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Come Hell or High Water —

Integrating Climate Change Vulnerability and Adaptation into Bank Work

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Executive Summary

This paper examines the vulnerability of World Bank projects to climate change, and the impacts of Bank activities on national vulnerability in client countries. The analysis is based upon an examination of six projects and six countries selected to illustrate a wide range of situations both with respect to the nature of the climate risks and the level of development, as well as regional diversity. It is concluded that significant risks exist in the present as well as in the longer term, and an opportunity is opening for the World Bank to develop a new line of business in helping clients to assess and then reduce their vulnerability to climate change and variability through precautionary and win-win adaptation measures, designed as an integral part of economic development work.

The paper identifies for priority attention the need to assess the success of current adaptation to present day climate risks and climate variability, especially as they may increase with climate change. It finds that climate risks are not well assessed in project preparation and in Country Assistance Strategies and makes 16 recommendations for integrating climate change vulnerability and adaptation into Bank work. A broad strategic approach is described by which the World Bank could strengthen its own capacity to address climate risks and help client countries reduce their vulnerability. This would include cooperation in the development of common approaches within the Bank between the Global Climate Change Team, the Disaster Management Facility and World Bank regions. New modes of cooperation could be developed with other organizations such as the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP).

There is a need to address as a matter of priority situations in which there is current vulnerability to extreme weather events, and where development activities are now close to the margin of tolerance of climate variability.

The opportunity for World Bank investments is likely to grow as attention to adaptation increases and as support becomes available under the UN Framework Convention on Climate Change (UNFCCC) to finance adaptation measures. It is concluded that there is no justification for "stand alone" climate change adaptation projects beyond activities required for National Communications under the UNFCCC and that win-win projects can be identified which are economically justified under present circumstances and in which benefits would be higher with climate change.

A number of studies, training activities, and institutional changes are proposed to facilitate the implementation of the strategy, and it is recommended that the World Bank maintain and if possible strengthen its capacity to provide leadership on climate change vulnerability and adaptation in the development community.

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Acronyms

AIJ	Activities Implemented Jointly
BP	Bank Procedure
CARICOM	Caribbean Community
CAS	Country Assistance Strategy
CDF	Comprehensive Development Framework
CDM	Clean Development Mechanism
CIA	Central Intelligence Agency (US)
COP	Conference of the Parties (to UNFCCC)
CPACC	Caribbean: Planning for Adaptation to Global Climate Change
DMF	Disaster Management Facility (World Bank)
EA	Environmental Assessment
EIA	Environmental Impact Assessment
ERL	Emergency Recovery Loan/Lending
ESW	Economic and Sector Work
FY	Fiscal Year
GCM	General Circulation Model
GEF	Global Environment Facility
GP	Good Practice
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
INC	Intergovernmental Negotiating Committee (of UNFCCC)
IPCC	Intergovernmental Panel on Climate Change
NEAP	National Environmental Action Plan
OAS	Organization of American States
OD	Operational Directive
OED	Operations Evaluation Department
OP	Operational Policy
PNG	Papua New Guinea
RER	Regional Economic Report
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

The emergence of climate change as an environment and development issue raises important questions concerning the role of the World Bank in the international effort to address one of the more salient global environmental problems. A new international regime for the management of the climate system is being developed under the United Nations Convention on Climate Change (UNFCCC 1992) and the subsequent Kyoto Protocol (adopted in 1997 and awaiting ratification). The Global Environment Facility (GEF) has been identified as a financial mechanism under the UNFCCC. The Bank serves as one of the GEF implementing agencies and in that capacity has become involved in the mitigation aspects of the climate change issue, specifically the steps being taken in some client countries to assess and then to reduce greenhouse gas emissions.[1]

Many developing countries are at risk from the impacts of climate change, but contribute proportionately very little to the global emissions of greenhouse gases. These countries place greater emphasis upon their vulnerability to climate change and the ways in which that vulnerability may be reduced by adaptation. In this context, the implications of climate change for ongoing Bank operations in developing and transition countries await further exploration and development. It is the purpose of this report to advance this exploration, to contribute to the understanding of the potential role of the Bank, and to suggest what further actions may be appropriate at this time.

Expressed at the broadest level there are three primary questions:

1. What pragmatic steps can and should be taken to assess and, if necessary, reduce the vulnerability of Bank projects to climate change?
2. What pragmatic steps can and should be taken to better understand and, if necessary, improve the impacts of Bank activities on national and sectoral vulnerabilities in client countries?
3. What are the implications of the provisions on adaptation in the UNFCCC for Bank business in general and for the Bank as an implementing agency of the GEF?

In order to address these questions the problem of global climate change is first described from a development perspective (Chapter 2). This is followed by a preliminary assessment of vulnerability at the level of projects and countries. The assessment is based upon an examination of a sample of six projects and six countries. These are summarized in Chapter 3 and presented in more detail in Appendices 1 and 2.

The potential for Bank activities is then explored in the context of the emerging international climate change regime (Chapter 4). Chapter 5 discusses how the Bank can improve its work on vulnerability and adaptation by looking at the Operational Manual and opportunities to create incentives and raise awareness. In conclusion (Chapter 6) a few pragmatic steps are recommended.

Note

1. In the context of climate change, mitigation refers to reductions of greenhouse gas emissions and carbon sequestration, in order to minimize anthropogenic climate change. Adaptation refers to reducing vulnerability to and impacts of climate change.

2 Climate Change from a Development Perspective

2.1 Adaptation to Climate and Climate Change

Climate change has been recognized as an issue of sufficient importance by the international community that a Convention, the UNFCCC, has been negotiated, adopted, and ratified. Under the UNFCCC the developed country Parties have agreed in the Kyoto Protocol to reduce their greenhouse gas emissions by an average of 5 percent within the time frame of 2008 to 2012 against the 1990 baseline. The Protocol also contains provisions with respect to adaptation to climate change in the context of development (see below Chapter 4). At the same time, the problem of how best to manage climate change remains charged with uncertainty and divergent views and interpretations. These circumstances constitute an important context for the consideration of appropriate response by the Bank.

The steps that might be taken by the Bank to better understand the impact of its own activities on vulnerability in client countries depend on how the problem is defined and constructed. The climate change problem has been formulated in the UNFCCC and elsewhere primarily as a pollution issue. That is to say that the primary cause of the problem is seen to be the emission of greenhouse gases as a result of human activities, and that the primary response that is therefore required is the reduction of emissions. This is the main intent of the Kyoto Protocol. This construction relegates adaptation to a minor role. For many developing countries however, adaptation is the larger and more important part of the question. Among the options that developing countries have to consider are the actions that they can take to reduce vulnerability in the human designed and managed systems as well as natural ecosystems. Thus concerns about development, vulnerability, and equity become mapped onto what was first construed as a pollution problem.

Adaptation is not something new. Economic and social activities in all countries are already designed and managed in ways that take the present climate and its variability into account. A logical place to begin, therefore, is to assess the success of present adaptation to present climate, including its variability. Steps to improve present levels and types of adaptation to reduce present vulnerability are an essential first step towards taking account of climate change. A general principle of adaptation science is that the stronger the adaptation capacity the lower the vulnerability to climate both in the present and the future, regardless of the specific environmental changes that may arise. Adaptation to climate (as distinct from climate change) is an ongoing everyday process.

Insofar as the UNFCCC applies to adaptation, it is limited to adaptation to climate change, and does not extend to adaptation to normal climate. From the point of view of the UNFCCC and GEF it is important, indeed necessary in terms of funding, to distinguish between adaptation to climate and adaptation to climate change. On the other hand such a distinction could have a distorting effect from the

development perspective of the World Bank and its clients, especially the people directly affected. For farmers or coastal dwellers it matters little how much of the damage from a drought, or coastal erosion can be attributed to climate and how much to climate change. The objective is to reduce losses from climatic events and conditions, including their variability and extremes. Bank activities which are economically justified on their own terms regardless of climate change may, if appropriately designed, also help to reduce vulnerability to climate change. The amount of additional benefits would depend upon the extent and rate of climate change. A challenge for the Bank policymakers and task managers, therefore, is to identify and modify appropriately those projects and related activities that provide "no regrets" adaptations to climate change or win-win results.

In the longer term the distinction between "normal" climate and climate change will be hard to sustain. By "normal climate" is meant the climate as it is or would be under natural conditions without alteration by human activities. Recognizing that under natural conditions climate does change significantly, although at a slower rate, the practice is to measure climate in terms of the observations made over the prior three decades. Such statistics describe what are known as the climate "normals." At the end of each decade the earliest of the three decades in the "normal" statistics is dropped and the latest decade is added. Thus the climate "normals" themselves change slowly from decade to decade. The selection of the baseline data for the onset of climate change is therefore an additional consideration. It is probably true to say that the climate normals now in use (1961-1990) already show some of the effects of climate change but this cannot be asserted unequivocally. According to the Intergovernmental Panel on Climate Change (IPCC) there is already "a discernible human influence" upon the climate. This means that when the switch is made to the next set of "normals" (1971–2000) the influence of some anthropogenic climate change will be contained within the "baseline" climate conditions. The task of separating normal climate from climate change in the 1990s is a question that cannot be fully resolved by climate science or climate statistics. This suggests that the definition of climate change induced damages will continue to be a matter for informed expert judgement on a case by case basis, unless some credible and acceptable decision rule can be agreed upon. The question of how best to ensure that consistency and equity considerations are brought into such decisions requires continued attention.

2.2 The Scope of Adaptation

In all countries there is everyday experience of economic loss from normal weather events and climatic conditions. Similarly, in all countries adaptation measures are in place and are routinely applied in order to reduce damage. Houses are designed to be cool when the weather is hot and to be warm in the winter. Bridges are built high and strong enough to withstand most floods. Crops are chosen to suit the prevailing temperature conditions and may be planted earlier or later according to the timing of seasonal rainfall.

Normal climate is a pervasive factor in social and economic development. It is so universally present and so deeply ingrained that when times are good it is barely noticed. Climate is indispensable and taken for granted. Human beings and their culture are adapted to the distinct climate of the place in which they live. This is most obviously understood in sectors such as agriculture where the choice of crops and the mode of cultivation have been finely tailored over decades, even centuries, to the prevailing climate. The same is true for other economic sectors that are obviously weather dependent and weather sensitive such as forestry, water resources, recreation and

tourism. What is less widely understood is that climate norms including climate variability and extreme events are taken into account in all human built infrastructure. Climate is a factor in the design of houses, industrial and commercial buildings, roads, bridges, drainage systems, water supply and sanitation systems, irrigation and hydroelectric power installations, docks, harbors, transmission and communications towers and lines and the like. In fact, everything that is built has to be designed and managed with climate variables taken into account. Often this is done in a formal way through procedures such as building codes, standards for wind resistance, heating and ventilating standards, water levels and so forth. Sometimes in more traditional societies the designs are not the result of formal analysis and regulation but have been developed over long periods of trial and error.

The significance of climate does not end with weather-dependent sectors such as agriculture, and weather sensitive infrastructure. It also extends to finance, banking, trade and other commercial activities, and to human health. The public health protection system has in-built safeguards against disease vectors including viruses, bacteria, insects, and parasites. Similarly, the practices of insurance, credit, commodity futures, and the like are all attuned to climate norms and known variability.

There are two sides to the story of climate damage and adaptation to normal climate. Viewed from the longer time perspective of human history the process of adapting to climate has been extremely successful. Viable human societies and productive economies have been established in a wide variety of climates encompassing an extremely wide range of climatic conditions. Successful societies have been established in open savannah woodlands; in semi-arid grasslands; in tropical forests; in mountains and in warm and cool temperate regions extending even into the sub-arctic. In addition peoples of diverse cultural groups from Inuit to Tuareg have been able to migrate between different climatic regions and adapt their culture and livelihood accordingly. From a probable origin in East Africa the human species has successfully occupied most of the land surface of the planet. Modern Europeans, Africans, and Chinese, among others, have migrated to other continents and have adapted to new climates. This experience supports the notion that, in principle at least, considerable adaptive capacity exists and that without a lot of public intervention a spontaneous process of adaptation will occur. Adaptation is, nevertheless, a painful process and can be costly. It takes time and it has not always succeeded. Failed attempts at adaptation leave little record, and the evidence of collapsed societies in archaeological investigations is silent testimony to this. Rarely, if ever, is climate implicated as the sole factor in social collapse. On the other hand, it is often a contributing factor to which it is difficult to assign a specific weight.

Against the long term record of generally successful adaptation the immediate perspective is less encouraging. The capacity to adapt to climate change is not evenly distributed across countries, peoples or economic sectors, but known to be less in the least developed countries and among the poor and disadvantaged in all developing countries. The determinants of adaptive capacity include the availability of financial resources (wealth); the availability of technology and a trained body of persons to utilize it effectively. Access to information, and the existence of legal, social, and organizational arrangements are also crucial. Conversely, poverty, lack of skills and undeveloped social institutions inhibit the capacity to adapt. *An implication for World Bank activities is that successful economic development; the alleviation of poverty; access to technology; education and training; and the strengthening of legal, social, and organizational arrangements are important means of reducing vulnerability to*

climate change. Since there is no single best or stable answer to the question of what adaptation measures are needed, when, where and by how much, the process of reducing vulnerability by adaptation necessarily involves incremental learning from experience. Therefore, institutions that encourage flexibility of response, like markets, are to be encouraged.

Beyond these broad generalities not a lot is known about the specific vulnerability of countries, development projects or economic sectors. Research to date has focused on the impacts of climate change in physical and biological terms. This research has been summarized and assessed in IPCC reports, but gives little indication of the magnitude of the new economic risks that developing countries now face. It has been generally thought that the poorest developing countries, small island states, and countries in semi-arid regions of now uncertain rainfall are likely to be most vulnerable, but no systematic test or measure of aggregate vulnerability has yet been developed.

2.3 Adaptation Science

If the Bank is to devote serious attention to assisting client countries to adapt to climate change, it is well to recognize the range of expertise that is potentially relevant. The body of knowledge crosses a wide spectrum of policy, management, and decision making and is fragmented into disciplinary expertise and professional specialization. This holds true in developed countries no less than in developing countries. Now, with the advent of climate change all the standards and criteria in these fields should be revisited and revised as appropriate. An important role for the Bank is to provide access to the knowledge base upon which such standards and criteria can be reassessed. The changes involved go beyond the careful adjustment of design standards and criteria on a project by project or sector by sector basis. Such an approach is sufficient for the direct effects of climate change on each sector, the so called first order impacts. A difficulty with such impacts is that they also carry over into second, third and nth order effects which are interrelated in complex and often unforeseen ways. For example, rising sea level can damage or destroy coastal marshes and wetlands that are breeding grounds for some species of fish. Thus, locally available food supplies from the sea may be reduced at the same time that less rainfall and higher temperatures on land are reducing agricultural productivity. This combination of threat to food supplies and consequent drop in nutrition standards may have health impacts on a population that is simultaneously being exposed to new diseases through the spread of hitherto absent disease vectors. In such circumstances expanding communities may occupy more hazardous lands along the coast, in flood plains and on steep slopes thus increasing vulnerability to tropical storms. An integrated adaptation response is required which might involve new coastal zone protection, the creation of new breeding grounds for fish, the expansion of irrigation agriculture, the implementation of new public health measures, and the avoidance of creating risks of larger disasters from extreme events by land use planning and building codes. Taken in a selective way and in the absence of an integrated assessment, such measures could well be ineffective or counter productive. *The assessment of vulnerability to climate change is not a simple matter. Bank assistance could be used to help create a capacity for developing a more integrated cross-sectoral assessment of climate change impacts and adaptation options linked into the overall national economic development strategy.* The Bank's capability to take a broad oversight view of national development planning provides a comparative advantage. This approach also conforms with the intent of the proposed Comprehensive Development Framework (CDF).

