforms generally accompany investment programs in the relevant sectors. The policies supporting the investments, however, need to be mindful of possible climate impacts. The following are the key transmission channels:

a. In agriculture, there is a serious risk of deforestation and cultivation of land that is better not cultivated as a result of policies that increase the profitability of some crops. This has impacts on carbon sequestration that need to be addressed. On the other hand, measures that promote agriculture now need to take account of how the changed outputs from that sector will stand up to climate change. Some of them may make it more difficult to adapt to the new patterns of drought, flood, and temperature. These impacts should be allowed for when appraising agricultural polices. If necessary, additional instruments may be needed to ensure adequate and effective adaptation.

b. Many sectoral reforms offer a real opportunity to promote GHG mitigation and adaptation. For example, with the prospect of credits for avoided deforestation, governments and donor agencies should look to support programs that develop baselines, measure forest growth, and market carbon credits (see Bank support for this in module 3). These will indicate a reduction in the more conventional activities that affects forests such as logging and land clearance.

c. Investments in several sectors will be affected by climate change. These include agriculture, mining, energy, irrigation, transport, tourism, and urban development. Future investment plans should reflect climate impacts as much as possible. In some places, development should be restricted. In other cases, it should be undertaken in the light of altered land and water

stresses. A tool to ensure that the environmental issues are taken into account at the strategic level is the strategic environmental assessment, or SEA. While promoting investment options in the infrastructure, energy, tourism, and other environmentally sensitive sectors, such options should encompass the possible climate impacts.

d. Promoting privatization and responding to climate change are not mutually exclusive; indeed, private sector development can help improve energy efficiency. But it does mean a different system of regulation and the greater use of indirect methods of control, often using market-based incentives. These should be developed in parallel with the sectoral reforms.

e. Development practitioners should be mindful of the need to ensure that the reforms do not cause hardship to the poor sectors of society. This is also important from a climate point of view. If people are unable to have access to resources they were previously using in a relatively benign way, they may turn to further damage forest and other resources that capture carbon. Social protection programs need to be aware of these possibilities and be designed to avoid them.

Agriculture

The broad objectives are to increase production and productivity, and increase competitiveness in specific commodities. There are also policies designed to stimulate farm incomes through extension services and research and development. The specific policies and their impacts are given in Table 2.9.

Because of its close links to adaptation, agriculture is a particularly vulnerable area where policy reforms with sound macroeconomic intentions can spill over into impacts that need to be addressed. Commentators have noted the pressures that some reforms may place on expansion of agriculture to areas that were previously forestland or marginal land unsuitable for cultivation. How much of this happens depends on the institutional arrangements for the protection of such lands. In other cases, too, reforms need to be accompanied by measures to ensure that environmental standards and requirements for good practices are respected. In the absence of such complementary policies, even the best designed reforms can have negative consequences for carbon sequestration and emissions of GHGs. This is important because—in the context of climate change—deforestation and expansion of agriculture reduces sequestration and releases GHGs.

The second concern is with respect to agricultural production and adaptation. Some crop expansion can make adaptation more difficult, as we noted in module 2. If the changes in trade regime result in a shift to crops that are less climate-resilient, it will make adaptation more difficult. This does not mean that such trade should not be promoted, but it does mean that care should be taken to ensure that adaptation strategies are modified to take account of the effects of the trade. In some cases it may even make sense not to encourage certain kinds of crops. This can be done through other instruments that complement the trade liberalization.

The third area is with respect to investment and maintenance of infrastructure, such as irrigation schemes or roads. These should be designed to withstand the climate changes that are foreseen. The government, with the aid of the donor community, can provide guidance in this regard. Development programs should ensure that such guidance is taken into account in infrastructure planning and management.

Finally, there is the possibility of improving tillage practices, use of fertilizers, etc. in a way that increases sequestration and reduces emissions of GHGs. Where agricultural reforms are being implemented, it could be desirable to include support for such measures where the costs and benefits justify it.

All areas of agricultural activity need research and extension support to facilitate adaptation and mitigation. The main themes that could be promoted are (a) techniques relating to carbon sequestration are promoted where appropriate, and (b) crop varieties

that are able to adapt to climate are researched thoroughly. Although such research should be part of the climate program, these aspects should be given some prominence where the Bank is supporting development in agriculture and rural economy.

Forestry

The broad objectives are to (a) shift to the sustainable management of forest resources, (b) improve management of production forests and (c) increase conservation of biodiversity. The specific policies and their impacts are given in Table 2.10.

As in the case of agriculture, forest sector reforms are closely tied to the environment. On the mitigation side, the aim should be to manage logging so as to reduce carbon loss. It is also now becoming possible to certify carbon credits from avoided deforestation. In drawing up forest sector plans, it is very important therefore to include this option, which may generate greater income than logging or clearing land for agriculture. The mechanisms for getting financial support for this are discussed in module 3.

On the adaptation side, it is clear that forests will change in their composition with climate change. A careful assessment of these changes should inform policy on forest management, as well as plans for biodiversity protection, protection of wildlife, and conservation areas.

Measures to mainstream climate concerns into forest management are thus of crucial importance. The Bank should play a leading role in ensuring that this happens.

Mining

The broad objective is to develop the mining sector as a source of growth. The specific policies and their impacts are given in Table 2.11.

The mining sector has major environmental impacts, which need to be considered in any programs that expand the sector. As far as climate change is concerned, development programs should ensure that energy efficiency is given prominence in any operations that are being supported, and that EIAs of mining operations, which last over several decades, take account of the impending climate impacts. These could affect the stability of mining areas, the availability of water, etc.

The risks of regional authorities turning a blind eye to such concerns so as to attract private investors have to be addressed. Similar concerns apply for different reasons in the case of artisanal mines.

Fisheries

The broad objective is sustainable development of the fisheries sector. The specific policies and their impacts are given in Table 2.12.

The high level of awareness of the risks of overfishing means that policies designed to promote this sector are sensitive to this factor. The danger of promoting industrial fisheries is the impact it can have on small-scale fishers, who in turn can damage their environment as they seek alternative sources of livelihood.

As far as climate considerations are concerned, they will play a major role in the way fish stocks evolve and where and how sustainable fishing can be practiced. Any reviews of future prospects must include these factors. Fishery policy must be made in conjunction with climate adaptation policy.

Environmental Management

Policies covered in development programs that relate to environmental management include:

- Ensuring adequate financing for building capacity and investments for environmental management
- Adopting environmental impact mitigation plans
- Passing laws and decrees on environmental regulation and monitoring
- Streamlining environmental and forest impact assessments

- Decentralizing environmental management instruments and plans
- Promoting transparency and public participation in environmental management
- Developing fiscal instruments to promote environmental management and allocating more funds to promote sustainability
- Promoting decentralization and the role of communities in environmental management.

Such policies are generally supportive of climate change adaptation. In fact, climate change is one of the key areas that these reforms will address. As already noted, it is critical to ensure that management systems for the environment are strong enough to address the additional challenges posed by climate adaptation and mitigation. In Table 2.1 we have provided a guide to the questions that should be asked of such systems. Where there are weaknesses, development programs should include a component to overcome these shortcomings, or identify other components of Bank support to the country that will do the same. For the review in module 1, we saw that most countries are still weak in their capacity to address these new challenges. It is therefore important to give high priority to building up capacity in this area while supporting the government through development policy lending.

Education

Policies covered in development programs that relate to education sector include:

- Promoting a fiscal framework and increased sector financing
- Facilitating the transfer of resources to districts to meet the needs of education service delivery
- Increasing the transparency of financial management processes and strengthening provincial and district capacity for monitoring flows
- Improving transparency in procurement procedures and practices
- Improving efficiency of education expenditure
- Improving sector governance
- Enhancing monitoring of school performance by communities
- Strengthening monitoring and evaluation
- Improving teacher management
- Revitalizing Parent-Teacher Associations
- Developing an education management information system
- Promoting community oversight of educational programs
- Promoting equitable access to education and improving quality
- Reducing dropout rates, especially at lower levels
- Ensuring equitable access to education at all levels
- Encouraging participation of the private sector
- Promoting equal access to boys and girls
- Targeting poor and marginalized areas with the weakest education indicators
- Reducing regional disparities
- Improving the quality of education
- Improving teaching practices, with a focus on schools and student outcomes

- Reducing repetition rates and increasing completion rates
- Reinforcing the capacity of existing academic structures and administration
- Raising awareness of parents
- Increasing accountability of schools to both government and community
- Improving teacher quality via emphasis on teacher recruiting and training
- Reducing corruption and misuse of public resources

From a climate perspective, increasing awareness of climate impacts is probably the main link to educational reforms. Actions at the household, farm, and enterprise level to use energy more efficiently can provide highly cost-effective reductions in GHGs. Likewise, these can be implemented through publicity programs for the public, school curriculum additions, and demonstration packages. By including such measures in any educational sector program, the development programs will help mainstream climate change objectives into that sector's policies.

Health

The main objectives of sectoral health policies are to improve financing and the fiduciary environment, and better target healthcare to the poor. Specific policies and their impacts are given in Table 2.13.

The main links to climate change arise through alterations in the priorities for health spending and the links between the health and infrastructure budgets. As climate–related health burdens increase, more attention will need to be paid (in some places) to vector-borne diseases, such as malaria and cerebrospinal meningitis. Addressing these would involve both reactive as well as preventive measures. Some of the latter entail increases in infrastructure investment, for example in water management, making expenditures in the two areas related.

In some countries, changes in diet and exercise can also have not only health benefits but also benefits in terms of reduced emissions of GHGs. Such impacts, however, apply to those with relatively high incomes and are therefore less likely to apply across the board in poor countries.

Infrastructure

The broad objectives are to implement general transport sector reforms, urban sector reforms, development of ports, water sector reforms, and liberalization of the telecommunications sector. The specific policies and their impacts are given in Table 2.14.

Most infrastructure investments will have some implications in terms of future use of energy and therefore of GHG emissions. They will also often be affected by climate change, given the long life of such investments. Development programs for infrastructure development should therefore make sure that all investment plans incorporate a climate-impacts perspective. Furthermore, when designing policies for the provision of infrastructure, they should also take account of the implications climate change will have on the impacts of these policies. The most obvious one is clearance of land for urban development. This has to be done in the light of future water variability, sea-level rise, and so on. Less obvious are the impacts of transport systems for private vehicles, and distances that people have to travel to work. Options for urban development need to go through a climate assessment in terms of the relative energy demands they imply.

Where options that are more attractive from a climate perspective turn out not to be the lowest cost ones, the additional costs can often be justified in terms of the climate benefits. Moreover, funds are available to finance this gap, or at least part of it. Some of these sources were discussed in module 1. Module 3 provides further details of Bank and other initiatives in this area.

Energy

The broad objectives of energy sector loans are to implement tariff structure reforms, privatization,

improvements in operational efficiency and fiscal sustainability of utilities, promotion of renewable energy, increased competition in the energy market, competition in the petroleum market, and improvements in social and environmental sustainability of energy reforms. The specific policies and their impacts are given in Table 2.15.

The energy reforms in development programs focus mainly on financial issues of cost recovery, institutional issues of privatization, and operational issues of efficiency improvement and financial sustainability. In addition, there has been some attention given in recent years to promoting nontraditional renewable energy.

As far as climate change is concerned, the last of these has a clear benefit in terms of mitigation of GHGs. There are several financial mechanisms to support the additional costs of adopting renewable energy, which are listed in module 1. It is crucial that the TTL be fully aware of all such possibilities and that any program of support for renewable energy be an integral part of the program of climate change mitigation. The additional link that development programs have to establish is that of providing the right incentives to the agents responsible for supply and using renewable energy, so that projects that are rendered financially viable through support mechanisms such as CDM do in fact deliver the reductions in GHGs that are promised.

The other areas of energy sector reform also offer some possible benefits for climate change if designed appropriately. In terms of tariff reforms, there is scope for green tariffs, as well as the use of feed-in tariffs to promote renewable energy. In terms of operational efficiency, one may be able to add to the financial benefits of reduced losses the benefits of reduced GHGs (converted into money flows). Finally, as far as subsidies are concerned, we may need to take a more nuanced approach, especially where removal of subsidies could result in increased deforestation, or where the subsidies directly support the adoption of clean renewable energy.

Financial sector

The broad objectives of development programs in this sector are to increase resilience and soundness of the financial system, implement reforms in the rural finance sector and reform the insurance sector. The main items included are the following:

Increase resilience and soundness of the financial system
Restructuring and privatization of state banks
Reducing the stock of non-performing loans
Reforming financial institutions
Improving internal control and audit in banks
Modernizing the payment system, legislation to prevent money laundering, and improving quality of financial information
Strengthening the fiduciary framework for public financial management and corporate financial reporting
Increasing access to finance
Reforming the rural finance sector
Establishing a rural finance agency
Reforming the insurance sector
Improving the legal, regulatory and supervisory framework for the banking sector and capital markets

While these reforms do not directly impinge on climate mitigation and adaptation, there is potential for including a climate overlay in the operations of banks so that they are aware of the need to undertake proper climate assessments when they make loans for infrastructure investments. Likewise, a rural finance agency should promote and support programs that involve adaptation and mitigation; if it is to do that, it must have adequate knowledge in that area. Finally, provision of insurance is an important part of the adaptation to climate change. Reforms in the insurance sector should include coverage of climate risks with support from the government to make the market work (excessive risks will not be covered by the private sector and its ability to provide coverage can depend on government policies for flood protection, etc.).

Tourism sector

The broad objective is to promote tourism and tourism revenue. Specific policies that have been supported include:

- Increasing the number of tourist destinations
- Establishing and implementing a set of benchmarks for good environmental practice in tourist facilities
- Promoting sustainable tourism
- Promoting environmental conditions, especially in regard to wastewater and solid waste at tourist sites.

Tourism strategies and investment have necessarily to look at the medium to long term. In this context, adaptation to climate change is essential. Much work has been done to estimate changes in flows of tourists as a result of climate impacts. Any country undertaking a development program in tourism should draw on the prior work on the impacts. It should undertake an SEA to configure the most effective tourist developments and the infrastructure support needed to implement the program.

Table 2.2 Transmission channels for policies designed to ensure macroeconomic stability

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Improve fiscal performance and fiscal sustainability				
Strengthen tax administration				
Maintain sound expenditure composition across sectors and improve management of public expenditure		Ensure proper support for energy efficiency		Ensure proper support for adaptation programs
Reduce primary spending				
Improve transparency of fiscal accounts and budget execution				
Reform tax policy to increase revenue base		Possible introduction of a carbon or energy tax		
Adhere to fiscal discipline, meeting target and ensure priority spending				
Make tax system more equitable, transparent and stable				
Reduce tax based expenditure	Risk of reducing support for energy efficiency		Risk of reducing support for adaptation programs	
Budget management and fiscal rules to ensure budget envelope and ensure allocations to line ministries are in accord with preset ceilings				
Set a fiscal framework, identifying priority spending				Develop capability to show benefits of programs
Encourage increased and more predictable revenues through improved compliance, broader tax base and reduction in tax rates to improve investment				
Create an operational fiscal policy office with capability and access to information sufficient to provide analysis of proposed tax, tariff and financial market policies				
Strengthen fiscal devolution	Risk of reduced support for mitigation measures			Risk of reduced support for adaptation measures
Strengthen budget reporting and planning				
Increase equity in intergovernmental transfers				
Improve efficiency and impact of public spending on national, sub-national and sectoral levels				
Improve budget execution and financial reporting				
Improve treasury operation				
Simplify expenditure management and make it transparent				

Table 2.2 Transmission channels for policies designed to ensure macroeconomic stability (continued)

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Improve fiscal performance and fiscal sustainability				
Strengthen public expenditure management				
Strengthen legislative oversight on public finances				
Phase out direct and indirect subsidies to state owned enterprises				
Implement a Medium-Term Expenditure (MTEF) to have greater visibility of policies and place budgetary allocations in a medium term framework				Risk that programs on adaptation cannot justify themselves on cost benefit grounds
Reallocate inefficient spending				
Reduction of government debt/ improve debt management				
Reduction of public debt				
Assessment of civil service pension liabilities and possibilities for reform				
Develop and implement a debt management strategy				
Improve debt management				
Reduce subsidies to the non-poor		These could help reduce energy consumption		
Make tax revenue administration more efficient				
Expand and deepen international trade				
Trade policy reforms; liberalization of trade regime, tariff and non-tariff regulations	Check impacts of reforms on GHGs and on carbon loss via deforestation	Can be a source of technology that reduces GHGs if so designed	Ensure that changes in output do not increase vulnerability to CC	
Expand market access for domestic exports				
Implement complementary measures to facilitate trade and customs clearance				
Implementation of regional trade agreements	SEA of policies should cover climate changes impacts of such agreements		Should not promote trade that makes adaptation more difficult	Use regional agreements to ensure common approach to adaptation.
Ensure compliance with international conventions and property rights				
Reform to promote foreign direct investment	Good practice should cover energy efficiency	Can be a source of technology that reduces GHGs if so designed	Ensure that FDI runs through a climate screen	

Table 2.3 Transmission channels for policies designed to improve the investment climate

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Improve investment procedures				
Reduce uncertainty for investors by implementing the investment law and its supporting regulations and new operating procedures.	Ensure that the supporting regulations include incentives to adopt energy efficient technologies where possible		Investment guidelines should provide some advice on likely climate changes and adaptation measures that the government intends to implement	
Reduction in business start-up time by simplifying and/or eliminating unnecessary business licenses, procedures and multiple registration requirements.	Ensure that this is not at the expense of considering GHG implications of the investments		This should not be done at the expense of due diligence on its consequences for ongoing and proposed adaptation measures (e.g. location of plants in areas to be affected by sea level rise)	
Facilitate doing business by streamlining registration procedures				
Establish one-stop center for business registration				
Ease entry of foreign professionals and skilled workers		Could help develop efficient technologies		
Strengthen arrangements for public-private partnerships	Should not be an excuse for lower standards	Can help bring in new technology	Should not be an excuse for lower standards	
Strengthen banking system				
Strengthen non-bank financial sector regulation and supervision to minimize chances of crisis				
Speed up licensing of complex operations such as forest concession, power plants, pulp mills, etc.	Can result in overlooking of GHG impacts.		Can result in ignoring implications for adaptation policy	
Improve access to international capital markets		Can help increase carbon efficiency		Can help awareness of CC risks
Establish a national investment program				
Issuance of international bonds		Can help increase carbon efficiency		Can help awareness of CC risks
Privatization, reform, and liquidation of state-owned enterprises				
Sell or cancel state's minority shares in enterprises		State enterprises are often least efficient, thus it can help increase efficiency		
Sell or liquidate companies with majority state ownership				
Sell state shares in shipyards				
Sell or liquidate agro-kombinants				
Reduce state subsidies to enterprises	Ensure that efficiency standards are not compromised			
Contain enterprise arrears				

Table 2.3 Transmission channels for policies designed to improve the investment climate (continued)

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Privatization, restructuring and bankruptcy of state enterprises		Can provide an impetus for increased energy efficiency		
Reforms for private sector development				
Reducing cost of factors like electricity, telephone, water, transportation	Costs of these services should include at least an element for the cost of carbon generated			Cost of water resources should take account of costs of CC adaptation
Facilitating transit of import goods				Design of routes should allow for CC
Lowering administrative barriers for private investors	Ensure that this is not done at expense of meeting efficiency standards		Ensure that this is not done at expense of ignoring need to adapt to CC	
Liberalize permitting and licensing rules				
Improve the rule of law for private sector		Can help ensure compliance with energy goals by private sector		Can help ensure adaptation by private sector
Liberalization of labor laws-less intervention by the state				
Improve functioning of land markets				Ensure markets reflect costs of adaptation
Increase private sector access to finance		Finance should not support bad practices		Finance should not support mal-adaptation
Improve functioning of labor markets				
Enforcement of standards for goods exported, especially WTO standards for food products				
Strengthen small business		Should help improve efficiency		
Promote export of handicrafts by revising laws and taxes (export tax) schemes				
Trade Facilitation				
Improve governance procedures and promotion of e-government				
Ensure compliance with international conventions and property rights				Rights should be limited by obligations to adapt
Simplification of customs regulations, computerization of customs procedures				
Enhance team tariff through improved governance procedure, better IT, and research capability				

Table 2.4 Transmission channels for policies designed to improve public financial management

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Strengthen budgeting and financial management				
Improve budgeting through future expenditure framework with a system of clear forward estimates				Estimates should include costs of adaptation
Improve controls and efficiency in treasury management by consolidating revenue and expenditure accounts	But earmarked taxes may promote energy efficiency /low carbon operations			
Increase accountability and transparency in government financial management				
Improve the stability of the financial sector by implementing good corporate governance and risk management standards, particularly in state-owned banks.		Banks should also adopt good practice standards w.r.t. energy efficiency		Banks need to be informed on good practice w.r.t. adaptation.
Commercialization and transparency of commercial banks				
Strengthen non-bank financial institutions to develop a diversified financial sector.		Special funds for energy efficiency may be desirable		Special funds for adaptation may be desirable
Improve Procurement				
Implement transparent procurement processes and better procurement outcomes				
Enhance efficiency of procurement, e-procurement				
Legal, regulatory, and institutional framework in public procurement that complies with international standards		Procurement rules could include efficiency standards		
Public procurement reforms to increase transparency				
Initiate Civil Service Reform				
Pension reforms				
Establish independent salary commission that can propose new pay designs for higher level state officials				
Civil service reform to include a framework for training, payroll verification, pay and grading policy				
Setting up functional human resource management office				
Capacity of civil service to ensure skills base and address issues of retention and sustainability				
Efficient, transparent, and fair policies regarding personnel				

Table 2.5 Transmission channels for policies designed to improve governance

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Improve Public Administration				
Institution building at the public administration sector to affect financial management, personnel management and economic decision making				Important to include capacity building w.r.t. adaptation
Raise awareness of citizens about rights, rule of law, corruption		Important to raise awareness on carbon footprints		Important to raise awareness on adaptation
Improve performance through introduction of internal auditing, evaluation, and performance review				
Improve performance of civil service through incentives				
Better fiduciary standards and public expenditure management				
Transparency and accountability in treasury cash management				
Regulations to prevent money laundering activities				
Strengthen Accountant General's department				
Set up public accounts committee and records management				
Strengthen internal and external audit				
Transparency and equity in decentralized resource allocation			Equity in allocation should take account of adaptation requirements of different zones	
Improve accountability and transparency of government financing				
Judiciary reforms				
Improve transparency and efficiency of judiciary				
Improve financial situation of the judiciary sector and sustain the allocation				
Strengthen institutional capacity, promote broader civil society participation, and provide judicial services in courts that are more transparent, fair, equitable and accessible			Important to include civil society in drawing up adaptation strategies	
Prepare and implement action plans to fight corruption and money laundering				
Strengthen institutional capacity of the Ministry of Justice			Should help implement adaptation measures and ensure compliance	
Set up anticorruption commissions/committees				
Regulatory and institutional mechanisms to fight corruption				

Table 2.5 Transmission channels for policies designed to improve governance (continued)

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Civil Service Reforms				
Rationalize employment in the public sector				
Reduce deficits in the pension system and move the system toward fiscal sustainability				
Create a lean, effective and efficient civil service free of corruption				
Develop a human resource management system				
Promote gender equality in civil service				
Improve human resource management in the public sector				
Promote early retirement options, redeployment of staff, stabilization of civil service staff				

Table 2.6 Transmission channels for policies designed to target policies for the poor

Policy Action	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Target policies for the poor				
Replace consumer subsidies with targeted programs for poor, cash transfers, etc.	Some subsidies are useful in reducing carbon emissions and energy use; they should be carefully evaluated		Removing subsidies may increase behavior that makes adaptation more difficult if they increase vulnerability of those dependent on natural resources; however, some targeted subsidies could actually reduce the vulnerability of the poor	
Improve monitoring and analysis of information on poverty and social well-being		Include in this the effects on energy use		Include if possible changes that impact on adaptation
Encourage participation of stakeholders in poverty reduction programs				
Decentralization of poverty reduction programs	Take account of dependence on non-commercial energy			
Social security and universal health insurance reform				
Improve poverty orientation of public spending				
Pension Reforms				
Increase pensions, pay pensions on time, and improve administration				
Reform of pension scheme to reduce the state expenditure				
Policies to encourage growth and development of small and medium enterprises				
Provide access to credit, technical assistance, and capacity building to these enterprises		Make this a function of their energy efficiency		Make credit available to implement adaptation measures
Promote the handicrafts industry, reduce the skill tax				

Table 2.7 Transmission channels for policies designed to promote decentralization

Policy Action	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Promote Fiscal Decentralization				
Improve resource allocation to the local levels and strengthen intergovernmental fiscal relations	It is important to take account of capacity in the regions and communities to promote energy efficiency and to develop projects for the carbon market, which is an international market		It is important to ensure that capacity for adaptation planning and implementation is adequate at the regional level before giving the regions the responsibility to manage programs in this area	
Strengthen capacity of communities to deliver public services				
Improve decentralization by issuing ministerial decrees for blue-book and on-granting procedures and improve the framework for sub-national government bond issuance and work-out procedures.				
Provide leadership, policy and regulatory frameworks				
Adequate and timely resources for local institutions, and capacity building			This is critical for adaptation planning	

Table 2.8 Transmission channels for policies designed to increase competition and entrench property rights

Policy Action	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Liberalization of Key Services				
Liberalization of railway services	Include a plan for improvements in energy efficiency in the private sector programs		Ensure that plans for investment are screened for climate impacts	
Liberalization of civil aviation services				
Liberalization of telecommunication services				
Strengthen capacity of communities to deliver public services				
Strengthen creditor rights				
Strengthen civil procedures for debt recovery				
Simplify procedure for property transactions				
Reform of State-Owned Utilities				
Privatization of state-owned utilities		Should improve energy efficiency	Should include plans to adapt to climate impacts	
Encourage private sector participation				