Vulnerability assessments should begin now in a few countries identified as most vulnerable.

As discussed in Chapter 3, they are an essential component of the Country Assistance Strategy (CAS) and the design of many projects in such highly vulnerable countries. These assessments might be financed with Trust funds or as part of Economic and Sector Work (ESW).

What is involved here is the creation of a new body of integrated knowledge and practice that may be called "adaptation science". This is a task awaiting all countries where significant impacts are expected. In developed countries the task is already on the research agenda, although it has not yet reached the level of application except in a very few cases. The revision of standards and criteria across sectors in developing countries will have to be undertaken as the impacts of climate change are increasingly felt.

How rapidly this should be done depends to some extent upon the rate and magnitude of climate change in any specific place. It also depends upon the capacity of the country, sector, and management unit to carry out the necessary studies and to take effective adaptation measures. Where the society or economic sector has financial resources that can be deployed, and is strong in technical and managerial skills, and the necessary administrative, political, and legal structures are in place, adaptation science and its application can probably proceed rapidly enough albeit at some social cost which is presently unknown. Where these resources and capacities are weak or lacking, as in the case of many developing countries, then adaptation will be more difficult, and the impacts of climate change are likely to be correspondingly greater. The World Bank can play a significant role in helping client countries strengthen and expand their own adaptation science capability, through the use of training programs, technical assistance and knowledge management.

The urgency with which this should be addressed varies greatly from country to country. As discussed in Chapter 3, it would be helpful to have a systematic screening process designed to identify situations of greater short run vulnerability. A two step process is suggested through which a preliminary screening would be used to identify more urgent situations, and these could then be the subject of more detailed risk assessment and supported by capacity building activities.

2.4 Management Criteria

There are two main underlying criteria that are present across the wide array of management decisions on adaptation, guided as they are by social policies. The first is economic efficiency. Because the weather constantly varies, and because the climate varies over time, decisions about climate risk always involve choices about the level of expenditure and the benefits to be gained. Under-investment in climate adaptation might result in significant losses that could have been avoided for a small marginal increase in adaptation expenditures. Similarly over-investment in climate adaptation is a waste of resources that might have been better spent elsewhere. Under conditions of strong constraints on financial resources this risk is probably low. To the extent that climate change risks are adequately captured in standard economic analysis, existing World Bank practices leave ample room to address the climate change issue, recognizing that expenditures on climate change adaptation will always have to compete for scare resources with other urgent needs. On the other hand, it is evident that project evaluation typically concentrates on financial and economic risks and neglects natural environmental hazards including those likely to be associated with climate change. This question is discussed further in Chapter 3.

The second criterion is disaster avoidance. While in theory the risk of catastrophic losses can be taken into account in a conventional economic analysis by reducing future anticipated losses to present annual value at an

appropriate discount rate, there is, it may be argued, a social value above and beyond this level which would accept higher costs in return for the avoidance or prevention of disasters. The degree to which people are or wish to be risk averse is probably not always well reflected in project design.

The application of the criteria of economic efficiency and disaster avoidance in the adoption of adaptation measures is prejudiced now in developing countries by the frequent lack of a quantitative risk assessment approach in investment decisions. This applies now under conditions of current or normal climate and can lead to unanticipated costs. *Unless action is taken to strengthen the use of risk assessment techniques in the assessment of adaptation measures now, more serious consequences can be expected as climate change advances.* There is a clear implication for World Bank activity here. Extra attention should be given to the risk of weather extremes such as floods, droughts, hurricanes, forest fires and the like, in the light of climate change. The risk analyses based solely on past records are unlikely to provide an adequate guide to future investments. At the same time, experience in dealing with extreme events can strengthen adaptive capacity for adapting to longer term climate change.

2.5 A Problem in Risk Assessment

Although anthropogenic climate change is not yet an established fact, proven according to the strict cannons of scientific proof, it is known that the observed increases in concentrations of greenhouse gases, especially carbon dioxide, are due to human activities and that unless the pattern of human development is changed quite rapidly and quite radically the concentrations will double over pre-industrial levels by the middle of the 21st century and will move on to increase three or four or more times in the next century or so. That such a process of change in the chemical composition of the atmosphere poses some risk of significant climate change is not in doubt.

While the potential consequences are uncertain, should something like the worst case scenario ever happen the potential consequences are very large indeed. The case of climate change is a classical example of an uncertain risk with uncertain (and possibly very high) consequences. Recognition of this situation has led to widespread international acceptance of the so-called "precautionary principle." While the precautionary principle has been advocated with respect to the reduction of greenhouse gas emissions it is also applicable to adaptation. Since the signing of the Kyoto Protocol there has been a steady evolution of debate in the direction of more recognition of the need for precautionary adaptation to climate change. This has happened for two main reasons. First, it has become increasingly clear that reduction of emissions will take time, and will not be accomplished rapidly enough to prevent significant climate change. *Since some climate change is now happening and more is inevitable, it is only common sense to extend the "precautionary principle" to the strengthening of adaptation capacity.* Second, the marked increase in losses due to extreme weather events over the past two decades is making it clear that present levels of adaptation to climate variability falls well short of what is possible.

Research to date on vulnerability to climate change has been driven to a considerable extent by the availability of outputs of General Circulation Models (GCMs) that project climate conditions out to so-called "two times carbon dioxide equivalent equilibrium" at some time around the middle of the next century (2050). Thus, the estimates of physical, biological, and less frequently economic damage are based on model studies which impose an uncertain future climate upon the present-day economy, or upon unknown future socioeconomic conditions. For the purposes of development planning and consideration of the vulnerability of Bank activities, a more pragmatic and effective approach would appear to be to focus

upon the present and near-term future, especially where the first impacts of climate change are likely to be felt. Adaptation actions designed to reduce the vulnerability of some future unknown economy to some future unknown climate are less likely to be on the mark than adaptation actions to reduce present and near term risks. At least the benefits of adaptation to currently well defined risks are more certain to be realized. Other things being equal, the more that climate changes the more benefits will flow from economically justified adaptation to present climate variability and extremes. The implications for Bank activities are that the prospect of such win-win situations should be allowed to influence the design and choice of near term investments. This holds true when adaptation to current climate variability is consistent with the kind of changes expected under climate change. Adaptation to floods in the short term might prove to be less attractive should floods cease to be a problem and droughts become a more prevailing risk. In practice such simple trade-off relationships are not likely to occur. Destabilization of the climate system and intensification of the hydrological cycle are likely to mean that the incidence of both floods and droughts increase.

For the purposes of discussion it may be helpful to adopt a rather arbitrary distinction between slow incremental changes in the climate system and climate variability, especially the most extreme events which are potential causes of disaster. Small scale incremental changes are likely to be of greater significance where the relationship between human activities and the weather is already stretched. Examples include situations where quantity of water use presses closely upon available supplies, (such as in many semi-arid zones) or where crops are being grown at or close to their limits of heat tolerance.

It is suggested that these two situations (close to the margin of tolerance for incremental change, and disastrous extremes) are where the impacts of climate change will first begin to be clearly seen. Consequently, it is here that the World Bank's vulnerability assessment and adaptation efforts should be focused for the time being.

3 Vulnerability of the World Bank and Its Client Countries

3.1 Dimensions of Vulnerability

In view of the present level of scientific knowledge (IPCC 1996a,b) and the nature of the threat as described in the previous section, it is clear that World Bank development projects and the success of the development process in client countries are at some risk from climate change. Vulnerability to climate change and variability may be found at several levels. At the level of individual projects, inadequate anticipation of the potential impacts of climate change can result in failure or premature obsolescence. Vulnerability also exists at the country level where development strategies frequently do not pay attention to climate change and vulnerability. The World Bank may miss very effective development opportunities, or even make investments that increase a country's vulnerability. There are also additional risks that transcend individual countries, such as when a sector is vulnerable across an entire region. Examples would be regional impacts on agriculture, or impacts that affect a shared water body, such as many international rivers. Although this is an important issue, it is not addressed in this paper.

Attention to climate change risks is often best included in an analysis of climate risks and other natural hazards. While current attention to climate change risks is very low, it also turns out that natural hazards in general are frequently overlooked in World Bank analyses. In order to gain some further understanding and a deeper appreciation of the nature and extent of the risks and their treatment in World Bank projects and country strategies, a selection of case examples has been made for a somewhat more detailed examination. The selection includes six specific projects, and six countries. These are reported in more detail in Appendix A (project level vulnerability) and Appendix B (country level vulnerability).

3.2 Vulnerability at the Project Level

Six projects have been examined in some detail and a larger number of others have been surveyed. Projects were selected mostly from the countries chosen for country level analysis (Section 3.3), to cover a range of sectors including coastal development, flood control, emergency assistance, hydroelectric power generation, agriculture and transport (roads). No attempt has been made to carry out a new assessment of climate vulnerability. This analysis examines the way in which projects addressed climate risk, and compares the project reports with known climate risks facing the project or the country.

All of the projects examined are at some unspecified (and perhaps unspecifiable) risk from climate change. It is not possible to specify the degree of risk without more detailed study which could best be made at the time of project preparation. It is possible that the risk from climate change and variability could have been reduced had climate change been specifically identified as a possible risk at the time of project preparation, and if available risk assessment methodologies had been employed.

Climate change risks are rarely identified in Bank project documents from the project

initiation, preparation and appraisal phases. Instead, the risks that are mentioned are institutional, economic, financial, political, or related to local ownership and support. In project documents from the implementation phase, such as the project status reports, climate risks often emerge as a significant threat, and tend to be recognized after an extreme event or disaster occurs. It appears that the climate risks so identified are seen as risks to project implementation rather than to long term sustainable operation.

The value of future benefits is strongly influenced by the discount rate used to determine the present value of future benefits. Economic analyses tend to have a limited time horizon because longer term developments are harder to plan and manage, and yield much lower economic returns (discounted to present value). However, the physical lifetime of some of these projects may be much longer. Beyond the planning lifetime in the economic analysis, a project may still affect a country's vulnerability and, therefore, project planners should take this longer-term perspective into account in project preparation.

Climate risks are likely to become more important in the future both as a result of climate change and the development process itself. The return period for a specific magnitude event may become significantly shorter. For example, a 100-year flood may become a 50-year flood. Similarly, as wealth increases and risk aversion grows, there is likely to be an increasing demand for protection.

Example 1: Coastal Embankment Rehabilitation Project in Bangladesh

This project approved in 1995 is part of an ongoing effort to provide adequate protection for the exposed agricultural areas and their populations on the outer coast of the delta. It is a component of the National Cyclone Protection Program and includes rehabilitation and improvement of sea-facing embankments as well as complimentary programs of afforestation, improved polder functioning, resettlement, technical assistance and other studies. The economic life of the project is 30 years and the major civil works are designed to provide full protection against 5 year magnitude events, partial protection for 20 year events (flooding in the polders should not exceed 1 meter), and some lesser degree of protection for 40 year events. Cyclones occurred during the project construction phase causing damage and resulting in cost overruns. This risk was not even mentioned in the original project documents.

While the project is economically justified on the basis of expected cyclone frequency these calculations do not take sea level rise into account. For a project with an economic life of 40 years this may be a reasonable approach. On the other hand, the physical life of the project, if well maintained, could be significantly longer and in any case it is clear that coastal defenses will be needed in perpetuity so long as the delta lands are occupied. This project has the characteristics of a stop gap or holding operation, while a long-term approach to the problem, taking sea level rise into account is prepared.

This longer-term approach is currently being developed. The World Bank South Asia Region is undertaking a comprehensive climate change adaptation study for Bangladesh. Additionally, the Bank's board approved, in April 1999, a Supplemental Credit to the Coastal Embankment Rehabilitation Project for emergency repairs following the 1997 cyclone. This loan also includes funding for the preparation of a follow-up project with specific climate change adaptation measures, taking a holistic approach to Bangladesh's coastal defenses. Similar concerns will be addressed in a new Integrated Coastal Zone Management Project. Finally, the fact that the effects of sea level rise will, for various reasons, be felt far inland, is taken into account in the preparation

of Bangladesh's National Water Management Plan, which is being funded under the Bank's Bangladesh River Bank Protection Project.

It seems clear that in countries like Bangladesh, with high vulnerability to climate change (including sea level rise), broad assessment of climate risk will increasingly be required as a context for sound project preparation and investment decisions.

Example 2: Lower Guayas Flood Protection Project in Ecuador

This flood protection project provides a good example of the interrelationship between normal development activity and climate risk and looks like a case of win-win. Approved in 1990, the project includes flood control and drainage measures such as dikes and bypass (flood relief) channels. The project was mostly completed when the 1997/98 El Niño event occurred, which, for the country as a whole, resulted in structural losses estimated at over 2.5 billion dollars (US). While the whole of the Guayas catchment area is reported to have been inundated, the completed drainage infrastructure successfully protected the 200,000 hectares project area, although the remaining safety margin was apparently very small. The project is designed to cope with a 50-year flood. While flood magnitude and frequency calculations are at the heart of the project, it seems that the risk of changing frequency was not factored in to the project design. The fact that a major flood occurred so quickly in the project life means that substantial project benefits have already been realized. On the other hand, a slightly larger flood may have resulted in substantial damage, including to the project itself.

According to the Staff Appraisal Report the project risks identified included the commitment and implementing capacity of the government and other partners, as well as the macroeconomic environment. Climate risks were not addressed over and above the normal hydrological estimates of flood frequency. It is possible that a consideration of the incremental risk of climate change in the project preparation stage would have led to a somewhat different design that would have provided a greater margin of safety in the El Niño floods. It seems clear that the Lower Guayas Flood Protection Project has reduced vulnerability in the project area for floods up to a return period of 50 years based on standard hydrological calculations without climate change. The implications for longer term sustainable development are not clear, except that the greater development fostered by the project may be at more substantial risk as climate changes.

Example 3: El Niño Emergency Assistance Project in Guyana

In the aftermath of the 1997/98 El Niño a number of countries were assisted by the World Bank with emergency loans. In Guyana this included an agriculture recovery and regeneration program with drainage and irrigation components; a potable water service recovery and restoration program and restoration of flood protection for the city of Georgetown.

It seems clear that the emergency assistance project in part addresses damages to previous flood protection works. New sluice and pumps were provided. Since this was an emergency assistance project there was not enough time for a reassessment of the risks. A large part of the city of Georgetown is below sea level, and with sea level rise the risk of flooding seems certain to increase. It is usually not practicable to consider potential climate change impacts in an emergency situation. However, the experience strongly suggests that the level of flood protection for Georgetown should now be reassessed in the light of climate change. Continued development without proper consideration of this risk seems likely to ensure that future damages will increase and result at some future date in the need for more emergency loans. In view of the risk of more

frequent and stronger El Niño events a reassessment of the risks would be timely.

Guyana is currently participating in CPACC, the Caribbean Planning for Adaptation to Global Climate Change Project. This is a GEF-funded project, administered by the World Bank and coordinated by the Organization of American States (OAS). Among others, it includes coastal vulnerability and risk assessment studies in Guyana, which could be used to improve future Bank projects.

Example 4: Nathpa Jhakri Power Project in India

This is a hydroelectric power project on the Sutlej River in northern India designed to alleviate the regional shortfall in electric power supplies. It was approved in 1989. At the time of project preparation hydrological, geological and sedimentation risks were considered. Since part of the upstream watershed lies outside India's national borders, the security of flow was a consideration, but the Bank concluded that" the Sutlej flows originating in India are sufficient to operate the power plant as planned."

Climate change is not addressed in the project documents, even though streams arising in the Himalayas may be subject to changes in flow. An IPCC regional report (IPCC 1998) states that"A reduction in average flow of snow-fed rivers, coupled with an increase in peak flows and sediment yield, would have major impacts on hydropower generation."It should be noted that apart from this general trend, as of yet no good models exist to predict the hydrological impact of climate change on any particular project site.

In practice these considerations are not likely to have changed the project design since the project economic analysis was based on a 25-year economic life and over that time it would require a combined adverse change in costs and benefits of 35 percent to render the project uneconomic.

There are two reasons that point to the importance of considering climate change in this type of project. First, the knowledge of potential climate change is greater than ten years ago when this project was designed, and as climate change accelerates projects started now will have a life extending into a time of potentially greater change. Second, although the economic evaluation is calculated on the basis of 25 years of benefits only, the physical life of the project is likely to be significantly longer. Longer term vulnerability is a consideration for the region above and beyond the shorter term economic analysis of the project.

Example 5: Oro Smallholder Oil Palm Development Project in Papua New Guinea (PNG)

This project is designed to strengthen the agricultural exports of PNG by the planting of 6500 ha of oil palms, and strengthening related support activities. The project was approved in 1992. The risks discussed are financial (risk of fall in prices) and possible implementation problems. Climate risks and other natural hazards are not mentioned.

In 1997/98 PNG was severely affected by drought and frost related to the El Niño event of the time. Oro province where the project is located was not in the worst affected regions, but did suffer some drought. There is no information to hand concerning any effect on the oil palm production as a result of the drought. Nevertheless, it would be reassuring to know that potential risk from drought, frost, forest fires, and the spread of plant disease and insect pests had been taken into account by the project planners. It is unclear from the project documents whether such climate risks either do not exist; or are considered too long term to be concerned about; or were considered, assessed and dismissed; or are unknown either because

the knowledge does not exists or the question was not asked. This example serves to underscore the conclusions about PNG at the country level described in Section 3.3.

Example 6: Emergency Road Rehabilitation Project in Samoa

This project was approved in 1990 to support an emergency road rehabilitation program to restore the road transport system after severe damage and disruption resulted from Cyclone Ofa earlier in the same year. Due to this cyclone, Samoa suffered damages estimated at US$140 million, in the same order of magnitude as Samoa's estimated 1989 GNP of US$139 million.

Vulnerability to cyclones is a recognized concern in Samoa and the project document states that roads would in some cases be relocated on higher ground. Elsewhere the previous alignment would remain but additional shore protection would be provided where required.

While the road restoration works were still in progress another cyclone, Val, struck causing even higher damage estimated at about US$300 million. An additional credit of $US5.1 million was quickly added to the Ofa reconstruction loan. Both the original and the supplemental credit involved a risk assessment which considered only the risks of further damage before rehabilitation was complete. This does not appear to have considered the risk of future cyclones of equal or greater intensity and frequency after project completion, nor does sea level rise seem to have been addressed.

The Implementation Completion Report on the project states that, "The sustainability of the project benefits is likely, assuming there are not substantial changes in the incidence and severity of natural weather-related disasters..." It is quite amazing that this could be written in a country this vulnerable to climate change, without the realization that climate change could indeed cause such substantial changes. Nevertheless, the road network is now considered to be in good condition and enhanced protection has been provided for levels up to 20-year weather related events. Since Cyclones Ofa and Val were 50-year and 100-year events respectively, their frequency falls well beyond the design of the new protective measures.

Recognizing that significant risk still exists, a follow-up project has been approved called the Infrastructure Asset Management Project. This project included a full analysis of two separate coastal protection subprojects and arrived at the conclusion that a ten year return period was the optimal level of protection. It is not clear to what extent retreat from highly exposed coastal locations was considered as an alternative to coastal protection. While cyclone risk now seems to be recognized as a significant factor, other climate change related risks, including sea level rise have not yet been taken into consideration.

Concluding observations from the project studies

Climate risk assessment has not been a routine component of project preparation. While this is not surprising, experience suggests that it should now become standard practice. This will not necessarily lead to changes in project design, but in some cases it may do so. Recognition of climate risks and related extreme events should also lead to consideration of a broader range of project alternatives. It is not solely a matter of building less vulnerable projects and taking a more sustainable development point of view. Some projects may seem less justified in terms of national development strategy when climate change is taken into account.

3.3 Vulnerability at the Country Level

Six countries have been selected for detailed examination of climate change vulnerability at

the country level. They are Bangladesh, Ecuador, Guyana, Papua New Guinea, Samoa, and Zimbabwe. A description of climate vulnerability for each country is presented in Appendix B. This section is limited to a summary of findings from the country level studies. The countries were selected from different world regions to represent a variety of climatic risk situations, and to illustrate a range of circumstances with respect to overall vulnerability and level of development. Final choice was also influenced by the availability of documented information. The specific projects selected for examination in Section 3.2 above were chosen from the six countries.

Several questions arise when climate risks are addressed in the broader context of national development. First, not all countries face the same pattern of climate change and not all are vulnerable to the same extent or in the same way. It is therefore important to have some sense of overall national vulnerability, as well as assessments of particular sectors (such as agriculture, coastal development and so forth) and particular types of risks such as drought, tropical cyclones, sea level rise and so on. Second, the extent to which the World Bank portfolio in each country may be vulnerable depends upon the mix of investments and their exposure to climate change. The World Bank's investment strategy in a given country may itself increase or decrease vulnerability according to the extent to which climate change considerations are taken into account. This leads to the third question of how climate change issues are treated within the Bank's Country Assistance Strategies (CASs).

a) Vulnerability of the countries

It would be helpful to have for each client country a profile of physical vulnerability. In the absence of any standard set of measures a geographical description can be of some help in a rather subjective and non-quantitative way. Clearly, the simple facts of location and size are of some significance, as are the climate change scenarios themselves derived from GCMs. In relation to sea level rise a crude measure such as length of coastline can be very misleading. Of more importance is the height of the coastal lands, and the density of population on low lying lands. Similarly, the amount of land and population subject to drought or periodic water shortages, the extent of floodplain land and its occupance, and the steepness of slopes used for human habitation are also factors in vulnerability. Beyond these physical measures the proportion of climate sensitive economic activities such as agriculture, forests, water use and tourism in the national economy is important. As discussed above in Sections 2.2 and 2.3 vulnerability is also highly dependent upon adaptive capacity for which national wealth, infrastructure development, level of literacy, life expectancy, and infant mortality rate might be used as indicators. In Table 3.1 a number of variables are listed for each of the six countries to give an indication of their comparative vulnerability.

In terms of physical geography alone, Bangladesh, occupying a low lying delta with a long coastline exposed to cyclonic storms and salt water flooding, is vulnerable and is also at risk from interior flooding. Pacific Islands like Samoa are also at considerable risk from sea level rise, particularly given the regular occurrence of cyclones and considering the long coastline relative to the total land mass. Guyana and Papua New Guinea also have coastal zone problems, and land-locked Zimbabwe is close to the level of tolerance of climate variability in terms of moisture availability and the risk of drought. Ecuador is notoriously at risk from El Niño related extreme events.

Table 3.1 also includes a number of variables which may serve as indicators affecting vulnerability and adaptive capacity. GNP per capita is a powerful variable since it substantially determines a country's capacity to adapt. From this standpoint Ecuador is relatively well placed while Bangladesh, the poorest of the six countries, is not. As a second

example, adaptive capacity is related to the ability to plan response and implement a response. This depends to some extent on the skills and training of the population. A rough indicator of this modality of adaptive capacity is a country's illiteracy rate. Once again, Bangladesh would be most vulnerable, followed by PNG, while Samoa and Guyana are in a much better position.

The development of a standardized index of comparative vulnerability is a complex research exercise best left to others, but an overall climate risk assessment at the country level can

Table 3.1 Country parameters indicating vulnerability

		Bangladesh	*Ecuador*	*Guyana*	*PNG*	*Samoa*	*Zimbabwe*
1	*Terrain*	River delta, flat plains, hilly in S.E.	Coastal plain highlands, jungle	Coastal plain, highlands, savanna (S)	Mountains, coastal lowlands	Narrow coastal plain, mountains	High plateau
2	*Variability*	Floods, cyclones, droughts	Droughts, floods	Frequent floods, droughts	Droughts	Cyclones	Recurring droughts
3	*GNP (US$ billion)*	41.4	19.8	0.78	4.6	0.19	8.9
4	*Present value of debt/GDP*	21%	68.8%	150%	39.7%	40%	47%
5	*GNP/capita (US$)*	360	1,570	800	930	1,140	720
6	*Population (millions)*	124	12	0.85	5	0.17	11
7	*Population growth/yr*	1.6%	2.0%	1.1%	2.3%	1.2%	2.0%
8	*Total area (1,000 sq km)*	144	284	215	463	2,8	391
9	*Coastline (km)*	580	2,237	459	5,152	403	0
10	*Coast/total area (km^{-1})*	0.004	0.008	0.002	0.011	0.141	0
11	*Unpaved highways (km)*	207,307	37,497	7,380	18,914	458	9,646
12	*Unpaved/all highways*	93%	87%	93%	96.5%	58%	53%
13	*Waterways (km)*	5,150-8,046	1,500	6,000	10,940	—	—
14	*Ports*	3	6	5	5	4	2
15	*Agriculture% GDP*	30%	12%	39%	26.4%	40%	18.3%
16	*Labor in agriculture*	63%	29%	35%	64%	65%	27%
17	*Life expectancy*	58	70	64	58	69	52
18	*Infant mortality rate*	75‰	33‰	58‰	61‰	22‰	69‰
19	*Child malnutrition under 5*	68%	17%	18%	30%	—	16%
20	*No access to safe water*	16%	30%	39%	72%	—	64%
21	*Male illiteracy above 15*	50%	7%	1%	19% (1995 est.)	3% (1971 est.)	6%
22	*Female illiteracy above 15*	73%	11%	3%	27% (1995 est.)	3% (1971 est.)	12%

Note: (data: rows World Bank 1999, except rows 9, 10, 11, 12, 13, 14, 15, 16, row 21 and 22 for PNG and Samoa: CIA 1998; row 20 World Bank 1997).

provide a useful guide for directing attention towards the most vulnerable situations and helping to ensure that climate risks are not overlooked. Additionally, such an indicator would be compiled from sectoral sub-indices, so that it would help to identify vulnerable sectors within countries and identify optimal responses to a country's vulnerability.

b) Vulnerability of the World Bank portfolio

Related to the physical and socioeconomic vulnerability of countries themselves is the question of the vulnerability of the World Bank's portfolio of investments. Factors influencing this Bank exposure include the number or proportion of investments at risk from direct impacts of climate change, including those which are close to the margin of tolerance for climate variability. Examples include coastal property and installations within the reach of expected sea level rise and/or storm surges; flooding and erosion associated with tropical cyclones; hydroelectric power and irrigation projects on rivers where the flow may diminish significantly and reduce power output and water available for crops; or a rural development project where roads and bridges may be washed away in floods.

Table 3.2 reflects our examination of the World Bank portfolio of investments in each of the six countries. First, the value of the projects that are possibly "vulnerable to climate change" has been calculated as a percentage of the value of the total World Bank portfolio. In addition, the World Bank's portfolio usually includes projects which could directly contribute to adaptation to climate change or the reduction of vulnerability. Such projects (listed as "relevant to climate change" in table 3.2) may or may not themselves be directly vulnerable, but can be used to reduce vulnerability at the country level by incorporating climate change considerations in their design and operations. For example, an agricultural research and development project could be modified to address vulnerability to climate change by developing drought resistant crop varieties, or an afforestation project could be sited and designed to protect water supplies and reduce erosion from climate change as well as to supply timber.

This examination shows that a considerable share of the World Bank portfolio in these six countries may be at risk from climate change. Additionally, an even larger share of projects could help to reduce the countries' vulnerability to climate change by incorporating adaptive considerations in their design.

Table 3.2 Climate change concerns in country lending portfolios
(Total number and value of projects in the portfolio of the six countries discussed in this report, and percentages by value of projects vulnerable to climate change or relevant to adaptation considerations.)

	Bangladesh	*Ecuador*	*Guyana*	*PNG*	*Pacific Islands*	*Zimbabwe*
Number of projects in portfolio 1999 (1994)	25 (33)	17 (16)	6 (8)	6 (9)	5 (11)	10 (15)
Total value of projects in portfolio 1999 (1994) (US$ million)	2,838 (2,773)	672 (853)	85 (200)	106 (198)	56 (101)	512 (932)
Projects vulnerable to climate change 1999 (1994) (% by value)	45 % (39 %)	30 % (20 %)	62 % (22 %)	30 % (31 %)	56 % (60 %)	0 % (26 %)
Projects relevant to CC adaptation 1999 (1994) (% by value)	53 % (42 %)	42 % (23 %)	62 % (22 %)	30 % (54 %)	56 % (60 %)	17 % (42 %)

Notes: Data are given for fiscal year 1999 and, between brackets, for fiscal year 1994.

c) Attention to vulnerability in the CAS

A third component of our analysis is the extent to which the Bank's dialogue with and assistance to a particular country reflects an awareness of the dangers of climate change and willingness to take appropriate action. The main outcomes and objectives from this dialogue and Bank assistance are reflected in the CAS, and it is this document that we have examined in our country analyses. Our examination indicates that climate change is not discussed at all in the CASs. Furthermore, natural hazards in general receive little attention. Instead, the CASs tends to focus on institutional, economic and financial risks.

A strong example is PNG. The 1995 CAS does not consider vulnerability to either climate variability or climate change. However, just two years later the Country Brief, another Bank document, mentions that "the severe El Niño induced drought of 1997 and depressed commodity prices (...) have adversely affected production and exports while raising imports." Clearly, climate did pose major threat to PNG's economy. Similarly, Ecuador's CAS, issued in 1996, does not mention any climate risks, but subsequently the country was hit severely by the 1997/98 El Niño, with damages totaling US$2.5 billion (NOAA Office of Global Programs, 1999). Even the CAS of Bangladesh does not mention climate change, although it does address general climate vulnerability. It should be noted however, that several climate change adaptation activities have recently been initiated in Bangladesh, including a general adaptation study and several projects that will fully take climate change into account. Similarly, climate vulnerability and adaptation is a major topic in the Pacific Islands Regional Economic Report for the year 2000, which is currently being prepared.

When preparing a CAS for each of the World Bank's client countries, it would be useful to have an overall assessment of climate vulnerability and risks. Such an analysis may point strongly in specific directions that would otherwise not receive attention in a purely economic analysis. Such directions might include activities to be avoided or discouraged as well as new activities designed to take advantage of new opportunities opened up by climate change. Certainly with climate change risks as a component of country level vulnerability assessment the composition of the project portfolio is likely to change, perhaps slowly, but nevertheless significantly .

An analytical framework could be designed for this purpose, thus assuring some approximate comparability between countries. Such a framework could be applied first to the most vulnerable countries. As discussed in Chapter 2 of this report, climatic risks can cause significant setbacks to development, and appropriate development can itself strengthen adaptive capacity and reduce vulnerability.

3.4 Broader Inferences from Project and Country Level Assessments

This examination of a number of projects in six diverse countries suggests that climate vulnerability is a factor to be considered in project design and selection as well as country planning. The weight that should be accorded to this newly emerging problem is difficult to specify both because the necessary detailed studies have yet to be made, and because of the uncertainty about the magnitude and rate of climate change and the lack of more precise scenarios on a regional level. These matters will no doubt be clarified in time.

In the meantime the evidence of risk is sufficiently compelling that precautionary action seems as appropriate for climate adaptation as for climate mitigation. Precautionary steps might be taken at both project and country level. This preliminary survey shows that both initial project documents and Country Assistance Strategies are focused heavily on economic performance and risks, and on the financial sustainability of

investments. However, climate disasters often interfere with successful completion or long term sustainability of projects. Additionally, it is increasingly recognized that climate risks are a threat to overall development, and that the costs of disasters associated with extreme weather events can be a significant setback to development. Taking these risks into account would be a worthwhile precautionary step to prepare for accelerating climate change.