Table 2.9 Transmission channels for policies designed to increase production and competitiveness in agriculture

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Increase production and productivity				
Improve access to markets (trade liberalization)	Ensure that measures do not lead to deforestation		If trade increases exports that make adaptation more difficult, adaptation policy should be adjusted and perhaps some exports discouraged	
Promote agronomic research				Should include research on resilience to climate change
Support for infrastructure and equipment				Equipment and infrastructure should be designed to withstand CC
Strengthen performance and productivity of the irrigation sector			Design of irrigation schemes should take account of climate effects	
Increase access to micro finance			Design schemes so as not to encourage mal adaptation	
Reform of land tenure laws and land acts				Laws should enforce the right to limit development where CC will pose a risk
Improve rural roads			Design of roads should allow for future climate impacts	
Product price and input price reforms	Ensure that measures do not lead to deforestation		Evaluate impacts on crops w.r.t. climate impacts	
Maintenance and expansion of irrigation			Design of irrigation schemes should take account of climate effects	

Table 2.9 Transmission channels for policies designed to increase production and competitiveness in agriculture (continued)

Policy Action	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Increase competitiveness in specific commodities (Coffee, tea, cotton, etc.)				
Provide better incentives and institutional arrangements to farmers to increase returns				
Improve marketing arrangements for improved seeds and fertilizers			Promote adoption of seeds that are more resilient to climate change	
Improve processing facilities				
Reform sector boards				
Improve trade and marketing of agro-processed products			Ensure that this does not lead to expended production that will make future adaptation more difficult	
Implement producer price-setting mechanism				
Privatize processing facilities (e.g., cotton ginning, coffee processing)				
Policies to modernize the rural economy				
Strengthen agricultural research and development	Ensure that part of the research program look at ways to reduce carbon loss through reduce tillage and other management practices		Crucial that the research include a component on how to adapt to changing climate by developing drought resistant crops, etc.	
Strengthen agricultural extension services				
Provide private extension advisory services				
Provide stimulus to agricultural research				

Table 2.10 Transmission channels for policies designed to develop the forest sector

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Sustainable management of forest resources				
Implementation and compliance with forestry code	Code should include adoption of measures to limit carbon loss			
Encourage domestic processing of logs		Logging should be low impact w.r.t. carbon		
Community engagement in forestry sector		Communities should be encouraged to adopt low-carbon-loss methods		
Implement forest sector monitoring				
Streamline Environmental and Forest Impact Assessment		Cover aspects related to sequestration		
Transparency in allocation of forest permits				
Sustainable forest management plans and timely delivery of services to the private sector				
Effective enforcement of forest fiscal regime like effective collection of forest taxes		Seek, if possible, to develop market for carbon credits		
Recruitment of internationally reputed observer to monitor logging activities				
Decentralization, allocating a share of forest revenues to the local governments				
Setting up national forest observatory with GIS capabilities to track timber flows and payment of related fees		If a market for carbon credits is to work it will need effective GIS capability	Changes in forest growth and forest products should be incorporated into forestry exploitation plans	
Capacity building for forest institutions				
Reform forestry fund with private sector and local government participation				

Table 2.10 Transmission channels for policies designed to develop the forest sector (continued)

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Biodiversity Conservation				
Strengthen institutions for management and administration of parks, protected areas, and wildlife				Management should take account of climate impacts
Promote local community participation in administration of protected and sensitive areas				
Systematic application of environmental impact assessment				
Implementation of socio-economic mitigation plans and resettlement of indigenous people				
Measures to exempt nationally protected areas from logging, industrial mining, fishing, or any activity that threatens biodiversity				
Management of production forests				
Complete forest estate zoning plan				
Implement forest management policies and plans for production forests		Include if possible carbon credits as an alternative to logging and land clearance		
Promote efficiency and value-added in timber product processing and reduce wastage				
Ensure control of forest production field applications and enforcement and application of penalties				
Valorize non-timber forest products		Especially carbon credits		
Continue the plantation development program				
Encourage competitive bidding of logging permits for natural and planted timber				
Develop a framework for effective log tracking system				
Enactment of sustainable forestry law				
Improve livelihood of natural resource owners through appropriate valuation of forest resources				

Table 2.11 Transmission channels for policies designed to develop the mining sector

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Develop the mining Sector as a Source of Growth				
Reform the legal, regulatory and institutional settings in the mining sector				
Improve governance and transparency				
Improve private sector investment in the mining sector		Ensure mining practices are as energy efficient as possible		
Expand administration of all mining licenses through cadastral system				
Improve the level and quality of mining extension services		Cover energy efficiency		
Improve competition in the mining sector				
Update regulatory and legislative framework to bring governance and institutional standards to international levels				
Design mechanism to share mining revenues with local communities				
Build capacity in the mining sector				
Set up environmental management policies and guidelines for social and environmental impact assessment			EIA should include effects of climate change on stability of mining areas, availability of water	
Introduce better practices for improved work and living conditions in artisanal mine sites	Provide advice and support for energy efficiency in these operations			
Improve economic efficiency and transparency of the sector				
Restructure mining right titling system				
Strengthen Environmental and Forest Impact Assessment of mining			EIA should include effects of climate change on stability of mining areas, availability of water	

Table 2.12 Transmission channels for policies designed to develop the fisheries sector

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Develop the mining Sector as a Source of Growth				
Establishing rules of a geo-positioning system to monitor industrial fishing			This is crucial to effective management of stocks under changing climatic conditions	
Implement transparency in industry fishing activities				
Comprehensive socioeconomic and environmental review of the industrial fishing sector			Such a review should include the impacts of changing fish stocks resulting from climate effects (and others) on communities dependent on fishing; changes in permissible fishery should follow	
Design and enforce conservation measures to protect and or restore fish populations in over-exploited or fragile marine areas			Conservation and protection measures should be influenced by expected climate impacts; thus adaptation policy and fishery policy have to be made in conjunction with each other	

Table 2.13 Transmission channels for policies designed to promote better healthcare

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Improve financing and fiduciary environment for health				
Increase and sustain government spending to healthcare			Increased spending to address increases in incidence of vector-borne diseases	Immunization programs Investment in infrastructure to respond to disease outbreak
Increase allocative and technical efficiency of healthcare spending			Increased incidence of malaria, cerebro-spinal meningitis, and cholera in some places should imply a modification of priorities in health spending	
Decentralization of delivery and public oversight				
Improve monitoring and evaluation				
Targeting healthcare to the poor				
Increase access to affordable healthcare				
Improve quality and equity				Access to improved water and food will reduce susceptibility/ exposure to vector-borne diseases and weather extremes
Decentralize health services, primary and secondary level services				
Planning, budgeting at the central, state, regional, district and peripheral levels				
Strengthen partnership with private and NGO sectors		Lower meat diets benefit health and reduce emissions from agriculture; similar double benefits from reduced motor transport		Health education can reduce risk of climate-related infectious diseases

Table 2.14 Transmission channels for policies designed to improve infrastructure

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Implement general transport sector reforms				
Rehabilitation of rural tracks and roads in production centers				Design should take account of climate impacts
Development and maintenance of road network		Design should take account of need to reduce energy use		
Modernize and streamline trade and transport logistics practices				
Increase private sector participation in rail and road services		Incentives for low-carbon programs should be included		
Sustained development of a safe, secure, and efficient national highway system		System should discourage long work journeys		Design should take account of climate effects
Catalyze institutional reforms in order to develop a sustainable toll highway system				
Reduce costs for port users and enhance management accountability				
Secure, safe, economical, and efficient civil aviation system				
Develop air transport		Consider internalizing carbon costs		
Increase resource generation and attract private capital				
Implement urban transport sector reforms				
Lanes fully dedicated to public transport	Benefits are even greater if we take account of reduced GHG emissions			
Congestion pricing				
Reduction of fleet and taxi services				
Rationalization of public transport supply		Take account of GHG impacts		
Measures for financial sustainability of urban transport sector				
Promote citizen's participation in government-sponsored infrastructure projects				
Establish air pollution reduction targets	Reduced air pollution also provide reduced GHGs			
Coordinate management of land use and land use planning for urban transport				Land use has long- term impacts on GHGs

Table 2.14 Transmission channels for policies designed to improve infrastructure (continued)

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Development of ports				
Privatization of core services				
Private sector participation in port development				
Water sector reforms				
Improve access to improved water and sanitation services			These have important health benefits that increase with CC	
Increase waste water treatment capacity			This can reduce adverse health impacts from open sewers, etc.	
Improve water use productivity in irrigated lands			This should be done taking account of changes in rainfall due to CC	
Foster integrated water resource management reform for sustainable water use				
Improve financial sustainability of water services				
Improve monitoring and evaluation				
Promote hand washing				
Measures for water pollution control				
Promote cost recovery in water utilities				
Promote private sector participation in water utilities				
Remove subsidies in water sector	This can have benefits when CC impacts are taken into account via reduced energy demand		Benefits will arise from reduced demand that can be part of adaptive response to CC	
Develop spatial water availability data				
Develop a water rights registry and implementation of water rights market			The price of water should reflect increasing scarcity and higher costs of management of variable flow	
Enforce water rights and permits for establishment of more efficient water markets				
Liberalize Telecom Market				
Encourage private sector participation		Reduce demand for travel		
Urban Sector Reforms				
Repeal urban land ceiling regulation				
Rationalize stamp duty in land transactions				
Reform rent control laws to stimulate private investment in rental housing and development				
Introduce of computerized land registration process				
Reform property taxes so they become a major source of revenue for urban and local bodies				
Reform user charges by urban local bodies				

Table 2.15 Transmission channels for policies designed to promote better energy use

Policy	Mitigation		Adaptation	
	Reactive	Proactive	Reactive	Proactive
Tariff Structure Reforms				
Reform of tariff structure to reflect costs, cover costs of generation		Promote green tariffs		
Privatization				
Develop rules and procedures for entry of private sector		Promote feed-in tariffs, incentives for clean energy		Allow for fact that water availability in future will impact energy production
Government programs to deal with the debt of electric utilities as they are being privatized				
Improve operational efficiency and fiscal sustainability of utilities				
Reduce transmission and system losses		Take advantage of carbon benefits		
Increase tariff rates to cover operating costs				
Improve operational efficiency of electric utilities				
Reduce corruption in power sector				
Increase collection rate				
Remove subsidies to utilities in the power sector		Subsidies for production of green electricity may be justified		
Improve fuel quality with respect to sulfur content, lead content	Possible CC impacts should be accounted for			
Promote use of renewable energy				
Reform legal environment to promote use of renewable energy				
Communication to increase public awareness		Inform public on benefits of clean energy		
Develop institutional arrangements for operation of renewable energy projects		Take advantage of carbon benefits		

Module III

This module presents the specific policy measures being introduced to reduce GHGs and to adapt to climate change in developing countries. The aim is to inform the development practitioners of what new policies or measures should or could be introduced, or what existing polices could be strengthened, to ensure that climate policy and development programs are reinforcing.

Policies and Measures for Adaptation to Climate Change

Although climate change has been occurring for some years and more change will occur even under mitigation measures, adaptation to the impacts of such changes has not received equal importance as the mitigation agenda in either the negotiations or in development planning. Though the Delhi declaration sought to raise the need for adaptation, the activity remained limited to capacity building, assessment, and a few pilot projects (see Annex 1 for details of the Delhi Ministerial Declaration).

In developing CEIF, the Bank emphasized that adaptation should be one of the three pillars in tackling the issues of energy access and climate change in development. CEIF further seeks to consider climate change, current and future, as an essential part of development planning through a climate risk management approach that seeks to deal with current climate risks and opportunities while considering projected climate trends. We present below specific policy measures that may be considered in development policy lending operations to adapt to climate change.

Policies for adaptation in the agricultural sector

Results from various assessments of impacts of climate change show that Sub-Saharan Africa is one of the regions likely to emerge as the most vulnerable, with likely losses between 2 and 7 percent of GDP. Western and Central Africa are also vulnerable, with impacts ranging from 2 to 4 percent of GDP. Losses in northern and southern Africa are estimated at 0.4 to 1.3 percent of GDP (Mendelsohn and others 2000). Drought conditions, flooding, and pest outbreaks are some of the stress factors due to climate change that may affect agriculture and food production systems. We present below a menu of policies to adapt to the above stress factors in the agriculture and food production sector. The following are the general approaches for adaptation in the agricultural sector:

1. Development of new crop types and enhanced operation of seed banks
2. Policies to encourage adoption of farming practices at the farm level for better adaptation to climate change
3. Policies to discourage monoculture and encourage farmers to plant a variety of heat and drought-resistant crops
4. Policies to improve efficiency of irrigation and water use in agriculture
5. Policies to improve soil conservation and prevent land degradation
6. Policies to promote better/improved agricultural drought management.

The specific policies for adaptation are presented in Table 3.1

Policies for adaptation in the water sector

Climate change impacts on water are important for all sectors. Changes in precipitation and temperature patterns lead to changes in runoff and water availability. Runoff is predicted to increase at higher latitudes and in some wet tropical areas, including populous areas in east and southeast Asia. It is expected to decrease in the mid-latitude regions and dry tropics due to a decrease in rainfall and higher rates of evapotranspiration. Many semi-arid and arid areas will likely suffer a decrease in water resources due to climate change. Endemic morbidity and mortality due to diarrheal diseases associated with floods and droughts are expected to rise due to changes in the hydrological cycle.

In Africa, climate change has the potential to impose additional pressures on water availability, accessibility,

Table 3.1 Agricultural sector policies for adaptation to climate change

1. Development of new crop types and enhanced operation of seed banks

Climate outcome	Specific policies	Indicators of progress
Seed banks and crop types/varieties provide an opportunity for farmers to diversify, allowing them to counter the threat of climate change. Development of heat and drought-resistant crops/varieties will enable agricultural production in marginal and areas with less rainfall	Schemes to promote seed banks to maintain different varieties of the crop so as to help farmers diversify crops and crop varieties	Capacity of public sector organizations like Department of Agriculture to maintain and distribute new crops and crop varieties
	Schemes for research and development of new crop types and crop varieties that are more resistant to heat and drought conditions	Capacity and operation of seed companies in the private sector, developing and distributing new crops and crop varieties
	Schemes to strengthen capacity of the Department of Agriculture to provide seeds of a diverse mixture of crops and crop varieties that better tolerate climate risks	Agricultural research and development activities for the development of new varieties and crops, mostly in public universities
	Programs to encourage international cooperation in the development of varieties and crops that will better adapt to adverse conditions	Capacity of public and private institutions to maintain germplasm banks
	Strengthen the capacity of organizations that maintain plant genetic resources, like national bureaus of plant genetic resources	

2. Policies to encourage adoption of farming practices at the farm level for better adaptation to climate change

Climate outcome	Specific policies	Indicators of progress
Such farming practices will help individual farmers to adjust to uncertain climate conditions at the farm level	Agricultural extension schemes to encourage adjustments in planting and harvesting dates	Percentage of farmers who adjust planting and harvesting dates to cope with adverse climatic events
	Schemes to encourage conservation practices such as conservation tillage, zero tillage, furrow diking	Percentage of farmers who adopt conservation tillage practices
	Programs to encourage terracing and contour planting when the land has an undulating topography	Area covered by terracing and contour planting schemes
	Schemes to develop windbreaks along borders	Area covered by windbreaks

3. Policies to discourage monoculture and encourage farmers to plant a variety of heat and drought-resistant crops

Climate outcome	Specific policies	Indicators of progress
Monoculture, growing a single crop, increases the vulnerability of farming to climatic variability	Schemes to provide economic incentives that will encourage farmers to switch and rotate crops and grow a mixture of crops rather than monoculture	Percentage of farmers who adopt diversification of crops and crop varieties
	Schemes to provide incentives to encourage farmers to plant the full acreage normally planted	Proportion of agricultural land suitable for cultivation but not cultivated
	Tax and price policies that reflect disincentives to monoculture	Indicators of relative output price/profitability that induces farmers to adopt monoculture
	Tax and other incentive policies to increase diversification of crops and crop varieties	

Table 3.1 Agricultural sector policies for adaptation to climate change (continued)

4. Policies to improve efficiency of irrigation and water use in agriculture

Climate outcome	Specific policies	Indicators of progress
Improvements allow greater flexibility by reducing water consumption and dependence on natural factors such as rainfall and runoff without reducing crop yields. This will help in adapting to the new scenario of availability of water resources	Schemes to reduce distribution losses of irrigation water by maintaining canals and better monitoring	Measures of irrigation water lost in canals and other distribution losses
	Improved pricing schemes for irrigation water to encourage use efficiency	Prices charged for irrigation water to reflect the true economic value, scarcity rents
	Schemes to encourage improved irrigation methods like drip and sprinkler irrigation	Area irrigated through improved, more efficient irrigation methods like drip and sprinkler irrigation
	Research on development of crop varieties that need less water	Indicators of water use efficiency in agriculture such as water requirement ratio (WRR) proposed by FAO
	Extension schemes to promote the best timing and dose of irrigation	Prices charged for irrigation water to reflect the true economic value, scarcity rents
	Tariff reforms on electricity used for agricultural production, removal of subsidies for electricity used for pumping irrigation water	Price of electricity used in agricultural sector

5. Policies to improve soil conservation and prevent land degradation

Climate outcome	Specific policies	Indicators of progress
Measures for land conservation will prevent soil erosion and land degradation, thus making land more productive and reduce water consumption without reducing crop yields. Conservation measures will increase greater resiliency in adapting to future climate changes	Reforms in tenure practices and land tenure laws	Security of tenure
	Schemes to promote changes in farming practices, such as minimum/zero tillage	Area under minimum/zero tillage practices
	Programs to encourage cover cropping with leguminous cover crops to preserve soil moisture, increase soil organic matter, and reduce soil erosion	Area covered by cover crops and other conservation practices
	Schemes to encourage contour planting when the topography is undulating	Proportion of area covered by contour planting under undulating topographic conditions
	Schemes to promote use of farm equipment, including tractors, harvesters, and other equipment	Proportion of area under mechanized farming
		Number of tractors, harvesters, and other farm equipment available

6. Policies to promote better/improved agricultural drought management

Climate outcome	Specific policies	Indicators of progress
Reduced impact of drought, which is expected to increase in frequency	Schemes to strengthen the meteorological department, meteorological stations and improve data collection, data management, and forecasting capacity	Number of meteorological stations and staff with the meteorological department
	Schemes to establish weather/meteorological stations	Data on geographical coverage of the meteorological stations and skills level of the staff
	Incentive policies to encourage better drought-management programs	
	Research programs to develop high-temperature/drought-resistant varieties	Availability and coverage of drought-resistant crop varieties
	Policies to alter cropping patterns to suit drought conditions	Shifts in cropping pattern

and demand. Even in the absence of climate change, based on the present trends in population and water use African countries are expected to exceed the limits of economically sustainable land-based water resources before 2025 (Ashton 2002). In Asia, while freshwater availability in the central, south, east and southeast regions are projected to decrease, coastal areas could be at greater risk due to increased flooding from the sea and rivers.

Table 3.2 presents water sector adaptation policies.

Policies for adaptation in coastal areas

In order to reduce the vulnerability of coastal areas to the effects of climate change, three basic strategies coined: (1) protect, (2) retreat, and (3) accommodate have been proposed. Protection strategies attempt to reduce the risk of the event by decreasing its probability of occurrence. Protection strategies include hard structural options, soft structural options, and indigenous options. Retreat strategies reduce the risk by limiting its potential effects by discouraging development in sensitive coastal areas and planning urban growth. Strategies for accommodation increase the ability of the society to cope with the effects of the event. The specific policy options for coastal areas to adapt to climate change scenarios are presented in Table 3.3.

Policies for adaptation in the forest sector

Forests cover about 30 percent of the land area. Forest area in the 10 most forest-rich countries account for about two-thirds of total forest area, but forests account for less than 10 percent of the land area in 57 countries. Projected long-term impacts of climate change on forests range from pronounced increases in productivity in some northern countries to die-back of tropical forests. In forests that are managed at low levels or not managed at all, as is the case for tropical forests in Asia and Africa, fewer options for adaptation exist and there is more uncertainty from climate change. To the extent possible, adaptive responses to climate change include reducing deforestation and enhancing species richness, maintaining continuity of forest ecosystems, and resilience. The menu of policy options for forest sector adaptation is presented in Table 3.4 under the following categories:

1. Enhance forest seed banks aimed at conservation
2. Forest conservation through watershed development and conservation
3. Encourage diverse forest management practices for rehabilitation
4. Policies that establish flexible criteria for intervention
5. Policies to reduce habitat fragmentation and promote development of migration corridors
6. Policies for development of forest plantations

Adaptation policies for preservation of biodiversity and ecosystems

Biodiversity increases the resilience of the physical and biological systems to changing environmental conditions and changes in climatic variables as genetically rich populations and species-rich ecosystems have greater potential for adaptation. The specific policies to preserve biodiversity and ecosystems are presented in Table 3.5 under the following general categories:

1. Integrated ecosystem planning and management
2. Policies to protect and enhance migration corridors or buffer zones
3. Enhance methods to protect biodiversity off-site

Adaptation policies in the health sector

Climate change is expected to affect the health status of millions of people: for example, through increases in malnutrition, mortality, diseases, and injuries due to adverse weather events. Adverse weather events could increase incidence of infectious diseases like malaria, cerebrospinal meningitis, cholera, and waterborne diseases in developing countries. Policies for better adaptation in the health sector are presented in Table 3.6 under the following categories:

1. Improving public health infrastructure
2. Improving access to adequate food and water
3. Health education
4. Policies to combat incidence of malaria

Table 3.2 Policies for adaptation in the water sector

1. Policies targeting household water use

Climate outcome	Specific policies	Indicators of progress
Water conservation at the householdv level and thus reduction in demand will benefit under current and under climate change scenarios	Schemes to encourage adoption of water conservation practices at home such as water saving taps, flushing and showering appliances	Proportion of household water use in relation to total water consumption
	Reforms in pricing of household water used so as to reflect the true economic value	Charges and price for household water services to reflect the true value
	Schemes to construct cisterns and install rainwater barrels to store rainwater	

2. Policies targeting industrial, commercial firms and businesses using water

Climate outcome	Specific policies	Indicators of progress
Conservation of water by industries and businesses will reduce the overall demand for the supply under current and climate change scenarios	Schemes to increase on-site storage capacities	Water storage capacity of industries and businesses
	Programs to recycle water used in cooling and processing	Amount/percentage of recycled water used for industrial purposes
	Schemes to promote alternative water supplies such as use of seawater and brackish water through desalination	Quantity of water used from alternative sources like sea water and from desalination
	Investment programs to upgrade wastewater treatment to improve efficiency	Capacity of wastewater treatment facilities and quantity of wastewater treated

3. Policies targeting water bureaus/supply utilities

Climate outcome	Specific policies	Indicators of progress
Policies by water bureaus/ authorities and or water supply utilities to increase water supply, reduce water demand, and make provisions for storage could improve performance of the water sector under current conditions and adapt under changing climate scenarios	Schemes to seek alternative water sources like water transfer from other rivers	Infrastructure for water transfer
	Schemes to promote water conservation initiatives directed to residential and other water users	Budget allocations for water conservation
	Investment programs for construction of additional reservoir storage	Capacity of reservoirs
	Incentives to discourage growth of water-intensive industries and encourage structural change in industry to less-water-intensive industries	Industrial water use per value-added industrial GDP
	Investment in water distribution systems to reduce leakage and system inefficiency and reduce non-revenue water (unaccounted for water)	Investment in maintenance of water distribution systems
	Schemes to subsidize municipal water infrastructure improvement	Non-revenue water or percentage unaccounted-for water
	Schemes to enhance water saving in public facilities	
	Investment to upgrade wastewater treatment facilities to improve effluent quality	Measures of water quality

Table 3.2 Policies for adaptation in the water sector (continued)

4. Policies for river basin planning and coordination

Climate outcome	Specific policies	Indicators of progress
Comprehensive planning across river basins will provide solutions to problems of water quality and quantity	Programs to create institutions for comprehensive planning across river basins to help solve problems of water quality and quantity	Existence of institutions/capacity for comprehensive planning
	Development of conflict resolution mechanisms and institutional capacity in water allocation scheme	Institutions for conflict resolution
	Schemes to enhance river basin management by coordinating different interest groups among upstream and downstream users	Capacity of local institutions/degree of decentralization
	Create institutions to regulate water supply and wastewater discharge within the basin by establishing legal priorities to regulate withdrawal during times of shortage	Budget allocations for river basin planning and watershed development
	Schemes to promote water conservation in the river basin	
	Programs to provide subsidies to losses due to water shortage	
	Schemes to subsidize long distance water transfer	

5. Adopt contingency planning for drought

Climate outcome	Specific policies	Indicators of progress
Measures to adapt to water shortages could help reduce losses due to drought conditions	Develop plans for short-term measures to adapt to water shortages and thus mitigate droughts	Measures of drought preparedness

6. Policies to make marginal changes in construction of infrastructure

Climate outcome	Specific policies	Indicators of progress
Increased variability in runoff and higher storage capacity may be required in the case of adverse effects due to climate change	Schemes to incorporate marginal changes in the planned construction of water resources infrastructure such as reservoirs, dams, canals, pipelines, pumping plants, storm drainages and flood control works to adapt to increased variability in runoff or to a need for greater storage capacity	Capacity of water resources infrastructure to accommodate short-term surges in storm water

7. Policies for interbasin transfer of available water

Climate outcome	Specific policies	Indicators of progress
Transfers of water between basins may result in more efficient water use both in current and changed climate conditions. Transfers are easier to implement than fully operating markets for water allocation.	Programs to create institutions for interbasin transfers to promote more efficient use of water and for responding to regional droughts or other problems of water supply	Existence of institutions/capacity for comprehensive planning

Table 3.2 Policies for adaptation in the water sector (continued)