For those countries known to be among the more vulnerable to climate change and variability, Country Assistance Strategies should be informed by periodic assessment of climate risk and the status of the country's vulnerability and change in adaptive capacity. For other countries a broad survey of comparative vulnerability including the development of one or more standardized indices of vulnerability would help to ensure that no potentially serious situations are overlooked. Such work might be routinely undertaken as part of national communications under the UNFCCC, provided that there is enough financial and technical support available. Projects should always include an assessment of climate risks as part of their risk and sustainability analyses.

4 The World Bank and the Emerging International Climate Change Regime

4.1 Avoiding a Two-Track System of Response

There is a juxtaposition of two related, and not well integrated arrangements. On the one hand, there is the World Bank with its long record of assistance and commitment to economic development and poverty alleviation, and its growing concern with environment and access to scientific knowledge. On the other hand, there is the newly emerging international regime of the UNFCCC and the Kyoto Protocol, and the diplomatic, financial, and scientific apparatus that serves them. In what ways might these institutions work together for the common good? What distinctive role can and should the Bank seek to play?

Given that there is a significant risk to infrastructure projects of various kinds, and given that entire national economies can be set back by extreme events and related disasters there is a clear and present danger to the development process. Under such circumstances it is incumbent upon the Bank to take all necessary steps to ensure the safety and efficiency of its investment loans and to assist its client governments in making their own development decisions in a way that reduces, wherever possible, their vulnerability to climate change risk, helps them to avoid disasters, and to change those policies and practices which may tend to increase vulnerability. The Bank could incorporate climate change risks into its own program of work with client countries to the extent that this is deemed appropriate by both the Bank and the client countries. This would be no more than good practice in response to a newly identified problem.

In this case, however, the nature of the issue is somewhat different. Climate change belongs to a new class of problems identified as "global." Among other things this designation serves to recognize that there are potential damages (the impacts costs) that will be distributed in an uneven manner, and that the actions giving rise to these imposed costs are distributed in a quite different pattern. It has been agreed in the UNFCCC that this situation calls for a response at the global level which goes beyond the normal processes of development assistance in the World Bank and other international lending agencies. There is a danger in this development that two parallel financial tracks will emerge that will distort development priorities. This is especially likely to happen if funds made available through the UNFCCC are provided at more favorable terms than those offered by the Bank (for example, grants instead of loans). In this section we outline the main features of the emerging "climate regime," and propose ways in which the World Bank may cooperate and place its own capacities and comparative advantages in this context.

4.2 The Emerging Climate Regime

The UNFCCC calls upon countries to adapt to climate change and refers in several places to the need for international cooperation and financial assistance in the area of adaptation to climate change.

The most general statement is in Article 3.3 which calls upon the Parties to take:

"...precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects.... [M]easures should...be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation."

Client countries may wish to approach the World Bank for assistance in the development of precautionary measures for adaptation, except where such precautionary measures might qualify for support under the UNFCCC. The clause does support an anticipatory approach to adaptation. Adaptation is not to be left until impacts are present. More than reaction after the event is required. It is appropriate, therefore, for the Bank in its normal lending activities to ask if precautionary measures have been considered and incorporated in project activities and country development strategies.

Beyond this admonition there is a remarkable lack of specific proposals for adaptation measures and how they are to be defined and implemented. The most specific characterization of what adaptation measures may consist of is given in Article 4.1 (e), which states that Parties shall:

"...cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and dersertification, as well as floods."

Further references to adaptation are made in Articles 4.1(b) and 4.1(f), calling for Parties to:

"formulate, implement, publish, and regularly update national, and where appropriate, regional programmes containing measures to mitigate climate change...and measures to facilitate adequate adaptation to climate change" (Article 4.1(b))

and to:

"...take climate change considerations into account...in their relevant social, economic and environmental policies and actions, and employ appropriate methods...with a view to minimizing adverse effects...of projects or measures undertaken by them to mitigate or adapt to climate change" (Article 4.1 (f)).

In all these clauses there is a clear opportunity for the Bank to help ensure that climate adaptation planning and consideration of adaptation measures is incorporated into the core of national economic development activity. To the extent that climate adaptation is seen as an integral part of the development process this should not be difficult to achieve. However, the availability of financial assistance through the UNFCCC, and meeting other criteria might tend to separate climate adaptation from national development planning.

The *financing* of adaptation policies is dealt with in two different provisions of the UNFCCC. Article 4.4 states that developed countries shall:

"...assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects."

For developing countries in general (including those not considered "particularly vulnerable"), the question of financial compensation is dealt with in Article 4.3, which requires that developed countries finance for developing country Parties:

- The agreed full costs of producing national communications of information related to climate change, as required by Article 12.1 of the UNFCCC.

- The agreed full incremental costs of implementing measures listed in Article 4.1 of the UNFCCC. As noted above, Articles 4.1(b), (e) and (f) explicitly refer to adaptation.

As long as the actions taken by the developing country parties to the UNFCCC are described as "communications" they qualify for full cost support. Once the boundary is crossed into planning it is only the incremental costs that are to be covered.[2] As we have noted in Section 2.1, separating the costs associated with adaptation measures to normal climate from those attributed to climate change is not possible on a purely scientific or statistical basis. This conclusion points strongly therefore to the need to integrate climate change adaptation into ongoing development activities including planning. It also leaves the development of a new modality for distinguishing between adaptation measures required for normal climate and for climate change open to negotiation.

The types of adaptation measures to be addressed were classified at the tenth session of the Intergovernmental Negotiating Committee (INC-10) of the UNFCCC, and its decision (Decision 10/3) was endorsed by the first session of the Conference of the Parties (COP-1). The decision identifies three stages in the adaptation process:

- Stage I: The emphasis is to be on impact studies, in order to identify "particularly vulnerable countries or regions." Attention is also to be focused on general assessments of policy options for adaptation, and appropriate capacity building to better understand the problem.

- Stage II: "Measures, including further capacity building, which may be taken to prepare for adaptation, as envisaged by Article 4.1(e)" are to be readied for those countries singled out as particularly vulnerable in Stage I.

- Stage III: "Measures to facilitate adequate adaptation, including insurance, and other adaptation measures as envisaged by Articles 4.1(b) and 4.4" for particularly vulnerable countries are to be initiated.

With respect to financing, COP-1 (Berlin 1995) decided to fund the agreed full cost of Stage I measures in developing countries when these are undertaken as part of the formulation of their national communications. This decision was extended to Stage II measures at the COP-4 meeting (Buenos Aires 1998), still within the context of national communications.

The GEF has been identified as a financial mechanism under the UNFCCC and is currently a channel for providing support under Stage I and Stage II in the adaptation process. Funds have so far been allocated largely for the preparation of communications.

4.3 The Initial Role of the World Bank in Adaptation to Climate Change

What are the implications of the emerging climate regime for Bank operations? Some evidence has been presented in Chapter 3 for the existing vulnerability of Bank supported projects and for the need to take climate change more specifically into account in country assistance strategies. In the light of the ongoing negotiations about climate change and the growing understanding of likely future impacts, as well as current experience with increasing disaster losses from extreme atmospheric events, there is an opportunity to create a specialized line of Bank activity in support of adaptation to climate change.

The most important need is to ensure that the planning for and implementation of adaptation measures is carried out within the context of national economic development. *While the GEF currently has a mandate as a financial mechanism in the emerging climate regime, the World Bank has an operational role in the development process. As a minimum close cooperation between the two agencies in the area of climate adaptation is imperative.* It is important to develop a common understanding and some specific agreements to facilitate such cooperation. One such understanding might be that *no adaptation*

activity, whether in impact studies, assessment of policy options, capacity building, planning and preparing for adaptation should be carried out in isolation from normal everyday national economic development. One way to ensure this would be to confine adaptation measures under Stage III to jointly funded activities in which the funds provided under the UNFCCC would be added to ongoing activities regardless of the source of support for such activities. Such an arrangement would only apply to adaptation activities in Stage III or beyond the level of "national communications."

In many cases such joint activities might be arranged between the Bank and the GEF. This would depend, however, upon the existence of a capacity within the Bank, and the orchestration of Bank work across regions through such mechanisms as the Climate Change Thematic Group working closely with other Bank units such as the Disaster Management Facility. Currently, there already are regional initiatives in Africa, South Asia (Bangladesh), and the Pacific.

There are at the present time a number of constraints that severely limit what can reasonably be expected to be achieved in the short term. Constraints are to be found in the Bank, the client countries, and the donor countries.

The potential range of adaptation measures is extremely wide, touching upon virtually all aspects of development. The donor community is cautious about committing funds to adaptation under the UNFCCC in part because the limits of adaptation to climate change are not easily defined.

From the perspective of many client countries adaptation to climate change does not occupy a high place on the list of national priorities. This reflects a perception that the threat of climate change is long term and that severe effects will not be felt soon. This compares with many other development needs in countries where per capita income is low and development priorities center upon economic growth through investment in productive activities and the conditions that facilitate growth. The demands for expenditure in health care, education, industrial and agricultural development, transportation and so forth are seen as most pressing. When the need for improving adaptation to climate change and variability is raised the argument can be made that economic growth and the alleviation of poverty are the surest means of building adaptive capacity. It is to be expected, therefore, that there will continue to be a low level of interest in borrowing money for adaptation activities beyond win-win situations.

The existence of financial undertakings in the UNFCCC further militates against borrowing for adaptation, since financial support may become available at more favorable terms.

The existence of this agreement has prompted some interest in developing countries, especially those that see themselves as particularly vulnerable, in beginning to formulate adaptive strategies under Stages I and II that may then qualify for further and more substantial assistance when Stage III funding is authorized under the UNFCCC.

There is a potential role for the Bank in encouraging this interest as part of its country development strategy work. Client country response is likely to be affected by the amount of funds for adaptation that are likely to flow from the UNFCCC agreements. So far the flow of funds appears likely to be quite small. Although a special provision has been made to provide funds for adaptation as part of the Clean Development Mechanism under Article 12.8 of the Kyoto Protocol, the adaptation revenues generated under the CDM when it comes into operation may not be large enough to create a substantial flow of funds for adaptation.[3]

For these reasons there is a case to be made for the development of a World Bank capacity to respond to adaptation needs in client countries. This could begin on a relatively modest scale, recognizing that constraints exist within the Bank itself as well as in client countries. The Bank constraints include the fact that so far adaptation to climate change has been accorded a low priority compared with mitigation, and that the donor member governments of the Bank are themselves cautious about adaptation precisely because of its close relationship to normal development program activities. Within the Bank itself there is a low tolerance for demands for attention to new issues without additional funding being provided. This resistance appears to be especially strong in the regions where there is strong appreciation of client needs and priorities. This has not prevented support for win-win activities where there is a need identified by the client country as in the case of the Caribbean, Bangladesh and the Pacific Islands.

While these client country and World Bank constraints suggest caution in the development of a climate adaptation capacity within the Bank, there is the substantive evidence that the need for adaptation is growing and will inevitably continue to increase as the impacts of climate change make themselves felt more and more. Nor is the perception that climate change is only a long term problem quite correct. It is true that the issue is likely to last for decades at least, but precautionary actions now can yield immediate benefits in loss reduction while reducing longer-term exposure to climate change, both in the context of extreme events and in cases close to the margin of tolerance for incremental change. This not only applies to large scale infrastructure projects with a long project life, but also to current practices in such sectors as agriculture, health, forestry, coastal zones, natural ecosystems and water management.

Notes

2. See Smith and others (1997).
3. No provisions for adaptation funding have been included in any of the other Kyoto mechanisms.

5 Orienting the World Bank Towards Adaptation

5.1 Formal Process Versus Awareness and Sensitivity

Climate risk assessment can be more specifically incorporated into Bank activities in a number of ways. The Bank's current Operational Manual already offers several opportunities to include climate change considerations in Bank work, but in practice, this does not happen. The formal way to address this would be to include vulnerability to natural hazards, including both current climate risks and increasing risks due to climate change, more specifically and directly in the Operational Manual. Also, steps could be taken to raise awareness, including creating incentives, so that Bank staff and client countries are conscious of the need to include these risks in projects and country development strategies. These two paths, changes in rules and changes in awareness, are not alternatives. Both could be done, and would be mutually supporting.

5.2 Climate Risks in the Bank's Operational Manual

The World Bank's policies and practices are encoded in the Operational Manual, which contains the Bank's Operational Policies, Bank Procedures and Good Practices.[4]

The current Operational Manual offers many entry points to include natural hazard vulnerability considerations into Bank work. However, most of them are very indirect. Climate change vulnerability is not specifically mentioned and general climate risks are mentioned explicitly in only a few instances. More commonly, natural hazards and climate issues arise implicitly, in the sense that they may, and should be included in the implementation of a certain policy, procedure or good practice. An example would be "a full risk analysis." Such an analysis should contain natural hazards, including climate risks and the possibility that these risks are increasing due to climate change.

These risks can be assessed on two levels, which are both reflected in the Operational Manual. On a country level, the issues are the country's vulnerability and the way the Bank's lending portfolio affects that vulnerability. The relevant policies deal with country strategies and information. On a project level, the issues are the vulnerability of a Bank project itself, and the effects of that project on the vulnerability of the country. The relevant policies deal with the project cycle, environmental assessments, economic evaluation, and emergency lending.

5.3 Operational Manual Review: Country Level

a) The Country Assistance Strategy

The Bank's Country Assistance Strategy (CAS) is discussed in BP 2.11 and its annexes. It is a document reflecting the Bank Group's strategy based on an assessment of priorities in the country. Although the CAS is prepared with the country government in a participatory way, it is not a negotiated document. It is important to note that the CAS is not designed to be a comprehensive treatment of all the

development problems facing the country: "strategic selectivity is central." Nevertheless, natural hazards may, in many cases, be among the main development issues facing a country, and may interfere with development work in many sectors of the economy. In these cases, the CAS should at least consider them. This is currently not prescribed by the CAS procedures.

A CAS normally contains a section on the external environment. In BP 2.11, "external environment" and "vulnerability" are used in a strictly economic/financial context. However, it would be fairly straightforward to expand this analysis to also include the natural environment. If natural environmental hazards are not considered part of the external environment, one should consider including a separate section on the natural environment and the opportunities and risks that it poses to the country's development. This would be consistent with a general movement toward a better treatment of risks, including natural ones.

CASs are expected to pay attention to "environmentally sustainable development." Whenever the analysis of the country's vulnerability to *natural* hazards identifies major risks, they ought to be addressed to ensure sustainable development of the country.

b) The Country Brief

The Country Brief, which is discussed in OD 2.01, is intended to provide executive directors, senior management, and staff with up-to-date information on all active borrowing countries. Although it does not play a very important role in the Bank's planning cycle, it may be a good vehicle for noting important developments and suggesting preliminary conclusions on implications for the Bank.

The Country Brief usually includes a discussion of the country's economy, which would include major economic disruptions by natural disasters, but not necessarily a risk analysis, and a section on the Bank's strategy and operations. The latter section, should contain "an assessment of the downside risks (...) to the Bank's lending strategy or to the country's continued creditworthiness and ability to repay." This assessment could include natural hazards and their significance to the country's development. Currently, however, attention to these issues is lacking. Minor changes to OD 2.01 could ensure proper discussion of natural hazards.

c) Country Economic and Sector Work

Economic and Sector Work (ESW), which is discussed in OD 2.00, is an analytic instrument used to analyze the development problems, policies, institutions, and investment priorities of the major economic sectors and subsectors of a country. As such it provides the framework for the Bank's lending program and for policy advice in the sector.