8. Maintain options to develop new dam sites

Climate outcome	Specific policies	Indicators of progress
Developing potential dam sites allows for options for storage of water in case of extreme events	Programs to reserve areas keep options open to develop dam sites to increase ability to adjust to water shocks	Availability of reserve areas for development of dams and other water storage areas

9. Policies to conserve water by reducing demand for water

Climate outcome	Specific policies	Indicators of progress
Water conservation and reduction in demand will benefit under current and under climate change scenarios	Programs to encourage efficient water use including education	Public extension/education programs to encourage water conservation
	Educational activities to promote voluntary compliance and water conservation	
	Pricing of water resources to encourage conservation policies	Prices/charges for water
	Schemes to enforce quota restrictions on water use	
	Rationing water or imposition of water conservation standards and technologies	

10. Policies to allocate water supplies using market-based systems

Climate outcome	Specific policies	Indicators of progress
Market-based allocations facilitate efficient allocation under both the current and expected climate change scenarios	Policies that respond more rapidly to changing conditions of supply to lower demand	

11. Policies to control pollution

Climate outcome	Specific policies	Indicators of progress
Water pollution reduces the supply of clean water	Policies to reduce point and nonpoint sources of water pollution	Measures of water quality

Table 3.2 Policies for adaptation in the water sector (continued)

12. Policies targeting water use in agricultural sector

Climate outcome	Specific policies	Indicators of progress
Agricultural sector uses most of the water in developing countries. Adaptation policies in the agricultural sector to increase the supply, increase the efficiency of water used, and reduce demand will benefit water sector in the current conditions and facilitate adaptation under climate change scenarios	Schemes to construct farm ponds to store water	Budget allocations for schemes in the agricultural sector to conserve water
	Programs to promote water harvesting techniques	Watershed development projects
	Incentives to adjust crop structure, switching to less water demanding/intensive crops	Cropping pattern and crop mix
	Schemes to improve irrigation efficiency by reducing wastage	
	Schemes to switch from low to high efficiency irrigation techniques	Coverage of efficient irrigation techniques
	Investment programs to upgrade canals and storage infrastructure to increase capacity and to reduce losses in transport and storage	Government spending
	Programs to increase use of brackish water	Share of brackish water used
	Schemes to encourage groundwater recharge and thus replenish the water table	Depth of water table
	Programs to promote use of sprinkle and drip irrigation techniques when appropriate	Area covered by drip/sprinkler irrigation
	Schemes to strengthen the maintenance of mechanical wells and anti-seepage of channels	
	Programs for adjustment operation and optimization of district water control and water distribution systems	
	Schemes to promote research in good quality seeds, advanced technologies and practices that conserve water use in agriculture	Availability of seeds/varieties of crops that use less water
	Programs to establish crop insurance covering losses due to drought and flooding	
	Provide farmers with subsidies for losses due to drought, flooding, and other natural hazards	

13. Policies to encourage rainwater harvesting

Climate outcome	Specific policies	Indicators of progress
The policy is diverting, collecting, storing, utilizing, and managing runoff for productive use. Runoff is collected from rooftops, ground catchments, as well as ephemeral streams (flood water harvesting) and road/footpath drainage	Schemes to construct different structures for storage of on-farm water and prevent runoff— structures include tanks, reservoirs, dams, water pans, etc.	Public investment in structures for water harvesting

5. Policies to prevent as well as cure cerebro-spinal meningitis (CSM) disease
6. Policies for management of cholera
7. Policies to prevent/control infectious diseases
8. Policies to prevent waterborne diseases
9. Policies to combat heat stress

Policy Options for Mitigation of Climate Change

There is substantial economic potential for mitigation of GHG emissions in the coming decades that could offset the projected growth of emissions or reduce emissions below the current levels. The potential in the industrial sector is especially high in the energy-intensive industries where the full potential has not been utilized, both in the developing and developed countries. Agricultural practices can make a significant contribution to low-cost mitigation by increasing soil carbon sinks and by contributing biomass feedstocks for energy use. Similarly, forest-related mitigation actions can considerably reduce emissions from sources and increase CO_2 removals by sinks at low cost. The waste sector, although a low contributor of emissions, can also positively contribute to GHG mitigation. Geoengineering options such as ocean fertilization and blocking sunlight by bringing material into the upper atmosphere are also being discussed, although their side effects are not fully known. The World Bank Group's initiatives on mitigation were discussed briefly in section 2.3.

Carbon finance at the World Bank

The World Bank's carbon finance initiatives are an integral part of the Bank's mission to reduce poverty through its environment and energy strategies. The World Bank Carbon Finance Unit (CFU) uses money contributed by governments and companies in OECD countries to purchase project-based greenhouse gas emission reductions in developing countries and countries with economies in transition. The emission reductions are purchased through one of the CFU's carbon funds on behalf of the contributor, and within the framework of the Kyoto Protocol's Clean Development Mechanism (CDM) or Joint Implementation (JI).

Unlike other World Bank development products, the CFU does not lend or grant resources to projects, but rather contracts to purchase emission reductions similar to a commercial transaction, paying for them annually or periodically once they have been verified by a third-party auditor. The selling of emission reductions—or carbon finance—has been shown to increase the bankability of projects by adding an additional revenue stream in hard currency, which reduces the risks of commercial lending or grant finance. Thus, carbon finance provides a means of leveraging new private and public investment into projects that reduce greenhouse gas emissions, thereby mitigating climate change while contributing to sustainable development.

The Bank's carbon finance operations have demonstrated numerous opportunities for collaborating across sectors, and have served as a catalyst in bringing climate issues to bear in projects relating to rural electrification, renewable energy, energy efficiency, urban infrastructure, waste management, pollution abatement, forestry, and water resource management. A vital element of this is ensuring that developing countries and economies in transition are key players in the emerging carbon market for greenhouse gas emission reductions. The role of the Bank's Carbon Finance Unit is to catalyze a global carbon market that reduces transaction costs, supports sustainable development, and reaches and benefits the poorer communities of the developing world.

Sectoral policies for mitigation

A wide variety of policies and instruments/technologies are available at the national level for mitigation of GHG emissions. The potential for mitigation in the industrial sector is predominantly in the energy-intensive industries through increasing energy efficiency and promoting greater use of renewable energy. In addition to the energy sector, there are opportunities for mitigation in the agricultural sector, building and transportation, the forestry sector, and in waste management. Such sectoral policies may be integrated with the carbon finance opportunities and may be become eligible for certified emission reduction (CER) credits. The specific mitigation opportunities in the above sectors are presented below.

Table 3.3 Policies for adaptation in coastal areas

1. Policies to retreat from (manage) coastal areas susceptible to effects of global warming to discourage development in sensitive coastal areas and plan for urban growth

Climate outcome	Specific policies	Indicators of progress
Planning for growth away from sensitive lands toward less vulnerable areas will reduce the risks associated with sea-level rise and also reduce vulnerability to severe coastal storms that may occur under current and under changing climate scenarios. The setbacks for coastal development will buy some time to avoid the destructive effects of sea-level rise. Similarly, buffer zones enable the sea level to rise up to a point without threatening coastal development	Schemes to increase or establish setbacks and buffer zones between the shore and new coastal developments to avoid the destructive effects of sea-level rise	Investment/ funds allocated for construction of setbacks and buffer zones
	Schemes to relocate threatened buildings	
	Programs to create upland buffers	Funds for creating upland buffers
	Schemes for managed realignment of coastal areas/ development	Funds for realignment of costal development
	Schemes to develop rolling easements for presumed mobility	Funds/investment in rolling easements
	Programs to phase out or prevent development in susceptible areas	Legislation to phase out or prevent development in susceptible areas
	Limit government subsidies or tax incentives to develop coastal land sensitive to sea-level rise such as barrier lands, coastal wetlands, estuarine shore lands, and critical wildlife habitat	
	Programs to discourage permanent shoreline stabilization and allow a gradual retreat from a sea-level rise thus facilitating the development market to decide if a property is worth developing	
	Policies to site large capital facilities away from coasts that would pose significant flooding hazards	

Table 3.3 Policies for adaptation in coastal areas (continued)

2. Policies to protect coastal areas: these include hard structural options, soft structural options and indigenous options

Climate outcome	Specific policies	Indicators of progress
Coastal areas are valuable natural areas that are difficult to re-create and hence there is a need to protect their irreversible loss. Protecting coastal areas and wetlands would also improve water quality, flood control, and fish and wildlife habitat under current climate conditions.	Hard structural options	Funds/budget allocation for construction of hard structural operations
	Schemes to construct dikes, levees, floodwalls	Funds allocated for investment in dikes, levees, floodwalls; indicator of the dikes, levees, and floodwalls constructed
	Construction of seawalls, revetments, bulkheads	Seawalls, revetments, bulkheads constructed; budget allocations for such investments
	Investment in development of groynes	Extent of groynes developed
	Schemes to develop detached breakwaters	Coverage of detached breakwater
	Investment programs to develop floodgates and tidal barriers	Coverage of floodgates and tidal barriers
	Soft structural options	Coverage of soft structural options; budget allocations
	Programs to develop barriers to salt water intrusion	Coverage of barriers to salt water intrusion
	Schemes for periodic beach nourishment	Coverage of periodic beach nourishment activities
	Schemes for restoration and creation of dunes	Dunes restored/recreated
	Indigenous options	
	Schemes for restoration and creation of wetlands	
	Afforestation programs	Area brought under afforestation program
	Schemes to create coconut leaf walls or coconut fiber stone units	Area covered by leaf walls or fiber stone units
	Schemes to erect wooden and stone walls	Area covered by wooden/stone walls

Table 3.3 Policies for adaptation in coastal areas (continued)

3. Policies to accommodate climate change in development and management of coastal areas

Climate outcome	Specific policies	Indicators of progress
Polices for accommodation of emerging climate scenarios in development and management of coastal areas will improve the ability of the society to cope with the effects of the event.	Schemes to develop early warning systems	Indicator of early warning systems in place
	Emergency planning for evacuation systems	Capacity for action under emergency, capacity of evacuation systems
	Hazard insurance programs to cover risks from adverse events and floods on investments in coastal areas	Investments covered by hazard insurance; availability of options for hazard insurance
	Policy initiatives to encourage private sector insurance companies to offer insurance to reflect the true risks of developing or living in coastal areas	Private sector participation in hazard insurance programs
	Modification of land use and agricultural practices	
	Programs to modify building styles and codes	Suitability of building styles and codes to suit adverse impacts
	Strict regulation of hazard zones	
	Programs to improve drainage by increasing diameter of pipes	
	Programs to improve drainage by increasing pump capacity	Measure of capacity of drainage systems to accommodate storm surges
	Scheme to increase capacity and or construction of desalination plants	
	Programs to incorporate marginal increase in the height of the coastal infrastructure such as bridges or sea walls to provide cushion to offset sea-level rise	

Table 3.4 Policies for adaptation in the forest sector

1. Enhance forest seed banks aimed at conservation

Climate outcome	Specific policies	Indicators of progress
Maintaining access to a variety of seeds to allow conservation of original genetic diversity of forests to be rebred provides an assurance that benefits provided by forests are not lost for ever. Seed collections should represent the variety of genotypes that exist for each species	Schemes to increase forest seed banks	Investment in forest seed banks

2. Forest conservation through watershed development and conservation

Climate outcome	Specific policies	Indicators of progress
Preservation and conservation of watersheds will prevent land degradation and desertification	Schemes to conserve watersheds	Investment in watershed conservation; number of watersheds conserved

3. Encourage diverse forest management practices for rehabilitation

Climate outcome	Specific policies	Indicators of progress
A diverse mix of forest management practices, strategies, and species will provide a buffer against uncertainties of climate change	Policies to include a mix of planting practices	Extent of species mix in forests
	Schemes to plant a greater variety of species	Extent of species mix in forests
	Schemes to plant tree species drawn from warmer climate zones	Extent of species mix with those that grow on warmer climates
	Forestry schemes with high planting densities	
	Planting of trees that have greater resistance to heat and drought on the southern range of managed forest boundaries if trees can survive in the current climate	
	Schemes to plant tree species and adjust management practices considering future climate scenarios	
	Schemes for forest rehabilitation through agroforestry	Coverage of agroforestry schemes
	A mix of different timber harvesting strategies to promote forest diversity	

Table 3.4 Policies for adaptation in the forest sector (continued)

4. Policies that establish flexible criteria for intervention

Climate outcome	Specific policies	Indicators of progress
Flexible policies let interventions be implemented to adjust to the changes in the structure of the forest because of climate change	Flexible policies for salvage harvests so as to allow adjustments as climatic conditions change	
	Flexibility regarding silivicultural management	
	Flexible policies for insect and fire control, and restoration activities	

5. Policies to reduce habitat fragmentation and promote development of migration corridors

Climate outcome	Specific policies	Indicators of progress
Geographic fragmentation threatens the ability of forests and forest species to migrate or adapt to climate change. Currently the health of many forests is stressed by existing fragmentation and is most likely to increase under climate change. There is a likelihood that climate change will cause forests to migrate in a poleward or vertical direction	Incentive policies and programs for multiple-use management that balances preservation and use with in a single parcel	Extent of geographic fragmentation of forests
	Negotiation of conservation easements that protect geographically important land parcels from development	

6. Policies for development of forest plantations

Climate outcome	Specific policies	Indicators of progress
Establishment of forest plantations will reduce impacts on forest ecosystems due to increased fuelwood demand	Schemes to establish fuelwood orchards	Coverage of fuelwood orchards

Table 3.5 Adaptation policies for preservation of biodiversity and ecosystems

1. Integrated ecosystem planning and management

Climate outcome	Specific policies	Indicators of progress
Integrated planning and management along watershed and ecosystem lines will reduce institutional fragmentation in the management of natural areas, ecosystems, and a variety of plant and animal species. Institutional coordination will help address many of the threats to diversity of species	Develop institutions for coordination in planning and management along watersheds and ecosystems	Capacity of institutions in planning and management along watersheds and ecosystems
	Programs to foster regional, national, and international coordination in preservation of a variety of species and ecosystems	Institutional capacity to foster coordination

2. Policies to protect and enhance migration corridors or buffer zones

Climate outcome	Specific policies	Indicators of progress
Such policies help maintain ecosystems by improving the likelihood of successful adaptation by plant and animal species	Schemes to increase buffer zones around current reserve areas that include different altitudes and ecosystems	Coverage of buffer zones
	Schemes to implement a graded system of management where the innermost areas receive greatest protection and more users are allowed in the outer buffer zones or corridors	
	Schemes to increase diversity of natural lands and land parcels to improve possibility of species adaptation to climate variability	Measure of diversity of natural lands and parcels
	Programs to develop corridors around reserve areas so as to allow animals to migrate as climate changes	Presence/coverage of corridors

3. Enhance methods to protect biodiversity off-site

Climate outcome	Specific policies	Indicators of progress
Offsite protection is important in preventing irreversible loss of biodiversity. Methods for offsite protection must be in place before climate changes to avoid irreversible loss of species extinction	Investment programs to create gene and seed banks, libraries, gardens, and zoos	Availability of gene/seed banks, libraries, and gardens

Table 3.6 Policies for adaptation in the health sector

1. Policies to improve public health infrastructure

Climate outcome	Specific policies	Indicators of progress
Public health infrastructure would reduce the vulnerability of the population to health impacts of climate change	Investments in public health training programs	
	Investment in disease surveillance mechanisms	Infrastructure and funding for disease surveillance
	Investment in sanitation systems	Coverage of public sanitation system
	Programs for vector control	Area covered by the vector control program
	Immunization programs	Percentage of the population covered
	Investment in infrastructure to respond to disease outbreak, diagnosis, and treatment	Number and coverage of health centers and rapid response teams

2. Improving access to adequate food and water

Climate outcome	Specific policies	Indicators of progress
Access to improved water and food will reduce susceptibility/ exposure to vector-borne diseases and weather extremes	Investment programs to increase access to improved water sources	Population with access to improved water
	Policies for improving access to food and nutrition under extreme conditions	Infrastructure for emergency management

3. Improving health education programs

Climate outcome	Specific policies	Indicators of progress
Health education can make people better prepared under possible health impacts due to climate change	Programs for public education on infectious diseases	Expenditure on public education programs to combat infectious diseases
	Program to educate public on control/ prevention of waterborne diseases	Expenditure on public education programs

4. Policies to combat incidence of Malaria

Climate outcome	Specific policies	Indicators of progress
Malaria is a climate-sensitive tropical disease; a warming trend is associated with increases in malaria incidence in some locations	Programs to develop vaccines and herbal preparations	
	Schemes to control mosquitoes	Public spending on mosquito control
	Programs to introduce predators to control vector population	Public spending on vector control
	Schemes to distribute insecticide-impregnated nets	Number of nets distributed
	Health education programs	Government expenditure on health education
	Programs for improved treatment of malaria patients	Coverage of health clinics and hospitals

Table 3.6 Policies for adaptation in the health sector (continued)

5. Policies to prevent as well as cure cerebro-spinal meningitis (CSM) disease

Climate outcome	Specific policies	Indicators of progress
Studies have shown an increase in incidence of CSM disease in West Africa, which is suspected to be associated with changing weather patterns. Changing climate patterns may trigger an increase in incidence	Schemes to improve architectural design of houses	
	Programs for vaccination against the disease	Percentage of population vaccinated, public spending on vaccination
	Schemes for health education	Government expenditure on health education
	Investment in mobile clinics to treat disease cases	Number of mobile clinics
	Programs for improved treatment of CSM patients	

6. Policies for management of cholera

Climate outcome	Specific policies	Indicators of progress
Changing climate patterns could trigger emergence of cholera and other infectious diseases	Programs for vaccination against the disease	Percentage of population vaccinated, public spending on vaccination
	Schemes for health education	Government expenditure on health education
	Investment in mobile clinics to treat disease cases	Number of mobile clinics and number of patients treated
	Programs for improved treatment of cholera patients	Coverage of health clinics and hospitals
	Schemes to use bore-hole drills for capturing water	
	Program to use activated charcoal in domestic water filter systems	Public/private spending on activated charcoal

7. Policies to prevent/control infectious diseases

Climate outcome	Specific policies	Indicators of progress
Changes in infectious disease transmission patterns are a likely major consequence of climate change	Programs to develop a computer information system on disease incidence	Coverage of health information database
	Public education scheme on health care, disease prevention and treatment	Public spending on health care
	Schemes to control vectors transmitting diseases	Public expenditure on vector control
	Schemes for primary healthcare, including vaccinations and medicines	Coverage of primary healthcare facilities, coverage of vaccinations

Table 3.6 Policies for adaptation in the health sector (continued)

8. Policies to prevent waterborne diseases

Climate outcome	Specific policies	Indicators of progress
Increased precipitation caused by global warming may increase flooding in some areas, which could lead to drinking water contamination and in turn incidence of waterborne diseases	Schemes to improve water supply systems	Percentage of population with access to improved water
	Improve water purification systems	
	Programs to develop a computer information system on disease incidence, surveillance and control	
	Schemes for improved sanitations	
	Schemes to improve primary health care, including vaccinations and medicines	Coverage of primary healthcare facilities, coverage of vaccinations

9. Policies to combat heat stress

Climate outcome	Specific policies	Indicators of progress
Increase in temperatures as a result of warming result in heat stress	Schemes to provide cost-effective technologies and cooling management systems	Percentage of population with such systems
	Schemes for adjustments in building designs such as insulation, blinds, better ventilation	
	Programs to encourage planting trees in urban areas	Urban tree coverage

Energy sector policies for mitigation

Energy sector offers the greatest opportunity for mitigation. The policies that could be followed in the energy sector are grouped into the following four general groups. The specific policies are then outlined under each group in Table 3.7

1. Policies to promote renewable energy generation and use of renewable sources to include wind, solar, hydro, sea water currents, geothermal energy, soil energy, air energy, biomass energy, landfill gas energy, sewage gas energy, and biogas energy
2. Policies to promote energy efficiency
3. Policies to encourage fuel switching for power generation
4. Policies to encourage carbon capture

Mitigation options/policies in the building sector

Substantial reduction in GHG emissions from commercial and residential buildings could be achieved through improving energy efficiency and use of renewable energy using technologies that are available and have been proved successful. Estimates by the IPCC show there is a potential to reduce 29 percent of the projected baseline emissions cost-effectively by 2020 in the residential and commercial sectors (highest among all sectors assessed). The policies and programs for GHG mitigation from buildings are presented under the following six groups in Table 3.8:

1. Policies to promote energy efficiency of appliances and electric and electronic equipment
2. Policies on building energy codes
3. Building certification and labeling systems
4. Education, training, and energy audit programs
5. Standards and labeling of appliances, lighting, and office/consumer plug loads
6. Voluntary agreements

Policies for mitigation in the transportation sector

In 2004, the transport sector accounted for 23 percent of the world's energy-related GHG emissions, with about three-quarters coming from road vehicles. Improving energy efficiency in the transport sector thus offers a significant opportunity for mitigation. Policies for mitigation in the transport sector are presented under two categories: (1) policies to promote energy efficiency and GHG emission reduction in the transportation sector, and (2) policies to reduce congestion on roads, highways, and urban centers (see Table 3.9).

Policies for mitigation in the forest sector

Forests have a very significant role in the global carbon cycle. Though forests play a key role in mitigation, forests are also affected by climate change, and their contribution to climate change may be affected by stresses resulting from it. Mitigation options in the forest sector include reducing emissions from deforestation and forest degradation, enhancing sequestration rates in existing and new forests, providing wood fuels as a substitute for fossil fuels, and providing wood products for more energy-intensive materials. As noted in module 1, the Bank is active in promoting finance for avoided deforestation. If these reductions in GHGs are accepted by the UNFCCC as part of the next climate agreement, there will be a major impetus to forestation. For purposes of this discussion, we present below forestry sector mitigation polices under the following five general categories:

1. Policies to increase or maintain the forest area by preventing deforestation
2. Policies to increase forest area by encouraging aforestation and reforestation
3. Policies to improve forest management to increase carbon density at plot and landscape level
4. Policies to encourage substitution of energy-intensive materials with less energy-intensive ones
5. Promotion of bio-energy

The specific policy instruments include economic instruments, regulatory instruments, voluntary agreements, and research and development and dissemination programs (see Table 3.10).

Policies for mitigation in agriculture sector

In 2006, agriculture accounted for about 10 to 12 percent of the global anthropogenic emissions of GHGs, 60 percent of N_2O emissions, and 50 percent of CH_4 (IPCC 2007). There are number of options for

mitigation of GHGs from agriculture, including improved crop and grazing land management, restoration of organic lands that are drained for crop production, and restoration of degraded lands. Land management practices include improved agronomic practices, nutrient use, tillage, and residue management. There are also opportunities for mitigation through improved water and rice-land management, set-asides, land use and agroforestry; and improved grazing and livestock and manure management. Table 3.11 presents a menu of policy options for mitigation under the following two categories:

1. Policies for improved cropland management
2. Policies for improved livestock management

Mitigation policies in waste management

Wastes are a small contributor of GHGs, accounting for less than 5 percent of total GHG emissions. Among the GHGs, the largest source is landfill methane, followed by wastewater methane and nitrous oxide. In addition, minor emissions of CO_2 result from incineration of wastes containing carbon. A variety of technologies are available for mitigation of GHGs from wastes. Landfilling with landfill gas recovery, post consumer recycling, composting of selected waste fractions and processes that reduce GHG generation compared to landfilling are some such technologies currently available. For purposes of this discussion, we present below in Table 3.12 specific policies for mitigation polices under the following four general categories:

1. Policies to reduce landfill methane emissions
2. Programs to promote incineration and other waste-to-energy
3. Policies to promote waste minimization, re-use and recovery
4. Policies and measures to reduce emission of fluorinated gases

Table 3.7 Energy sector policies for mitigation/adaptation to climate change

1. Policies to promote renewable energy generation and use of renewable sources to include wind, solar, hydro, sea water currents, geothermal energy, soil energy, air energy, biomass energy, landfill gas energy, sewage gas energy, and biogas energy

Climate outcome	Specific policy instruments
Development and use of renewable energy reduces the demand for and generation of energy from coal-fired power plants and thus reduces GHG emissions	**Economic policy instruments**
	Proposals to provide capital investment grants to promote renewable energy generation
	Schemes to provide feed-in tariffs for energy produced from all renewable sources
	Programs to enforce mandatory renewable energy targets (quota obligations) to raise the contribution of renewable energy sources in the total electricity supply mix
	Development of tradable renewable energy certificates (RECs) to demonstrate compliance with the objective of mandatory renewable energy targets
	GHG taxes on power plants, CO_2 taxes-green tax program
	Implementation of tradable emission permits
	Schemes to provide supply tariffs to renewable generation units such as hydro plants and other ecofriendly generation units
	Investment subsidy and an exemption from real estate taxes to companies that invest in use of sustainable sources of energy (hydroelectric energy, wind energy, solar energy, geothermal energy, biogas, organic products and waste from agriculture and forestry arboriculture, biodegradable organic part of waste), cogeneration and energy savings during the manufacturing process
	Capital cost allowance to renewable energy equipments used to generate electricity or to produce thermal energy for direct use in an industrial process
	Fiscal incentives for development of renewable energy, photovoltaic rebate program
	Subsidies for development, demonstration, and commercialization of new products and processes for energy efficiency
	Schemes to reconstruct and improve efficiency of hydroelectric plants, e.g. Russia
	Regulatory instruments
	Schemes to enforce targets like mandatory share of energy from renewable sources in the total energy supplied
	Liberalization of energy market providing access to grids for energy generated from renewable sources
	Schemes to commercialize generation and use of renewable energy
	Development of a stringent accreditation program that sets environmental and reporting standards for renewable energy products offered by suppliers to households and businesses
	Programs to develop codes and procedures for renewable energy generation and distribution
	Legislation on promotion of the use of renewable energy sources
	Programs to assess and develop the legislative, institutional, and regulatory framework for geothermal power development
	Voluntary agreements
	Voluntary agreements to install renewable energy capacity