In many cases, vulnerability to natural hazards is a major sectoral concern. However, this issue is not mentioned at all in the OD, which focuses heavily on economic and financial issues. The transfer of the OD into the new format of OP, BP and GP could provide a good opportunity to explicitly include the importance of vulnerability considerations in many development issues.

However, the scope and direction of ESW is more determined in the country dialogue and internal discussions, than by the formal specifications of the Operational Manual. Awareness, training, and good methodology studies to promote risk management may therefore be more important than general policy changes. Good examples of ESW would be a useful demonstration tool for risk and adaptation analyses in vulnerable countries.

d) National Environmental Action Plans (NEAPs)

The Bank encourages and supports the efforts of borrowing governments to prepare and

implement an appropriate National Environmental Action Plan (NEAP) and to revise it periodically if necessary (GP 4.02). The NEAP is not a Bank document and is prepared by the country. However, it plays an important role in the dialogue between the country and the Bank on environmental issues.

Although NEAPs are primarily aimed at reducing negative impacts of development on the environment rather than the negative impacts of the environment on development, it may be a good place to discuss vulnerability to natural hazards, and particularly the effect of certain development strategies on the vulnerability of the country. GP 4.02 already contains many references to vulnerability. First, it specifies that, among others, a NEAP should address "protection of the public from environmental pollution and hazards." Second, it mentions the importance of good data on public health and safety, amongst others for preparedness to respond to natural disasters, including risks of occupation of hazard-prone land and of extreme events (e.g. storms, earthquakes). By discussing natural hazards, NEAPs could become a useful vehicle for consideration of vulnerability to climate risks.

5.4 Operational Manual Review: Project Level

In the early stages of project identification, the project rationale (consistent with the CAS), composition, potential benefits/risks, and so on, are presented in a Project Concept Document. Ideally, a first assessment of the main vulnerabilities should be done at this very level, and depending on this assessment taken into account throughout the project cycle (preparation, appraisal, negotiations, and implementation), as is the case with environmental issues. In the current Operational Manual, potential attention to natural hazards is reflected mainly in the guidance on economic evaluation, environmental assessment, implementation completion reporting, and emergency recovery lending, which is discussed below.

a) Economic Evaluation

OP/BP 10.04 describes the economic evaluation of investment operations. The goal is to determine the rate of return of a project relative to other investment opportunities.

OP 10.04 specifies that, to obtain a reasonable assurance that the project's benefits will materialize as expected and will be sustained throughout the life of the project, the Bank assesses the robustness of the project with respect to economic, financial, institutional and environmental risks. Additionally, it mentions that "the economic analysis of projects is necessarily based on uncertain future events and inexact data and, therefore, inevitably involves probability judgments. Accordingly, the Bank's economic evaluation considers the sources, magnitude, and effects of the risks associated with the project by taking into account the possible range in the values of the basic variables and assessing the robustness of the project's outcome with respect to changes in these values. (...) The main purpose of this analysis is to identify the scope for improving project design, increase the project's expected value, and reduce the risk of failure."

The risk of natural hazards ought to be a part of these economic evaluations. In practice however, they are highly focused on economic and financial risks, and ignore natural hazards. This could be addressed by slightly changing the wording of this OP/BP to explicitly include these kinds of risks in the analysis.

Although the economic analysis often does not influence the project design in a major way, it is a natural place to consider risks to natural hazards. Additionally, it is required for almost all projects (only excluding emergency projects), which makes it a powerful tool to focus attention to these risks in all projects.

b) Environmental Assessment

Environmental assessments (EA), discussed in OP/BP/GP 4.01, are required for most projects, particularly for those that are expected to interact in a significant way with the natural environment. According to OP 4.01, depending on the project, a range of instruments can be used to satisfy the Bank's EA requirement: environmental impact assessment (EIA), regional or sectoral EA, environmental audit, an environmental management plan, but also a hazard or risk assessment. Additionally, GP4.01, which lists potential issues of environmental assessments mentions that "the EA should review whether the project may be affected by natural hazards and if so, should propose specific measures to address these concerns."

In practice, however, EAs rarely include full natural hazard risk assessments. This is consistent with the intent of the EA. It aims to identify and address risks *by* the project *to* the natural environment, rather than the other way around, which is the issue when assessing a project's vulnerability to natural hazards. Consequently, environmental assessments are not required for projects that do not impact the environment substantially, even if they may face risks from the natural environment themselves (such as school buildings in a flood prone area). It is also waived for many emergency reconstruction projects (for the sake of a timely response), although these projects deal with areas that are almost certainly very vulnerable to natural hazards. Thus, the EA may not be the best place to address the vulnerability of a project. If the EA would be used for this purpose, the guidelines would need major revisions and should apply to all projects rather than just the ones that may have a negative impact on the natural environment.

However, the EA could be a good place to examine negative side effects on the vulnerability of the project's environment. An example would be a seawall that protects against small cyclones with a short return period. The risk that the seawall itself would be damaged by bigger cyclones should be part of the project's general risk analysis. However, there also is a risk that the seawall increases vulnerability, for instance by giving people a false sense of protection, leading to development in areas that are vulnerable to bigger cyclones. Such side-effects of projects on general vulnerability could be addressed in the EA, along with, in this example, direct environmental risks to the coastal environment.

c) Implementation Completion Report (OP/BP/GP 13.55)

The main purpose of the Implementation Completion Report (ICR), which is required for all projects, is to learn lessons from past projects, improve the quality and effectiveness of Bank loans and heighten borrowers' ability to design, implement, and operate projects. Thus, it is a good place to evaluate how a project's vulnerability was assessed and addressed.

Vulnerability will automatically be discussed in the ICR as long as it is taken into account in the project design. If this was not the case, it will only come up when natural hazards have substantially affected the project's implementation or will affect the project's sustainability. GP 13.55 lists a number of factors that should be taken into account to assess a project's sustainability, including borrower commitment; policy environment, institutions and management effectiveness; economic, technical, financial, and environmental viability; social impact, local participation, and incentives for participants to sustain the project. Arguably, natural hazards should be added to this list.

d) Emergency Recovery Lending (OP/BP/GP 8.50)

Emergency Recovery Loans (ERLs) are used to quickly restore economic activity after major emergencies (including natural disasters). Because speedy implementation is a key issue, many of the rules and safeguard policies

outlined above do not apply to ERLs. For example, no environmental assessment or economic evaluation is required. ERLs are interesting in the current context because they have traditionally been used to assist in the recovery after a natural disaster. Consequently, the rules guiding ERLs are particularly rich in their treatment of natural hazards.

With respect to a particular emergency project being planned, OP 8.50 specifies that the Bank's ERL projects use disaster-resilient reconstruction standards and also include emergency-preparedness studies and technical assistance on prevention and mitigation efforts, to strengthen the country's resilience to natural hazards or lessen their impact. This is the most concrete attention to this issue in all of the Bank's policies and procedures. Unfortunately, it only applies in the context of emergency lending. Such emergency projects have to be implemented quickly to have maximum results, so they may not be the best place to address long-term risk management and mitigation issues. Additionally, it is preferable to address these issues before a disaster occurs rather than in response to it.

However, OP/BP/GP 8.50 also discusses disaster prevention and mitigation outside of emergency projects. It explicitly encourages the design of freestanding investment projects for prevention and mitigation of disasters in countries prone to specific types of emergencies. Such operations could include developing a national strategy, establishing an adequate institutional and regulatory framework, carrying out studies of vulnerability and risk assessment, reinforcing vulnerable structures and adjusting building and zoning codes, and acquiring hazard-reduction technology. Laying out some of the modalities of such prevention and mitigation, GP 8.50 mentions that the Bank's assistance may take a variety of forms, including dissemination and adoption of hazard-resistant technologies, inclusion of mitigation components in normal investment operations, preparation of freestanding preparedness and mitigation projects, and establishment of close ties to the international and nongovernmental organizations involved in disaster prevention and mitigation.

This OP/BP/GP provides a strong tool for natural hazard reduction. However, given its scope, it is rarely applied outside of emergency lending. To really incorporate mitigation and prevention into general Bank work, it would be preferable to apply this guidance generally, rather than only in the context of Emergency Recovery Lending. A revision of the operational policies would help in this regard. Explicit attention could also be given to longer-term changes in risks and vulnerability, such as due to climate change.

5.5 Raising Awareness

One way to increase attention to natural hazards and climate risks in general and climate change in particular would be to revise the Bank's Operational Manual. The previous sections point out several places where that could be done with small amendments. However, formal changes in operational policies and procedures could take considerable time. Therefore, it is important to focus not just on revising policies and procedures, but also to examine how to make the best use of the existing ones.

The previous section also shows that the current manual already contains many opportunities for including climate vulnerability considerations in Bank work. However, in practical Bank work, the importance of these issues is often undervalued, as shown in Chapter 3. The underlying problem, in all likelihood, is a lack of awareness and concern about the importance of climate risks to economic development. This problem is even stronger for climate change, probably because it is associated with the perception of being a low priority and a long-term issue.

Thus, raising awareness about climate risks needs to complement attention to the content of the Operational Manual. In fact, the two are mutually supporting. While a formal change would focus attention on these issues, increased attention can also be the driving force behind a change in policies and procedures, help overcome institutional impediments to such changes, and foster successful implementation.

The same would be true for many of the other recommendations from this report. For example, training and studies raise awareness, but increased awareness also stimulates development of training and studies. An additional tool to encourage all these mutually beneficial activities is to create incentives for attention to adaptation. Such incentives could include an extension of the Bank's Global Overlay program to vulnerability assessment and adaptation.

Note

4. Operational Policies (OPs) specify the parameters for the conduct of operations. They are short, focused statements that follow from the Bank's Articles of Agreement, the general conditions, and policies approved by the Board of Executive Directors. Bank Procedures (BPs) explain how Bank staff carry out the policies set out in the OPs. Good Practices (GPs) contain advice and guidance on policy implementation. Operational Directives (ODs), which are now being replaced by OP/BP/GPs, contained a mixture of policies, procedures and guidance.

6 Adaptation Now

6.1 Summary Assessment

It is clear that World Bank projects and client countries are at some significant risk from climate change and variability and that this risk will increase in future. The magnitude and extent of the risk cannot be precisely stated and it is important that additional steps be taken that will help to improve further understanding of vulnerability; the adaptation options that may be available, and the adaptive capacity to implement them. Such knowledge is required to inform the broad policy orientation of the Bank as well as to provide better input to project preparation, and the CAS.

At the present time, and in the near term, the impacts most likely to be felt are from extreme weather events and from less extreme variations in climate where development activities are close to the margin of tolerance. Thus, the most cost effective approaches to climate change vulnerability, which deserve priority attention among other development needs, are i) to reduce vulnerability to extreme events in investment loans, including emergency loans, ii) to invest in risk reduction in those situations where present development activities are close to the limits of tolerance for climate variability, and iii) to enhance the capacity to adapt to future climate changes including surprises.

There is a theoretical distinction between normal climate and climate change which is an important consideration for financial assistance under the UNFCCC but which matters little from a development perspective. There is a danger of creating a two-track system in which adaptation to climate change could become isolated from normal development activities. The Bank is in a good position to use its influence to help ensure that climate change adaptation is carried out as an integral part of the development process. This lends additional rationale for a focus upon extreme events and situations close to the margin of tolerance.

Extreme weather events potentially associated with climate change now cause disasters which, in turn, can cause severe setbacks to economic development. Adaptation to extreme events now (called "mitigation" in the community of disaster specialists), can be good preparation for longer term climate change. The stronger the adaptation capacity the lower the vulnerability both now and in the future. Unfortunately, emergency loans for disaster recovery and rehabilitation tend to focus on the restoration of conditions to the pre-disaster state, and the opportunity to reduce vulnerability to future events, including increased risk from climate change, is missed.

Vulnerability varies substantially by sector and region within countries, and also by socioeconomic groups. The poor and otherwise disadvantaged are at greater risk and will become more so unless the distributional effects of losses are taken into account. Better understanding is also needed of this aspect of vulnerability and the means to reduce it.

There is substantial variation in the degree and type of risk between sectors. For example, large capital infrastructure projects with high initial

costs and a long physical life are at higher risk, and projects that affect the long-term development path of a sector or region (such as land zoning) can have an equally if not more powerful impact on overall vulnerability.

Although no standardized and comparable indices of vulnerability are available either at an aggregate level or for sectors, it is possible to identify in broad terms those countries which are more vulnerable, as well as those sectors and regions within countries where priority attention to climate risks is most urgently needed. Such assessment has not yet been incorporated into Bank work and project preparations do not take existing risks of climate and climate variability into account, nor the need to reassess those risks where they are likely to be increasing due to climate change.

In project preparation considerations of vulnerability are rarely extended beyond the time horizon of the economic analysis of a project. In many cases the physical life of a project is expected to be significantly longer and the project itself as well as the dependencies it creates may be vulnerable to climate change. Unless a more sustainable development perspective is adopted Bank projects can serve to increase vulnerability to climate change and variability.

The Bank's Country Assistance Strategies do not take climate change and variability into account. They also tend to overlook the risks of current climate and natural hazards. The inclusion of a climate and natural hazard risk assessment, parallel to the economic risk assessment, would influence the design of projects and over time the mix and character of the investment portfolio. This in turn would contribute to the reduction of disaster losses and adaptation to climate change.

Adaptation is becoming more important as the specification of the probable impacts of climate change improves and as evidence of losses mounts. Attention to adaptation is also increasing as arrangements for adaptation activities under the UNFCCC expand under Stage II with the prospect of an eventual move to Stage III. There is an important opportunity to play a complimentary role in this work and to help avoid the emergence of a two-track approach to climate change adaptation based in part on grants and in part on loans. Such a system would have a distorting effect on the development process and not be in the best interests of the Bank nor its client countries.

The Bank can play an effective role in helping reduce the vulnerability of its client countries and its own investment portfolio by expanding its own capacity to address vulnerability and adaptation centrally and regionally.

6.2 Recommendations

a) Strategic Level

An important opportunity is opening for the World Bank to develop a new line of business in helping clients to assess and then reduce their vulnerability to climate change and variability through precautionary adaptation measures designed as an integral part of economic development. In order to seize this opportunity, the Bank should adopt a general strategy including the following components:

1. The Bank should strengthen its own capacity to provide assistance in the area of vulnerability assessment and adaptation in client countries centrally and regionally. The Bank should cooperate closely with other organizations, such as the GEF, to ensure that adaptation to climate change and variability is closely integrated into national economic development strategies.

2. An essential first step is to assess current adaptation practices to present day climate and its variability in a sustainable

development context, including the identification of good practices.

3. Beyond the stage of communications under the UNFCCC there is no case to be made for "stand alone" projects on adaptation to climate change and all investments, whether loans from the Bank or otherwise should be designed as incremental additions to projects justified for general economic development purposes. In other words, they should be "win-win" projects where climate change would result in additional benefits.

4. More systematic attention should be given to climate risks (present climate, climate change and variability) in Country Assistance Strategies and project preparation. This can be done within the existing Operational Manual (although minor changes in wording would help to make the need for attention to climate risks explicit), and should also include steps to raise awareness of climate risks among Bank staff and within client countries. Steps should also be taken to develop new modalities such as the extension of the Global Overlay Program to climate change adaptation.

5. This strategic approach should begin on a pilot scale in those countries identified as most vulnerable. A two-step process is involved. First, it is important that a general assessment of vulnerability be made in order to identify the most urgent situations and to ensure that critical problems are not overlooked. Second, more detailed risk assessments are needed for the most vulnerable countries. A model for this approach may be found in the present study being made for Bangladesh.

b) Studies

Several actions are needed to create new knowledge and understanding of vulnerability assessment and adaptation, including new or improved methodologies. The appropriate division of responsibility for these actions has to be considered carefully, but the Bank could certainly play a facilitating role, while leaving the more basic research questions to others.

6. It would be helpful to have improved measures of vulnerability and better vulnerability assessment at the country level, coupled with assessments of adaptive capacity. While the technical research might best be done elsewhere, it is important to provide for use at the country level a framework for assessing climate risk comparable to economic and financial risk. Such a framework should also be addressed to the diagnosis of adaptive capacity and means of strengthening it.

7. Special pilot projects on vulnerability and adaptation can be justified for countries found to be among the most vulnerable (see 5 above), and are already underway in Bangladesh, the Caribbean, and the Pacific Island states. This work could be expanded with an added comparative dimension.

8. As the priority accorded to adaptation increases, there will be an additional need to provide access to the knowledge base required for a review of standards and criteria in adaptation science. This should not be limited to risk assessment by sectors but should also include a capacity for integrated assessment.

c) Training

As the Bank and its clients prepare to do more work on climate vulnerability and adaptation there will be a growing need for training in the understanding of related concepts and methods. Such activities would also help inter alia to increase awareness.

9. World Bank Institute seminars, workshops, and short training courses should be

offered on a regional basis wherever there is client country demand, and where regional Bank staff become involved in climate change vulnerability and adaptation work. This is already underway in some regions.

10. The content of such training activities should include some or all of the following as appropriate to local or regional needs and circumstances;
    - Methods of impact and vulnerability assessment
    - Methods of risk analysis as applied to climate change and variability and natural hazards
    - Methods for the identification of adaptation measures and their evaluation
    - Approaches to the integration of climate change adaptation into national economic development strategy and planning
    - Assessments of adaptive capacity and the means of strengthening it.

d) Institutional

In order to facilitate the implementation of the above recommendations some institutional requirements also should be addressed.

11. A basic level of expertise and responsibility to advance the World Bank's agenda on climate vulnerability and adaptation should be maintained and probably strengthened within the Global Climate Change Team of the Bank's Environment Department.

12. Vulnerability and adaptation studies (see B above) are needed in greater depth than is possible in the context of National Communications under the UNFCCC. The World Bank Regions are the place where such studies should be developed, in cooperation with the Global Climate Change Team and other interested parties. They would:
    - Focus in detail on adaptation strategies and measures (National Communications concentrate much more on vulnerability)
    - Concentrate on present and near-term adaptation
    - Identify and assess opportunities for win-win projects
    - Be closely tied to the CAS process and, where possible, be timed to produce results that would feed into it
    - Seek donor funding or draw upon Trust Funds.

13. A subgroup on vulnerability and adaptation should be established within the Climate Change Thematic Group and provided with resources commensurate with the tasks assigned to it.

14. The Global Climate Change Team should cooperate with the Disaster Management Facility to improve the Bank's approach and policies regarding disaster mitigation and adaptation to climate change. While it is true that not all disaster mitigation relates to climate change (disaster mitigation includes earthquakes and other non-atmospheric hazards), and that not all climate change adaptation relates to extreme events (for example, the problem of development close to the limits of tolerance of normal climate variability), there is, nevertheless, a sufficiently large area of common concern that joint activities could be very beneficial for both parties.

15. The Global Climate Change Team should develop stronger links with the GEF in the area of climate vulnerability and adaptation, and the Bank should position itself to play a role in the management and implementation of adaptation projects under Stage III of the financial mechanism for adaptation, in order to help ensure that such projects are an integral part of national economic development strategy.

16. The World Bank Environment Strategy and the OED Environment Review should pay attention to the risks that the environment may pose to Bank projects and development, not just to the effects of Bank projects and development on the environment.

Appendix A — Project Studies

A.1 Introduction

This appendix presents the project studies discussed briefly in Chapter 3. It discusses the selection and methodology, followed by the project descriptions.

A.2 Project selection

We selected projects mainly from the countries that are discussed below in the country vulnerability analyses, and tried to cover a number of sectors that may be vulnerable to climate change: hydropower, irrigation and drainage, transport infrastructure, flood control, and agriculture.

This led to the choice of the following projects:

1. Coastal Zones
   Coastal Embankment Rehabilitation Project in Bangladesh
2. Flood control
   Lower Guayas Flood Control Project in Ecuador
3. Emergency Lending
   El Niño Emergency Assistance Project in Guyana
4. Hydropower
   Nathpa Jhakri Power Project in India
5. Agriculture
   Oro Smallholder Palm Project in Papua New Guinea (PNG)
6. Infrastructure
   Emergency Road Rehabilitation Project in Samoa

A.3 Method of analysis

The exact vulnerability of the project components and the effect of the project on a country's vulnerability is very hard to assess. This analysis does not include such an assessment, but merely looks at whether project documents address climate risks and how their analysis compares to a few actual climate risks facing the country and the project. Rather than making detailed statements about the exact risks facing a project or the effects of a project on the vulnerability of a country, this analysis is intended to identify whether climate risks are properly assessed and taken into account in World Bank projects.

We should point out that some of these projects were planned before climate change became as prominent an issue as it is now. Therefore, our purpose is not to assess current project design, but to identify vulnerabilities (both to climate change and climate variability) and see how these considerations could improve Bank work.

To assess attention to climate risks, we looked at several World Bank documents. First, from the preparation phase of the project we looked at:

- Project Appraisal Documents or Memorandum and Recommendations of the President, which both describe the project for discussion about its approval by the Bank's board,
- The Project Status Reports, or supervision reports, which are updated regularly during implementation

- Where available, the Implementation Completion Report, which evaluates the project at the end of the implementation phase.

In the case of the Bangladesh Coastal Embankment Rehabilitation Project, we also looked at the Environmental Assessment/ Analysis Reports, used in preparing the project.

A.4 Coastal Embankment Rehabilitation Project in Bangladesh

Background

Bangladesh is plagued by recurring natural calamities, including severe cyclones, which lead to large losses of life and widespread devastation. For instance, a 1991 cyclone caused about 140,000 deaths and severe damage throughout the eastern coast of the Bay of Bengal. These losses could have been much less severe had the embankments, partly financed by an IDA credit in the 1970s and very successful in protecting large areas from cyclones in the 1980s, been in better maintained.

In 1986, Bangladesh formulated a National Cyclone Protection Program, including proposals for improving the coastal embankments, protecting newly accreted lands, developing forests, improving telecommunications, roads and coastal transport and provision of improved and less costly cyclone shelters. Consultants' studies were in progress when the 1991 cyclone struck. Immediately afterwards, various donors, including the Bank, funded a Priority Works Program to provide for the most urgently needed embankment repair and rehabilitation work.

In the longer run, projects were started to facilitate effective post-disaster relief operations and to protect human lives by construction of shelters and improvement of communications systems. This credit of US$53 million, approved by the Bank's Board in November 1995, complements these efforts by providing partial protection of crops and infrastructure, as well as additional protection of human lives.

Objectives

The objectives of the project are (a) to provide improved cyclone protection, including improving the security of persons living in the protected areas, reducing damage to houses and other buildings and infrastructure and minimizing the loss of crops and livestock, (b) to increase agricultural production in the project area, through preventing saline inundation during normal weather and improved cropping patters due to reduced cyclone risks, as well as (c) introduction of improved technology in the design and construction of protection works and improved methods of embankments maintenance.

Components

The project includes:

a) Rehabilitation and improvement of sea-facing embankments
b) Complementary programs to improve the functioning of the polders that are being protected
c) Afforestation of the embankments and a belt behind them
d) Improved polder and embankment operation and maintenance
e) Resettlement of people displace by the project
f) Environmental monitoring and provision for appropriate mitigating measures
g) Studies to investigate the possibility of cost-effective town protection works for one particular town, Sandwip
h) Technical assistance for the components mentioned above, for coordination with other projects, and for involvement of NGOs
i) Training
j) Vehicles and equipment.

Treatment of risks

Although the project deals with cyclone protection, and previous embankments have been severely tested and even destroyed by cyclones, the project's Memorandum of the President does not list climatic events among its risks, which only include implementation and participation problems, management and institutional weaknesses and overestimation of yields or farmer response. However, the project's current status report clearly indicates that climate risks did and do threaten the project's success. Cyclones in 1997 caused cost overruns that are now one of the main problems facing the project. Additionally, the status report rates climatic risks as substantial, and finally, it stresses the risk of low sustainability due to poor operation and maintenance, which makes the project susceptible to future damage.

The project's Memorandum of the President mentions that the proposed design, including embankments design, use of afforestation and community participation in maintenance reflects the result of economic and technical analyses of alternative designs and maintenance options. The major civil works in the current design provide full protection for 5-year events, protection for 20-year events in the sense that resulting water levels in the polders should not exceed 1 meter, and some protection for 40-year events. The economic analysis estimates that about 50 percent and 40 percent of the crops would be saved in the case of cyclonic surges with return periods of 10 and 20 years, respectively. The economic evaluation includes project benefits up to 30 years from the starting date, with benefits starting in the third year. However, the physical life of the investments may be longer, if maintained properly.

Such proper maintenance, already indicated as a problem in the current status report, is crucial to ensure that the long-term effects of the project are indeed beneficial. More strongly, once the protection is constructed, it must be maintained for a very long time, well beyond the time horizon in the economic analysis, and at least at the current level (which may mean large additional investments if the structures deteriorate or climate changes). Otherwise, development may take place in certain areas while they are protected, and more assets will be at risk once that protection fails. In that scenario, the project would even have a negative effect on the country's vulnerability.

The environmental analysis refers to an environmental assessment of a previous project by the EU, which indicated that the overall environmental impact of such projects is positive. The brief environmental analysis for this project only deals with effects of the project on the environment, not discussing risks to the project itself.

Climate change, which could affect Bangladesh in a major way, and would, through sea level rise, particularly increase the damage of recurrent cyclones, is not considered at all in the project documents.

Follow-up project

In response to the major cyclone of 1997, a Supplemental Credit for emergency repairs was approved by the Bank's Board (in April 1999). This project also includes funding for the preparation of a Second Coastal Embankment Rehabilitation Project, which will include specific climate change adaptation measures.

Conclusion

The project did not explicitly include climate risks in its original analysis. However, two years later, cyclones damaged project structures, interfered with implementation and caused major cost overruns. Apart from current climate risks, the project is also vulnerable to climate change. This issue is not mentioned in any of the project documents.

Fortunately, Bangladesh's vulnerability to climate change is increasingly being addressed

by the Bank. The Supplemental Credit to this project already included funding for the preparation of a Second Coastal Embankment Rehabilitation Project, which will fully take climate change into account. Additionally, an Integrated Coastal Zone Management Project, and Bangladesh's National Water Management Plan, funded through the Bank's River Bank Protection Project, will address adaptation issues. On a broader level, the Bank is currently undertaking a comprehensive climate change adaptation study for Bangladesh (available in the fall of 1999)

A.5 Lower Guayas Flood Control Project in Ecuador

Background

Floods are a natural phenomenon in Ecuador's Lower Guayas Basin, caused by the limited capacity of the wide meandering river system in the flat Guayas Basin to evacuate the high-velocity water flows coming off the Western face of the Andes Mountains. The floods have adverse consequences for both urban and rural life, hampering development in the region, particularly in the agriculture sector. In June 1990, the World Bank's Board approved a 59 million dollar loan to Ecuador for the Lower Guayas Flood Control Project. The total size of the project is US$97.5 million (other contributors include the government of Ecuador, the project's beneficiaries and the Dutch government).

Objectives

The project objectives are:

a) To reduce the risk of flooding and the resultant losses to life, property and output in the Lower Guayas Basin
b) To improve health and living conditions through flood control and drainage; (c) to increase the productive capacity of the Region
c) To enhance the capacity of central and local organizations
d) To protect and conserve the natural environment and
e) To delineate a sound development strategy for the area's natural and human resources.

Project components

The project consists of flood control and drainage measures, including dikes, bypass (flood-relief) channels, main and secondary drainage systems, rural roads, bridges and various control and conveyance structures. Additionally, it includes an Agricultural Development Plan aimed at supporting and improving smallholder production systems, including adaptive research programs, seed production, extension, and strengthening smallholder farmer organizations. Together, these two components should result in substantial on-site investments, financed by farmers themselves. Finally, the project contains an environmental protection and conservation component, it finances a Master Plan that would delineate a sound development strategy for the area's natural and human resources, and it includes support for management and training.

Treatment of climate risks

According to the Staff Appraisal Report, all project risks have to do with commitment and implementing capacity of the government and other actors, as well as the macroeconomic environment. Climate risks were presumed to be addressed due to the very nature of the project. As shown below, that assumption turned out to be false when the 97/98 El Niño threatened the project.

An analysis of the infrastructure works (Annex 1 to the Staff Appraisal report) mentions that the works foreseen for the project would provide 1:50 years frequency flood control. Apparently, the main concern is to decrease the risk of frequent flooding to stimulate agricultural development of the region, rather than providing full protection from big, low-

frequency floods. The economic rate of return of the project (17 percent) is calculated on the basis of a project life of 40 years, reflecting the expected economic life of most of the major investments.

This project reduces Ecuador's vulnerability to current climate risks, both with physical measures and by increasing Ecuador's institutional capacity. However, it does not include any analysis about climate change. If climate change would worsen the intensity or frequency of floods, the actual return rate of floods that the project will not be able to prevent may go up higher than just 1:50. Additionally, climate change is expected to accelerate during the lifetime of the project investments, so that it could have influenced the economic analysis of the project. On the other hand, accepting risks of a 1:50 years flood may imply also accepting the kinds of longer-term risks that climate change deals with. Nevertheless, the project may have missed opportunities to reduce climate vulnerability by not taking all future, possibly increased, climate risks into account.

Developments during implementation

In 1997/98, while the Lower Guayas Flood Control Project was being implemented, Ecuador experienced one of the strongest El Niño's of the century, resulting in direct structural losses of over 2.5 billion dollars (NOAA Office of Global Programs 1999). Impacts included both droughts and floods. The World Bank supported prevention and reconstruction efforts with a separate Emergency Assistance Loan of US$60 million. The Lower Guayas loan was not amended for the emergency recovery efforts because its goals were already consistent with prevention of flood damage.

El Niño also threatened the Lower Guayas Flood Control project itself. During El Niño, the project status' risk rating rated climatic risks as high, among the two main risks to successful project implementation at that time (together with political/security risks). Now that El Niño is over, and the risk is downgraded to substantial. Interestingly, the high risk of climatic conditions was not mentioned in the original project documents, even though El Niño is a recurring phenomenon, which always causes major floods and droughts in Ecuador.

Luckily, this time the project did not suffer any major damage and already contributed greatly to the reduction of flood damage in the region. The status report mentions that:

> *"... while the phenomenon "El Niño" completely inundated the Guayas catchment area last year, the completion of the drainage infrastructure managed to successfully protect the 200,000 ha project area. The flood control works have already generated remarkable benefits in avoiding serious losses in urban and agricultural investments. As a result, the economic rate of return is very high, and land value in the project area increased from US$300/400 per ha to between US$1,200–1,800 per ha."*

The status report also discusses bad maintenance of the civil works. This factor may severely hamper investments (and may even be a more limiting factor in success than original design standards).

Conclusions

This is a good example of a win-win project that decreases a county's vulnerability to climate change simply by decreasing vulnerability to current climatic conditions. However, the project might have benefited from climate change considerations, which could have improved the assessment of design standards for long-term flood protection. The economic analysis has a time horizon of 40 years, a time scale significant for climate change. It is unclear to what extent that such considerations would have changed the project,

considering that a 50-year flood standard was deemed acceptable.