Table 3.7 Energy sector policies for mitigation/adaptation to climate change (continued)

1. Policies to promote renewable energy generation and use of renewable sources to include wind, solar, hydro, sea water currents, geothermal energy, soil energy, air energy, biomass energy, landfill gas energy, sewage gas energy and biogas energy (Continued)

Climate outcome	Specific policy instruments
Development and use of renewable energy reduces the demand for and generation of energy from coal-fired power plants and thus reduces GHG emissions	**Information dissemination and strategic planning:**
	Programs to develop local expertise in the installation, operation, management, and maintenance of technically and economically proven renewable energy systems
	Development of decision-making tools that reduce the cost of pre-feasibility studies; disseminating knowledge to help people make better decisions
	Government investment to build knowledge and accelerate the development of renewable technology to include fuel cells and other technologies that will form the basis of the emerging hydrogen economy, including technologies to produce hydrogen from renewable energy sources
	Support demonstrations of renewable energy technologies to encourage adoption
	Implement demonstration programs for development and use of renewable energy
	Programs to encourage private sector participation in renewable energy generation
	Schemes to develop solar water heating industry and to promote development of private sector in installation and maintenance of these systems
	Programs to strengthen and expand existing biomass expertise in energy and forest industry to new areas
	Programs to promote the commercialization of developed biomass products and technologies such as district heating from wood chips, biogas
	Promotion of biogas plants in rural areas
	Schemes to build business competence and to support pilot projects and demonstrations of biomass technologies
	Incentives to encourage small and medium-sized enterprises to work on niche products and markets
	Strategic planning for development of combined heat and power generation
	Research, development, and dissemination of technology:
	Schemes for research and demonstration to promote electricity production from natural gas and renewable sources and quality co-generation
	Programs to fund technology projects that promise to reduce GHG emissions while sustaining economic and social development
	Financial incentives to support the development of advanced electricity storage technologies to store generated energy from renewable sources (wind and solar in particular) and use it when required
	Investment for development and installation of software and systems to allow accurate wind forecasting and promote wind and solar energy in the national electricity market
	Investment in biomass and waste conversions; cellulosic ethanol from biomass and other biofuels including biodiesel; bio-processes; biomass production, harvesting and transportation; and energy from biomass
	Schemes to explore technology and research needs for the development of geothermal energy and geothermal resource assessment
	Programs to assess the training and skills development to exploit geothermal power sources

Table 3.7 Energy sector policies for mitigation/adaptation to climate change (continued)

2. Policies to promote energy efficiency

Climate outcome	Specific policy instruments
Energy efficiency in buildings, appliances, home electronics, heating and cooling, office equipment, lighting equipment, other products will reduce energy consumption	**Economic policy instruments**
	Increase taxes on energy and lower subsidies on energy
	GHG taxes on power plants, CO_2 taxes-green tax program
	Fiscal incentives to increase energy efficiency
	Subsidy schemes to provide financial incentives/ discount the retail purchase price of the energy saving bulbs, CFLs
	Financial incentives (fines/subsidies/penalty) to enforce energy efficiency labels on equipments, appliances and electronic products
	Financial incentives for investment in energy efficient technologies by small and medium sized business
	Setting up stand-alone energy efficiency funds or specific windows for energy efficiency in existing funds, as in Bulgaria, Egypt
	Implementation of tradable emission permits, cap and trade
	Schemes to provide financing incentives for investment in energy efficiency
	Regulatory instruments:
	Schemes to enforce minimum efficiency standards for power plants
	Schemes to promote energy efficiency labels on appliances, home electronics, heating and cooling, office equipment, lighting equipment, other products
	Quota restrictions on emissions from point sources
	Programs to enforce minimum energy efficiency requirements/standards for household appliances, office equipment, and other products
	Schemes to enforce mandatory energy labeling
	Programs to phase out yellow incandescent light bulbs
	Programs for substitution of lamps and technical development of control equipment and luminaries and improved lighting design
	Legislations requiring standards for energy efficiency of heat and electricity production, transmission, distribution and use, energy planning requirements, energy auditing obligations, certification of energy auditors, energy labeling program, energy performance of buildings, and inspection of boilers and air conditioning units.
	Energy audit program and incentives to participate in energy audit
	Programs to encourage energy efficiency in government operations through programs (like the National Appliance and Equipment Energy Efficiency Program in Australia)
	Energy efficiency requirements for lighting, including fluorescent lighting ballasts
	Schemes to set up clean-vehicle quotas for government vehicle procurement programs
	Voluntary agreements:
	Voluntary agreements to reduce GHG emissions
	Voluntary agreements to increase power plant efficiency

Table 3.7 Energy sector policies for mitigation/adaptation to climate change (continued)

2. Policies to promote energy efficiency (Continued)

Climate outcome	Specific policy instruments
Energy efficiency in buildings, appliances, home electronics, heating and cooling, office equipment, lighting equipments, other products will reduce energy consumption	**Information dissemination, strategic planning and capacity**
	Development of a national policy on energy
	Programs to raise the awareness of senior management of commercial enterprises and motivate action to improve the skill base to identify energy efficiency opportunities, demonstrate leadership to the government, business sector and wider community
	Educational programs to encourage consumers to select energy efficient products, equipments, lighting, and home and office electronics equipments
	Programs to develop the capacity of the relevant professions and trades to identify opportunities and implement energy efficient solutions
	Educational programs to demonstrate the benefits of energy efficiency to commercial and industrial sector
	Programs to build industry capacity to deliver energy efficient solutions
	Public awareness campaign for promoting energy efficiency
	Educational programs to encourage users to switch off lights and electronic equipment when not in use
	Establish a national climate change forum of government officials at the federal, state and municipal level along with representatives from academia, NGOs, and corporations
	Establish a Sustainable Development Technology Fund/climate fund to stimulate the development and demonstration of technologies aimed at reducing greenhouse gas emissions
	Creation of a multisectoral technology and innovation initiative
	Research and development and dissemination of technology:
	Research and development of cleaner power generation
	Develop and demonstrate advanced near-zero-emission coal technology through carbon capture and storage

3. Policies to encourage fuel switching for power generation

Climate outcome	Specific policy instruments
Switching from coal-fired power plants to generation from nuclear, natural gas, renewable, and hydrogen sources will reduce GHG emissions	**Economic policy instruments:**
	Taxes on GHG emissions, green tax
	Programs to implement tradable emission permits
	Fiscal incentives to switch to power generation using less polluting technologies/fuels
	Regulatory instruments:
	Schemes to introduce standards in power plant fuel portfolio
	Quota restrictions on emissions from point sources
	Schemes that require power suppliers to purchase power from renewable generation and CHP and financial incentives
	Voluntary agreements:
	Schemes to encourage voluntary agreements to encourage environment friendly fuel portfolio
	Information dissemination and strategic planning:
	Development of a national policy on energy
	Programs to provide up-to-date information and educational campaigns
	Research and development and dissemination of technology:
	Research and development of cleaner power generation
	Develop and demonstrate advanced near-zero-emission coal technology through carbon capture and storage

Table 3.7 Energy sector policies for mitigation/adaptation to climate change (continued)

4. Policies to encourage carbon capture

Climate outcome	Specific policy instruments
Carbon capture envisages capturing carbon dioxide from large point sources such as fossil powered power plants and storing it instead of releasing it into the atmosphere, thus reducing total greenhouse gases emitted into the atmosphere.	**Economic instruments:**
	GHG taxes on power plants, CO_2 taxes-green tax program
	Programs to implement tradable emission permits
	Subsidies on investment in carbon capture mechanisms
	Regulatory instruments:
	Quota restrictions on emissions from point sources
	Voluntary agreements:
	Programs to promote voluntary agreements to develop and install carbon capture systems
	Information dissemination and strategic planning:
	Development of a national policy on energy
	Schemes for dissemination of information on carbon capture
	Research and development and dissemination of technology:
	Investment in research and development of chemical and biological sequestration
	Investment in research and development of sequestration in geological formations

Table 3.8 Policies for mitigation/adaptation to climate change in commercial and residential buildings

1. Policies to promote energy efficiency of appliances and electric and electronic equipments

Climate outcome	Specific policy instruments
Improvements in energy efficiency of appliances, home electronics, heating and cooling systems, office equipments, lighting equipments and , other products will reduce energy consumption	Schemes to promote energy efficiency labels on appliances, home electronics, heating and cooling systems, office equipments, lighting equipment and other products
	Educational programs to encourage consumers to select energy efficient products, lighting, and home and office electric and electronics equipments
	Programs to enforce minimum energy efficiency requirements/standards for household appliances, office equipments, and other products
	Financial incentives (fines/subsidies/penalty) to enforce energy efficiency labels on equipments, appliances, and electronic products
	Subsidy schemes to provide financial incentives/ discount the retail purchase price of the energy saving bulbs, CFLs
	Schemes to enforce mandatory energy labeling
	Programs to encourage energy efficiency in government operations through programs like the National Appliance and Energy Efficiency Program in Australia
	Educational programs to encourage users to switch off lights and electronic equipment when not in use
	Program to phase out yellow incandescent light bulbs
	Programs for lamp substitution and technical development of control equipment and luminaries and improved lighting design
	Schemes to provide incentives for solar heating and cooling systems
	Schemes to improve the policy framework of efficient heating and cooling systems

2. Policies on building energy codes

Climate outcome	Specific policy instruments
Performance-based codes that require compliance with energy consumption levels will reduce overall energy use and thus have significant climate impacts	Schemes to develop and enforce Minimum Energy Performance Standards (MEPS) for all classes of buildings
	Implementation of prescriptive codes that set separate performance levels for major envelope and equipment components such as minimum thermal resistance of walls, maximum window heat loss/gain, and minimum boiler efficiency
	Development of legislation and institutional capacity for implementing energy efficiency in buildings

Table 3.8 Policies for mitigation/adaptation to climate change in commercial and residential buildings (continued)

3. Building certification and labeling systems

Climate outcome	Specific policy instruments
The use of buildings and equipment, excluding industrial equipment, account for a major share (about 50% in UK) of CO_2 emissions. Significant reductions in energy demand and CO_2 emissions may be achieved by improving energy performance of buildings	Voluntary energy star ratings for buildings
	Schemes for energy labeling of buildings-energy star labeling of homes
	Schemes to provide expert consulting services to households and measures to improve energy efficiency
	Programs to conduct energy audits for public and private buildings and providing incentives to participate in such audits
	Certification schemes for all buildings and regular inspection and assessment of boilers/heating and cooling installations
	Develop energy performance labeling for window products for consumers and backup technical support for industry members designed to inform consumers and influence their purchase decisions

4. Education, training, and energy audit programs

Climate outcome	Specific policy instruments
A survey and analysis of energy flows in a building, process or system with the objective of understanding the energy dynamics of buildings and the system could improve energy efficiency and thus CO2 mitigation	Development of technical manuals and consumer guides to raise awareness for building professionals, interested owner-builders, and consumers on energy saving options and technologies
	Programs to disseminate knowledge about strategies and available technologies of sustainable energy use for cooling and heating services

5. Standards and labeling of appliances, lighting, and office/consumer plug loads

Climate outcome	Specific policy instruments
Standards and labeling facilitates significant reductions in energy demand and GHG emissions	Energy efficiency performance standards and labels of appliances, lighting, and office/consumer plug loads to stimulate adoption of more efficient technologies and products
	Schemes to encourage optimized thermal insulation or even zero-energy-houses

6. Voluntary agreements

Climate outcome	Specific policy instruments
These agreements reduce energy use in buildings and greenhouse gas emissions	Voluntary agreements between government and manufacturers to a mutually agreeable level of energy use per product
	Schemes to promote third-party financing for energy efficiency in public buildings
	Programs to encourage cooperation of technology suppliers to improve energy efficiency in buildings

Table 3.9 Policies for mitigation/adaptation to climate change in the transport and infrastructure sector

1. Promote energy efficiency and GHG emission reduction in the transportation sector

Climate outcome	Specific policy instruments
Transport sector accounts for a major share of the GHG emissions and there are significant marginal benefits from emission reductions in this sector	**Economic instruments:**
	Tax incentives to promote the use of natural gas
	Scheme to provide vehicle tax incentives based on emission-tax deductions for cleaner cars
	Programs to impose lower taxes on cleaner fuels
	Investment programs to improve fuel efficiency of vehicles
	Fiscal incentives and production grants for fuel ethanol and biodiesel
	Policies to promote the use of biofuels and renewable fuels in transport, requiring a minimum proportion of biofuels in the total fuel use
	Programs to provide discounts and other incentives for using public transportation system
	Regulatory instruments:
	Program to enforce energy labeling with fuel efficiency standards of all new cars and other vehicles sold
	Set up clean-vehicle quotas for government vehicle procurement programs
	Programs to phase out leaded gasoline, where used
	Strategic planning and information dissemination:
	Schemes to improve or develop public mass transit systems in urban areas

2. Policies to reduce congestion on roads, highways, and urban centers

Climate outcome	Specific policy instruments
Reducing congestion and taking vehicles out of the road will reduce consumption of fuels	Programs for congestion pricing-enforcement of tolls on congested routes
	Incentive programs to promote use of mass transit systems
	Schemes to improve or develop public mass transit systems in urban areas