Additionally, there could have been more attention to climate risks, such as damage by very large floods, to the project itself. Climate hazards were not included in the original risk analysis, while the events during implementation, and the updated risk analyses show that the climatic conditions did become an important risk, which may become larger over time when impacts of climate change increase.

A.6 El Niño emergency assistance project in Guyana

Background

The 97/98 El Niño was one of the worst on record. Worldwide, it caused damages of over US$36 billion (NOAA Office of Global Programs 1999), ranging from floods and droughts in Peru, to fires in Indonesia, to floods in Kenya, to droughts in Papua New Guinea. Guyana was also hit badly, with both heavy flood and drought conditions. On September 29, 1998, the Bank approved a US$9 million credit to Guyana for an El Niño Emergency Assistance Project.

Objectives

The objectives of this credit were to help to restore the country's agricultural capacity in drought-stricken areas through vulnerability reduction measures in the areas of hydrologic extremes, help in providing safe and reliable potable water service to marginal urban and remote hinterland and riverine communities which were affected by drought, and help to restore flood protection in low-lying areas of the city of Georgetown.

Components

The project includes:

a) An agriculture production capacity recovery and regeneration program. This included both drainage and irrigation components (mobile pumps, sluice outfalls, sluices, conservancy structures) and a hydrometeorological supply and dissemination program.
b) A potable water service recovery and restoration program, including construction of wells, pumps and storage facilities and a drought mitigation component
c) A flood restoration program for the city of Georgetown, including installation of new sluices and pumps.
d) A project coordination component, including institutional strengthening of the agencies involved.

Treatment of climate risks

Natural hazards are not mentioned anywhere, neither in the project documents, nor among the project risks, which all deal with implementation. However, operation and maintenance of the investments are considered a major problem, and it is recognized that if infrastructure should deteriorate, the population would be exposed to the same risks that it faces now. In fact, if the protective measures first stimulate development, more assets and people would be at risk once that protection starts to fail.

Climate change is not considered anywhere in the project documents, although such considerations could have been relevant to several aspects of this project.

For instance, a large part of the Georgetown area is below sea level. Therefore, with sea level rise, flood risks are bound to become more severe. Thus, in the light of climate change, additional drainage investments may have been justified, depending on the lifetime of the investments.

Additionally, a similar concern as with failing protection due to poor operation and maintenance could be voiced about climate change. The current protection could cause development in areas which will not be

protected sufficiently once sea level rise occurs (unless large additional investments are made).

Climate change may also influence the economic rate of return of the project. The drainage and irrigation components have an economic rate of return of 19 percent, partly based on avoided losses due to preventive measures. The assumptions include estimates of the frequency of El Niño and La Niña, the damage that could have been avoided by the measures put in place (70–85 percent) and the total losses in the current El Niño episode. Additionally, a reduction in losses due to the regular droughts and floods that occur twice a year is included. Changes in sea level might increase or decrease the economic rate of return of the investments (they may protect against more frequent floods, thus preventing more damage, or they may be insufficient, unable to prevent damages in the major floods, while some additional measures could have done the job). Changes in frequency or intensity of extreme events, including El Niño, could also work both ways. In any case, some additional investments may have been economically justified based on the chances that additional risks will appear.

Conclusions

This project includes measures that decrease the country's vulnerability to the current climate, thus also decreasing the vulnerability to climate change, and is an example of a win-win project. However, good operation and maintenance will be crucial for long-term project success. If poor operation and maintenance should lead to a deterioration in protection, the net effect could be an increase in vulnerability, due to development in vulnerable areas. A similar effect could apply when climate change causes the current levels of protection to become inadequate. Nevertheless, climate change was not explicitly considered, even though the project could have benefited from such considerations, since additional cheap adjustments and win-win opportunities may exist.

A.7 Nathpa Jhakri Power Project in India

Background

India's hydropower potential is equivalent to about 100,000 MW. In 1989, only 16,000 MW had been developed, At the same time, electricity shortages and the poor quality of the electricity supply clearly indicated the need for more investments in power systems. The Nathpa Jhakri Power Project was approved by the Bank's Board on March 2, 1989. The total project costs US$1.837 million, of which US$485 million is provided by IBRD, US$300 million by other cofinanciers, and the rest, US$1.052 million, by the Indian Government and Electricity Agencies.

Objectives

The project is intended to alleviate the acute shortage of generating capacity in Northern India through the addition of 1500 MW hydropower capacity.

Components

The project entails:

a) Construction of a 1500 MW hydropower plant
b) Construction of related transmission and distribution systems
c) Help to improve construction, operations and management of power supply and distribution.

Treatment of risks

For such huge investments, most hydrological and geological risks are well mapped. Physical risks, such as sedimentation, are also considered. Additionally, political factors, which can change the water available from a river that originates elsewhere, are considered. In this case "the bank is satisfied that the Sutlej flows originating in India are sufficient to operate the power plant as planned. Therefore, the effects of any extractions of water from the Sutlej upstream of the Indian border do not pose any significant risk to the project."

During implementation, a few risks became more prominent, including increased risks of geological difficulties and heavy sedimentary loads. However, both of these were already considered in the project design.

Climate change is not mentioned anywhere in the project documents.[5] The project's hydrological analysis is based on the record in the 56 previous years, without incorporating possible trends due to climate change. However, the IPCC regional report (IPCC 1998) does mention the possibility of lower runoff from Himalayas (or first higher, then lower runoff from snow-fed rivers), and even specifically mentions risks to hydropower plants:

> *" A reduction in average flow of snow-fed rivers, coupled with an increase in peak flows and sediment yield, would have major impacts on hydropower generation . . ."*

It should be noted that apart from this general trend, as of yet no good models exist to predict the hydrological impact of climate change on any particular project site.

In practice these considerations are not likely to have changed the project design. The project's economic rate of return is based on planned benefits during 25 years, originally until 2021. According to the economic evaluation, the project would still have an economic return above 12 percent, the presumed opportunity cost of capital, with a combined adverse change in costs and benefits totaling 35 percent. Consequently, climate change will only have small impacts during the time horizon of the economic evaluation of the plant and will not be a major factor in the project's economic performance.

However, there are two reasons that do point to the importance of considering climate change in this type of projects: First, climate change will accelerate, meaning that projects that are being planned now, 10 years later than Nathpa Jhakri, will involve much more climate change impacts during their economic planning time horizon. Second, although the economic evaluation is calculated only on the basis 25 years of economic benefits, the physical lifetime of the plant is much longer than that, so in that sense there could be some benefits from taking longer-term changes into account in this project. Additionally, the question about longer run vulnerability remains open.

Conclusions

Climate change is probably of little economic concern to hydropower projects now installed and operational, considering that the economic evaluation is based on benefit only until 2020. However, for similar projects starting now, climate change may become an important consideration, to be included among other hydrological risks and evaluations. Additionally, from a perspective of sustainable development, risks and vulnerability should be evaluated for a project's physical lifetime (or even longer), often well beyond the economic evaluation's time horizon.

A.8 Oro Smallholder Oil Palm Development Project in Papua New Guinea (PNG)

Background

Palm oil and kernels account for more than one fifth of PNG's tree crop production (the other ones being mainly coffee, cocoa, coconut, tea and rubber), which in 1991 accounted for virtually all agricultural exports and 13 percent of total export revenue. However, price declines since the mid-1980s seriously eroded the profitability of PNG's Oil Palm industry. Still, in many areas of PNG oil palm offered much higher income and returns to labor than any other cashcrop. However, to ensure that the industry remained viable, it was imperative that smallholder yields be improved, and production, processing and marketing costs be reduced. The Oro Smallholder Oil Palm Development Project was approved by the

Bank's board on June 9 1992. In addition to the IBRD loan of US$27 million, the project is financed by the government of PNG (US$6.4 million) and local farmers (US$3.4 million).

Objectives

The project is intended to increase PNG's agricultural production and exports, provide employment opportunities, generate income for poor farmers in the Oro province, and protect the habitat of the world's largest butterfly, which is and endangered species.

Components

The project consists of:

a) Smallholder oil palm development: planting 6500 ha of oil palms, strengthening extension services and building and maintaining agricultural roads and social infrastructure
b) Main road improvement
c) Environmental protection of and endangered butterfly and its ecosystem
d) Institutional strengthening of the Department of Agriculture and Livestock, the Oil Palm Industry Corporation (OPIC) and oil palm research
e) Technical assistance to the OPIC
f) Studies in the tree crop subsector

Treatment of climate risks

The project risks do not include natural hazards. The main risks that are identified are financial, particularly palm oil price changes, or related to possible implementation problems. The project documents mentions that the climate is considered ideal for oil palm, and does not mention the risk of climate variations. However, although we have no direct evidence that the palm oil production was affected, there are good reasons to believe that it was harmed by the 97/98 El Niño, which caused severe drought and frost in PNG. Although the Oro province was not the worst hit, it did experience drought problems,[6] and palm oil production is certainly vulnerable to such droughts.[7]

Nevertheless, in the project status report, climatic/environmental conditions are not rated or not applicable.

In the light of the recent El Niño it seems surprising that the project documents do not discuss to what extent oil palms would be vulnerable to droughts, frost, forest fires, or for that matter, plant diseases and insect pests. It is unclear whether the lack of attention means that risks did not exist, were considered and dismissed, for example as too long-term, or were unknown.

As a longer-term investment, the development of an Oil Palm industry might be at risk from climate change. Particularly a drier climate, including more severe El Niño droughts, could hurt the project. The first fruit bunches on the palms become available after 3 years, while production would extend over at least 17 years, until it would become too difficult to harvest bunches due to the height of the palm. Therefore, although it is a longer-term agriculture investment, these time scales do not necessitate immediate concern about the actual effects of climate change in the current project design.

Although the project may be vulnerable itself, it has little additional effect on the overall vulnerability of the country.

Conclusions

Climate risks are not considered in this project, although these risks may play a role in the projects' success. These risks would become greater with climate change. However, the expected lifetime of the investments (palm trees) is shorter than the expected time until major climate change impacts will be felt.

A.9 Emergency Road Rehabilitation Project in Samoa

Background

In February 1990, Samoa was struck by Cyclone Ofa, which caused widespread damage to

infrastructure, buildings, water and electricity supply. Total damage was estimated at 140 million dollars, a huge amount for Samoa's small economy (in 1997 Samoa's GNP was US$200 million). Damage to the transport sector was estimated at US$40 million. This amount included damage to inter-island transport (ferries and airstrips), but particularly also the internal road network, which suffered extensive damage. On May 17, 1990, the Bank's Board approved a credit of US$14 million, supplemented with US$1.75 million from the Samoan government and US$0.38 million from the Australian International Development Assistance Bureau.

Objectives

The objectives of the project were to assist the Government in carrying out an emergency rehabilitation program to alleviate the severe disruption in the transportation sector. It would also help restore economic activities along the cyclone affected coasts of Samoa's two main islands, and provide assistance for extraordinary maintenance requirements of the road network in areas exposed to erosion by wave action. Additionally, the project aimed to strengthen planning, implementation and management capacity, especially for road maintenance.

Components

The project consists of:

a) Extraordinary maintenance to keep roads passable and coastal protection of the main roads
b) Rehabilitation of priority road links
c) Technical assistance and consultancy for design, supervision, and management
d) Procurement to restore cyclone-damaged navigation facilities and road maintenance equipment
e) Training and institutional strengthening

Treatment of climate risks

When this road rehabilitation project was planned, Samoa's vulnerability to future natural hazards was clearly a matter of concern. For instance, for the reconstruction of the roads, the project design took into account the option to relocate vulnerable road sections, or to include protection from future damage:

> *"Destroyed sections would be relocated on higher ground, as the coastal dunes on which they were previously located have disappeared in many cases, and to prevent or mitigate future cyclone damage. The other sections would be reconstructed or rehabilitated on the old alignment but shore protection will be provided where required for some of its badly damaged sections."*

The question remains whether relocation only applies to those road sections that were located on coastal dunes that were washed away, or also to other sections vulnerable to cyclone damage. From a short-term perspective, it may be tempting to reconstruct roads at the same place, considering that relocation is costly and often takes much longer, relative to quick reconstruction. However, in the longer term, these investments may be washed away again, or it may be very expensive to protect them properly.

Apart from the risk of implementation and maintenance problems, the overall risk analysis of the project mentions that further damage to the road network could occur during the period before rehabilitation commenced, although it does not consider the risk that the current investment in road rehabilitation could be destroyed again by a future cyclone.

The project documents do not mention the chances of increased risks due to climate change, in particular the risk of a rising sea level and the resulting increased intensity or frequency of storm surges. Theoretically, this consideration could have lead to other decisions on relocation and protection of the road sections.

Second cyclone and additional credit

In December 1991, just 22 months later and while Ofa restoration works were still in progress, another cyclone, Val, hit Samoa. The damage was tremendous, even surpassing the Ofa's devastation. Estimates of total losses were around US$300 million. Together with Ofa, the impacts of Val caused a decline in Samoa's GDP of 4.5 percent per year in the period 1990–92.

Just like Ofa, Val severely hit the transport sector. Roads and bridges were damaged and destroyed and coastal protection works, some hastily constructed after cyclone Ofa, were severely damaged. The World Bank quickly approved an additional credit of US$5.1 million to the Ofa reconstruction project. While total damage to the transport sector was estimated at US$34.8 million, the Bank's supplemental credit was intended only address only the most immediate concerns, involving damage done by Cyclone Val to roads in the project area. Therefore, the original project objectives and components remained essentially the same.

The supplemental credit contained a new risk analysis. Once again, the main risk that was considered is further damage before rehabilitation commenced. Interestingly, the risk of another cyclone like Ofa or Val still was not considered, and neither were the chances of increased frequency and/or intensity of such events with sea level rise.

Implementation Completion

The project, including the supplemental credit, was completed on 31 December 1997, three years later than originally planned (mainly due to the additional damage caused by cyclone Val).

The Implementation Completion Report (ICR) is satisfied with the project's outcomes. Objectives were met, and implementation was successful. The road network is considered to be in good condition, and enhanced protection should have reduced the risk of transport disruption to low levels for up to 20-year related weather-related events (seawalls and other coastal protection systems were even designed for only a 1 in 10 year event, but can take a bit more with some damage to the structure itself). Ofa and Val were 50-year and 100-year events, respectively, so they fall well beyond what these protective measures are supposed to cover.

The ICR mentions that:

> *"The sustainability of the project benefits is likely, assuming there are not substantial changes in the incidence and severity of natural weather-related disasters, and assuming the continuance of the government's new performance-output approach to budget allocations.*

Interestingly, there is no recognition that these changes are exactly what might be happening under climate change. In that respect, sustainability may be reduced, depending on the expected lifetime of the investments. Apparently, protection against a 20 year disaster is deemed optimal, considering the costs and benefits of protective measures. Climate change, which will occur over even longer time scales, may have little impact on current optimal project design. However, it is also possible that increased investments would have been justified considering the risk of future increases in intensity or frequency of storm surges.

The Implementation Report also discusses the danger of reliance on seawalls and similar "hard" protective measures. Other solutions, e.g. beach replenishment and submerged breakwaters, are not only less environmentally intrusive, they also do not create a deceptive impression of security. Such feelings of security may lead to behavior that increases vulnerability. For instance, people may construct villages behind a seawall thinking that they are protected from cyclones like Ofa

and Val, while it really only protects against 10-year storms. Considering the importance of protection to natural hazards, but also the integrated approach needed to address that issue, the ICR proposes a strategic approach to all coastal hazard levels.