Table 3.10 Policies for mitigation in the forest sector

1. Policies to increase or maintain the forest area by preventing deforestation

Climate outcome	Specific policy instruments
Deforestation, according to FAO, causes 25% of carbon dioxide emissions. Reduction of forest loss offers significant opportunities to mitigate greenhouse gas emissions	**Economic instruments:**
	Schemes to provide financial incentives for private owners for retention of forest cover
	Programs to implement emission reduction credits
	Environmental service payments to private forest owners to retain private forest
	Incentive policies to reduce emissions from deforestation
	Programs to develop carbon markets and trading in emission allowances
	Regulatory instruments:
	Schemes to improve the regulatory and institutional capacity to prevent deforestation and degradation of forests
	Schemes to protect forests by designating them as protected areas, indigenous reserves, non-timber forest reserves, or community reserves
	Reforms and implementation of tenure laws to preserve forests
	Forest Law Enforcement and Governance (FLEG) to combat illegal logging
	Policies to encourage forests in private lands; for example, Namibia
	Reforms that require private landowners to maintain a share of private holding as forests; for example, Brazil
	Voluntary agreements:
	Schemes to partner with local communities to reduce deforestation
	Research and development and dissemination of technology:
	Schemes to provide technical support in sustainable forest management

2. Policies to increase forest area by encouraging afforestation and reforestation

Climate outcome	Specific policy instruments
Reforestation has no or only a marginal effect on GHG gas emissions. However, reforestation could reduce the adverse effects due to climate change	**Economic instruments:**
	Economic incentives in the form of afforestation grants
	Energy subsidies for reforestation programs
	Tax exemptions for forestry investments
	Schemes to impose tariffs against competing imports
	Regulatory instruments:
	Schemes to create plantation forests in public and private lands
	Development of institutional capacity of government for reforestation activities
	Reforestation schemes with joint management agreement between government and communities
	Voluntary agreements:
	Schemes to partner with local communities in aforestation programs
	Schemes to encourage forestation and forest development in private lands
	Research and development and dissemination of technology:
	Schemes to provide technical support in sustainable forest management

Table 3.10 Policies for mitigation in the forest sector (continued)

3. Policies to improve forest management to increase carbon density at plot and landscape level

Climate outcome	Specific policy instruments
Forests with high carbon density will reduce GHGs and thus provide positive climate impacts. Changing species mix, lengthening rotations, reducing harvest damage, and or accelerating replanting rates increase carbon sequestration	**Economic instruments**
	Incentives in the form of tax credits, subsidies, cost sharing and environmental service payments for improved management
	Incentives to lengthen rotations, species mix, reduce harvest damage, and accelerate replanting
	Trade liberalization in forest products to enhance competition in forest products
	Regulatory instruments:
	Schemes to strengthen institutional and regulatory framework
	Schemes to increase availability of trained personnel
	Schemes to reform tenure laws and security of tenure
	Regulations that require procurement of certified wood and forest products from well-managed forests
	Information dissemination, strategic planning and capacity
	Development of and or investment in technical and institutional capacity
	Schemes to protect forests against natural disturbance agents like insects and diseases
	Schemes to protect forests from forest fires and to suppress forest fires
	Voluntary agreements:
	Voluntary certification schemes to encourage sustainable forest management
	Increased market access or price premiums to certified producers who meet sustainable forest management
	Programs for aforestation of marginal agricultural lands

4. Policies to encourage substitution of more energy-intensive materials with less energy-intensive ones

Climate outcome	Specific policy instruments
Stocks of products not vulnerable to climate change may be affected. Shift away from energy intensive products will have positive impact on climate change	Reforms to encourage substitution of fossil-energy- intensive products by wood products

5. Promotion of bio-energy

Climate outcome	Specific policy instruments
Bioenergy plantations seek to produce maximum biomass per unit area to ensure sustainable supply of biomass feedstock.	**Economic instruments**
	Tax exemptions to encourage plantation establishment for production of industrial charcoal
	Tax exemption for income originating from plantation companies
	Exclusion from excise taxes for ethanol production
	Tax incentives and accelerated depreciation schedules for equipments that burn biomass
	Incentives for development of renewable energy from plantations and wood waste
	Regulatory instruments:
	Schemes to enforce mandatory requirements of energy use from renewable sources
	Schemes for bio-energy generation from forestry products

Table 3.11 Policies for mitigation in the agriculture sector

1. Policies for improved cropland management

Climate outcome	Specific policy instruments
Improved crop land management reduces emissions of greenhouse gases	Programs to promote use of improved crop varieties
	Schemes to encourage crop rotations, preferably with perennial crops
	Programs to improve soil fertility by applying fertilizers when soil is deficient in nutrients
	Schemes to encourage crop systems with reduced reliance of fertilizers, pesticides, and other inputs
	Schemes to promote rotations or intercrops with leguminous crops
	Programs to encourage catch or cover crops between successive crops
	Schemes to implement precision farming and nitrogen application based on precise estimation of crop needs
	Schemes to promote use of slow or controlled release nitrogen fertilizers or nitrification inhibitors
	Implement programs to encourage time of application of nitrogen when it is least susceptible to loss
	Schemes to implement reduced tillage or no-till farming practices to reduce soil carbon loss and maintain crop residues
	Programs to expand irrigation while reducing possible NO_2 emissions and reduce energy use
	Schemes to improve efficiency of irrigation and water use
	Development and promotion of rice cultivars with low exudation rates that will reduce methane emissions
	Schemes for improved water management, keeping fields dry in the off-season to reduce methane emissions
	Programs to encourage composting before addition of organic matter to reduce methane emissions
	Agroforestry schemes
	Schemes to convert crop lands to grassland/native vegetation in set-aside areas, waterways, shelterbelts
	Programs to encourage adjustments in intensity and timing of grazing to increase carbon sequestration in pasture lands
	Research and development and/or introduction of new species with higher productivity and carbon allocation capacity in the roots
	Schemes to discourage row crops and tuber crops in highly organic peaty soils
	Programs to maintain a shallow water table and encourage minimum ploughing
	Schemes to plant grasses and vegetation
	Schemes to encourage water conservation practices

2. Policies for improved livestock management

Climate outcome	Specific policy instruments
Livestock are one of the most significant contributors of GHG. Increasing the efficiency of livestock production and feed crop agriculture, controlling degradation of pastures and improving efficiency of irrigation could produce desirable outcomes	Programs to feed more concentrates than forages and include oils or oilseeds to the diet, thus reducing methane formation
	Schemes to improve pasture quality
	Research and development to improve productivity through breeding and heifer management
	Schemes to include additives that reduce methane formation
	Programs to use grains, crop residue, cellulosic crops and residues, various tree species for promotion of bioenergy
	Schemes to increase efficiency of irrigation of feed lots and water use efficiency in livestock production and management
	Schemes to increase efficiency of livestock production
	Programs to prevent degradation of pastures

Table 3.12 Mitigation policies in the waste management sector

1. Policies to reduce landfill methane emissions

Climate outcome	Specific policy instruments
Methods to increase energy recovery from wastes, restrict choices for waste disposal, waste recycling and re-use and waste minimization could produce desirable climate outcomes	**Economic incentives:**
	Incentives for electricity generation from landfill gases
	Tax credits for electricity generation from landfill gases
	Regulatory instruments:
	Schemes to implement standards for land-fill performance to reduce CH_4 emissions

2. Programs to promote incineration and other waste-to-energy

Climate outcome	Specific policy instruments
Promotion of incineration and energy generation from wastes reduces greenhouse gas emissions	**Economic incentives:**
	Subsidy schemes for construction of incinerators with standards for energy efficiency
	Programs to provide tax exemption for electricity generated by waste incineration with energy recovery
	Landfill taxes to increase cost of landfilling and reduce waste generation

3. Policies to promote waste minimization, re-use and recovery

Climate outcome	Specific policy instruments
Programs to promote recycling and waste minimization have been successfully implemented in Europe	Schemes to implement extended producer responsibility
	Programs to implement unit pricing on waste, or Pay-as-you-Go
	Schemes to implement landfill taxes
	Educational programs to reduce waste and promote recycling
	Schemes to encourage domestic composting of degradables rather than burning; for instance, leaves in developing countries
	Programs for procurement of recyclables (green procurement)

4. Policies and measures to reduce emission of fluorinated gases

Climate outcome	Specific policy instruments
Programs for collection and safe disposal fluorinated gases will reduce their atmospheric concentration	Schemes for collection of fluorinated gas products still in use
	Reforms to implement extended producer responsibility for appliances
	Implementation of regulations prohibiting disposal of appliances in landfills

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Annex 1

The Delhi Ministerial Declaration on Climate Change and Sustainable Development

The Ministers and other heads of delegation present at the eighth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change

Recalling the ultimate objective and principles of, and the commitments under, the Convention,

Reaffirming that economic and social development and poverty eradication are the first and overriding priorities of developing country Parties,

Recognizing with concern the findings of the IPCC Third Assessment Report, which confirms that significant cuts in global emissions will be necessary to meet the ultimate objective of the Convention, and recognizing the on-going consideration in the Subsidiary Body for Scientific and Technological Advice of the implications of this report,

Noting that mitigation actions are now taking place both in Annex I and non-Annex I countries and emphasizing that mitigation of greenhouse gas emissions to combat climate change continues to have high priority under the provisions of the Convention and that, at the same time, urgent action is required to advance adaptation measures,

Recognizing that climate change could endanger future well-being, ecosystems and economic progress in all regions,

Deeply concerned that all countries, particularly developing countries, including the least

developed countries and small island developing States, face an increased risk of the negative impacts of climate change,

Recognizing that, as Africa is the region suffering the most from the combined impacts of climate change and poverty, development initiatives such as the New Partnership for Africa's Development (NEPAD) should be supported in the context of sustainable development,

Resolve that, in order to respond to the challenges faced now and in the future, climate change and its adverse effects should be addressed while meeting the requirements of sustainable development. Therefore, we call for the following:

(a) Parties that have ratified the Kyoto Protocol strongly urge Parties that have not already done so to ratify the Kyoto Protocol in a timely manner;

(b) Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each Party and should be integrated with national development programs, takinginto account that economic development is essential for adopting measures to address climate change;

(c) National sustainable development strategies should integrate more fully climate change objectives in key areas such as water, energy, health, agriculture and biodiversity, and build on the outcomes of the World Summit on Sustainable Development;

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(d) All Parties, taking into account their common but differentiated responsibilities and respective capabilities, and their specific national and regional development priorities, objectives and circumstances, should continue to advance the implementation of their commitments under the Convention to address climate change and its adverse effects in order to achieve sustainable development;

(e) Adaptation to the adverse effects of climate change is of high priority for all countries. Developing countries are particularly vulnerable, especially the least developed countries and small island developing States. Adaptation requires urgent attention and action on the part of all countries. Effective and result-based measures should be supported for the development of approaches at all levels on vulnerability and adaptation, as well as capacity-building for the integration of adaptation concerns into sustainable development strategies. The measures should include full implementation of existing commitments under the Convention and the Marrakesh Accords;

(f) Parties should promote informal exchange of information on actions relating to mitigation and adaptation to assist Parties to continue to develop effective and appropriate responses to climate change;

(g) The specific needs and concerns of developing country Parties arising from the adverse effects of climate change and the impact of the implementation of response measures should be given full consideration;

(h) International cooperation should be promoted in developing and disseminating innovative technologies

in respect of key sectors of development, particularly energy, and of investment in this regard, including through private sector involvement and market-oriented approaches, as well as supportive public policies;

(i) Technology transfer should be strengthened, including through concrete projects and capacity-building in all relevant sectors such as energy, transport, industry, health, agriculture, biodiversity, forestry and waste management. Technological advances should be promoted through research and development, economic diversification and strengthening of relevant regional, national and local institutions for sustainable development;

(j) Access should be improved to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services and resources, taking into account national specificities and circumstances, through various means;

(k) Actions are required to diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included, and their transfer to developing countries on concessional terms as mutually agreed;

(l) Actions are required at all levels, with a sense of urgency, to substantially increase the global share of renewable energy sources with the objective of increasing their contribution to total energy supply, recognizing the role of national and voluntary regional targets as well as initiatives, where they exist, and ensuring that energy policies are supportive to developing countries' efforts to eradicate poverty;

(m) Annex I Parties should further implement their commitments under the Convention, including, for Annex II Parties, those relating to the provision of financial resources, technology transfer and capacity-building, and demonstrate that they are taking the lead in modifying longer-term trends in anthropogenic greenhouse gas emissions, consistent with the ultimate objective of the Convention, through the adoption of national policies and corresponding measures for the mitigation of climate change;

All Parties welcome the good cooperation achieved at the Conference of the Parties at its eighth session in Delhi, in particular the progress of technical work and the constructive discussions that have taken place, and express their gratitude to His Excellency Mr. T. R. Baalu, President of the Conference at its eighth session, and the Government and people of India for their gracious hospitality.

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