Follow-up: Infrastructure asset management project

One of the key lessons learned from the Road Rehabilitation Project was that:

> *". . . the infrastructure sector is a crucial link determining the country's ability to respond to high risk natural shocks. Ensuring appropriate standards and sustainable management of infrastructure are thus important priorities for the Government, and warrants continued engagement of IDA in the sector with these objectives."*

Consequently, a follow-up project was planned: the Infrastructure Asset Management Project. This project, consisting of a US$14.4 million IDA credit complemented by US$1.3 million from AusAID and US$3.1 million from the Samoa Government, intends to upgrade key infrastructure assets and make sure they are sustainable, under service-oriented management. It has components dealing with the airport, road system assets, coastal infrastructure, and institutional strengthening.

Treatment of climate risks in the Infrastructure Asset Management Project

As expected after the experiences in the previous project, the infrastructure asset management project does take natural hazards, and in particular cyclone risks into account. Rather than just upgrading the current facilities, sustainability with respect to natural disasters is an important aspect. The project does not only mention the risk of cyclones among other project risks (like economic and implementation risks), but also includes an economic evaluation of coastal protection works. This cost-benefit analysis of coastal protection balances the additional capital works and maintenance costs (together with any environmental disbenefits) with increased savings in expected asset (and service) loss. This full analysis was done for two separate coastal protection subprojects. In this case, a 10-year return period protection turned out to be economically optimal. Interestingly, for 15 year return period protection, the net present value drops to negative level.

Although natural hazards are included prominently in this project, climate change itself is not incorporated in these concerns. As in the previous project, climate change could have changed the economic analysis of the protective works slightly, by changing the frequency of a certain level of cyclone, so that a certain level of protection will yield higher returns by avoided losses. However, the short return period that seems economically optimal may also indicate that climate change considerations would have little impact yet on economically optimal physical protection. However, as time progresses and climate change accelerates, climate change considerations will become more and more important.

Conclusions

This project provides protection against climate risks, and therefore helps to decrease the country's vulnerability to the current climate, and presumably therefore also to climate change. Some concerns are voiced about the risk that physical protection measures against a certain level of cyclones could result in a deceptive feeling of safety, leading to behavior that actually increases vulnerability to bigger events.

Even though it was dealing with climate damage, the project did not list climate as a major risk. Even after a second cyclone caused additional devastation, this risk still was not mentioned. However, there may be higher

awareness now, considering that a follow-up project does list cyclones as a major risk, along with the regular economic and implementation risks.

The economic analysis of the follow-up project, but also the judgements on optimal protection in the previous project resulted in protective measures for 10-20 year events. Considering the low level of the current optimal protection, climate change considerations, which were not included at all, probably would have made little difference.

Notes

5. The fact that the electricity generation by hydropower instead of fossil fuels may contribute to climate change mitigation is not mentioned either.
6. World Bank El Niño Drought Response Project, Technical Annex to the Memorandum of the President, February 24, 1998 (e.g., in February 1998, 20 percent of the population in the Northern Province, which includes Oro, suffered from severe food scarcity due to droughts).
7. According to Glantz (1996):"Palm Oil production in the Philippines declines during El Niño events, which tend to spawn droughts in the region. As a result, commodity brokers who wish to purchase palm oil at low prices must find other sources of palm oil, for instance in West-Africa. If they wait until the full effects of El Niño are felt, the price of palm oil will likely have increased due to reduced supplies from the Philippines. In fact, even the hint of the onset of an El Niño could be of value to these decisionmakers."

Appendix B — Country Studies

B.1 Introduction

This appendix presents the country studies discussed in Chapter 3. It discusses the selection, methodology, and then the country descriptions.

B.2 Country selection

The countries were selected by three criteria. First, we looked for countries with interesting modalities of vulnerability. Second, we wanted different geographical regions to be represented. Third, we tried to use countries that were relatively well documented. This lead to the choice of Bangladesh, Ecuador, Guyana, Papua New Guinea, Samoa, and Zimbabwe.

B.3 Method of analysis/survey

Our analysis consisted of three parts. First, a rough assessment of the country's vulnerability (sensitivity and adaptive capacity); second, an assessment of the World Bank lending portfolio in the country with respect to climate vulnerability; and finally, the attention paid to these issues in the World Bank's CAS.

First, we tried to assess the vulnerability of various countries, without going into technical detail. Obviously, since vulnerability involves many detailed technical issues, this is very difficult. Nevertheless, it is possible to say something about the vulnerability of a country on the basis of more general observations. As described by IPCC (1998), vulnerability is a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given change in climate, including both beneficial and harmful effects), and the ability to adapt the system to changes in climate (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of the opportunities created, due to a given change in climate). Under this framework, a highly vulnerable system would be one that is highly sensitive to modest changes in climate, and one for which the ability to adapt is severely constrained. The level of a country's adaptive capacity is determined by many factors, such as a country's wealth, structure of the economy, and level of education and health care. These issues are discussed in the Sections 2 and 3 and reflected in table 3.2.

Second, we assessed the importance of climate vulnerability in the World Bank lending portfolio in the various countries. For the lending portfolio in the past three years (1997–99) and, to reflect longer term changes, five years ago (1994), we determined which projects could be vulnerable to climate change, and which projects were relevant to climate change.

The first category consists of only those projects that could result in direct physical vulnerabilities, e.g., developing infrastructure near the coast, building a big hydropower plant in a river that may become dryer, or switching to vulnerable crops.

The second category are those projects that could directly contribute to adaptation to climate variability or change. Those projects

may or may not be directly vulnerable to climate change, but can be used to reduce physical vulnerabilities by incorporating climate change considerations in their design. For example, an agricultural research project, while not vulnerable itself, could be modified slightly to include climate change considerations and prepare the country's agriculture sector for changing climatic conditions by developing drought resistant crops rather than just aiming for larger outputs. Similar issues apply for many technical assistance projects (e.g., for irrigation and drainage), which are not vulnerable themselves, but can have significant impacts on the country's vulnerability. The share of this second category of projects in a country's portfolio gives an indication of the extent to which climate change considerations could be included to improve the development benefits of the World Bank's projects.

We limited this category to those projects that directly contribute to physical vulnerability reduction. Projects that reduce vulnerability by increasing general adaptive capacity, such as education or health projects, were not included because climate change considerations would not change their design. In fact, such a broad definition would include almost all projects, considering that all good economic development will boost adaptive capacity and thus decrease vulnerability (as long as this increase in general adaptive capacity is not offset by direct increases in vulnerability).

In both these categories (vulnerability and relevance to climate change issues), we rated all projects in the countries' portfolios as either y, p+, p- or n, indicating sure, presumably yes, presumably not, and not. To generate the percentages of vulnerable and relevant projects (based on numbers of loans and amounts committed), we combined y and p+, and n and p-. There is some measure or arbitrariness in these totals, for several reasons. First, our judgments are based on a summary assessment of the underlying projects. Second, we judged projects as vulnerable or relevant based on just the most vulnerable or relevant project component, although the project may have components that are not vulnerable or relevant to climate change. In that sense, the numbers are high estimates of the importance of climate issues in the World Bank's portfolio. On the other hand, we have been fairly conservative by limiting relevance to climate change issues just to physical vulnerability rather than also including related issues like health consequences.

Third, to assess the attention of the World Bank to issues of climate vulnerability, we looked at the various Country Assistance Strategies (CASs). These documents reflect the World Bank's continuing dialogue with and assistance to a particular country. We examined whether the CAS mentioned vulnerability to climate variability and climate change, whether these issues were considered important, and how they were addressed.

B.4 Bangladesh

By any measure Bangladesh is one of the most vulnerable countries in the world to extreme climatic events. Much of the national territory is on the flood plain lands of the Ganges-Brahmaputra delta, and in addition there are large areas of low lying coastal lands that are periodically inundated by the sea water driven inland by cyclonic storms tracking up the Bay of Bengal. Furthermore, the country is very densely populated, and many of its resources (ports, tourist facilities, shrimp farms, agricultural areas) are on the coast. Inland, the country is plagued by droughts and water shortages. Much of this hazard land is densely populated by low income people engaged in subsistence agriculture; GNP per capita is only 360 dollars, and agriculture provides employment for 63 percent of the workforce. Illiteracy is high and child mortality and malnutrition are widespread. Life expectancy is only 58 years. Floods and tropical cyclones are a severe threat to present day development.

Droughts are also a recurrent problem. Any further increase in the incidence of these natural hazards could only have severe repercussions for Bangladesh

The World Bank is heavily involved in Bangladesh with over $6 billion of outstanding IDA credits. The 1999 portfolio consisted of 25 credits worth US$2.8 billion. We estimate that some 45 percent of these projects by value, including, e.g., transport infrastructure, water/ sanitation, river bank protection and coastal embankments, is directly at risk from climate change, and that climate change is a consideration for up to 53 percent (by value) of the existing projects, additionally, including agricultural research and a municipal services project dealing with infrastructure planning and management.

Given the severity of the situation facing Bangladesh it is not surprising that the CAS addresses climate vulnerability, mainly by providing assistance with disaster forecasting and preparedness, and including these concerns in water and land management projects. The Country Brief, issued after the high toll of weather-related disasters in 1998, states;

> *"As the unprecedented and sustained flooding in 1998 has shown, Bangladesh is highly vulnerable to devastating cyclones and floods, which, combined with high population densities, make the damage and loss of life from natural disasters particularly great. (...) Since Bangladesh is highly vulnerable to natural disasters, environmental issues are a high priority in the Bank's assistance strategy."*

The climate change risk in Bangladesh is among the highest in the world because the country already severely disadvantaged in terms of physical vulnerability, socioeconomic vulnerability and low adaptive capacity. Bangladesh therefore is an appropriate country in which to carry out further climate change work, and must be a high on the list of candidates for assistance in the strengthening of adaptive capacity. It is encouraging, therefore, that Bangladesh is one of the few countries where a specific climate change vulnerability and adaptation study is underway (which should become available in the fall of 1999). Additionally, a follow-up project to the Coastal Embankment Rehabilitation Project (discussed in the project section of this report) will include climate change considerations, and steps have already been taken to incorporate climate change issues in an Integrated Coastal Zone Management Project and in Bangladesh's National Water Management Plan (funded through a Bank project on River Bank protection), both now in their initial phases.

B.5 Ecuador

Because Ecuador is mostly mountainous, and the most highly developed part is in the high plateaus and intermountain valleys of the interior, the extent of vulnerability to sea level rise and coastal storms is much less than in Bangladesh. However, together with Peru, Ecuador bears the brunt of the El Niño phenomenon and in 1997/98 suffered approximately US$2.5 billion direct structural losses due to floods (NOAA Office of Global Programs, 1999). In non-El Niño years droughts and forest fires have occurred with increased frequency, and there are also increased health risks from climate change as the diseases endemic in the coastal zone and the Amazon region threaten to expand to higher elevations where more people live.

In contrast to these physical vulnerabilities Ecuador has a relatively high per capita income, and rates of illiteracy, child mortality and malnutrition are low. Agriculture accounts for only 12 percent of the Ecuador economy. Ecuador is perhaps in a better starting position therefore to adapt to climate change than many other developing countries.

Ecuador's total debt to the World Bank group is almost US$900 million, most of it to IBRD. The FY99 portfolio consisted of 17 projects totaling US$672 million An examination of the World Bank Group's investments in Ecuador suggests that in 1999 about 30 percent (by value) of the projects could be vulnerable to climate change, including transport infrastructure and flood control projects, and that climate change is relevant to some 42 percent (by value) of the loans, additionally including agricultural research and irrigation technical assistance (both percentages have increased during the last five years).

Neither the CAS nor the Country Brief mention the risks of climate change or variability, although in the case of one hydro-power plant drought risk is mentioned. Given the recent history, Ecuador is clearly vulnerable to the weather extremes associated with the El Niño phenomenon and since there is a concern that such events may be increasing in frequency and intensity with climate change there is a strong case for increased attention to the risks.

B.6 Guyana

Guyana is a member of CARICOM, and while it is not an island state, it shares many of the vulnerabilities to climate change with other Caribbean countries. It has a vulnerable coastline, currently protected by an extensive system of rigid sea defenses. Its populated coastal zone (containing 90 percent of the population) consists largely of polders, low-lying areas of land encircled by embankments to prevent flooding. Protection costs would be very high. Furthermore, Guyana suffers from climate variability as well. Its capital, Georgetown, suffers from frequent floods and flash floods are a constant threat during the rainy season (twice a year). El Niño impacts can lead to both floods and droughts.

Guyana has a GNP of 800 dollars per capita, and while illiteracy is very low (2 percent), life expectancy is only 64 years, infant mortality 58/ thousand and child malnutrition 18 percent. Furthermore, agriculture accounts for a large share, 39 percent, of the economy. These numbers indicate that Guyana's adaptive capacity may be quite low compared to its sensitivity to climate change.

Guyana has loans from the World Bank Group for about US$240 million, most of from IDA. In FY99, the portfolio consisted of six projects for a total amount of US$85 million. Both the number and the total amount of projects has been going down over the past five years. We estimate that in fiscal year 1999, about 62 percent of the portfolio, by value, is vulnerable to climate change. In the years before that it used to be between 20 and 40 percent. The main reason for this change is the completion of a couple of non-vulnerable loans and the initiation of an El Niño Emergency loan. Other possibly vulnerable projects are a sewerage and a transport infrastructure project. There are no project that are not vulnerable but that do should nevertheless incorporate climate change concerns.

The 1996 Guyana Country Brief does not mention climate variability or climate change at all. A May 1994 National Environment Action Plan (NEAP) however, recognizes frequent flooding of the coastal plain, with all its consequences, as the major environmental problem, and "appeals to the donor community for a program of environmental mitigation and prevention in the coastal zone to address public health issues that have reached crisis proportions." Sea level rise due to climate change is explicitly mentioned as a serious threat. For these reasons, Guyana is participating in the CARICOM vulnerability and adaptation assessment project, funded by GEF and executed by the Organization of American States (OAS).

B.7 Papua New Guinea

PNG mainly consists of mountainous terrain. However, its very long coastline, and some

coastal lowlands, make it quite sensitive to sea level rise. Additionally, PNG is plagued by floods, cyclones, and droughts, some related to El Niño. GNP per capita is US$930. Illiteracy stands at 19 percent for men and 27 percent for women. Life expectancy is 58 years, child malnutrition is 30 percent and the infant mortality rate 61/thousand. Only 28 percent of the population has access to safe water. PNG is vulnerable to climate change both due to its sensitivity and its poor adaptive capacity.

PNG has outstanding credits and loans worth some US$375 million. In FY99, there are six ongoing projects totaling US$106 million. We estimate that two projects of the 1999 portfolio, 30 percent by value, could be vulnerable to climate vulnerability considerations, including an El Niño emergency assistance project and the Oil Palm project discussed above. No additional projects are only relevant but not vulnerable to climate change.

Despite the country's high vulnerability to climatic disasters, the CAS does not consider vulnerability to either climate variability or climate change. It only focuses on pure economic risks, like changing oil prices. However, the 1998 Country Brief, issued just two years later, does mention that

> *"The severe El Niño-induced drought of 1997 and depressed commodity prices (...) have adversely affected production and exports while raising imports."*

Still, the Country Brief does not indicate any Bank efforts to address PNG's vulnerability.

B.8 Samoa

Samoa consists of a group of islands in the South Pacific Ocean, about half way from Hawaii to New Zealand. It is very small, about 2,860 square kilometers, and its inhabitants live mostly on the narrow coastal plain. The interior consists of volcanic, rugged mountains. Apart from the risk of sea level rise to its relatively long coastline, Samoa may suffer from increased intensity or frequency of the already recurring cyclonic storms. Some other Pacific Islands are less mountainous but consist of low-lying atols, and are thus at even higher risk from sea level rise.

Samoa has a GNP/capita of $1,140. Life expectancy 69 years, and infant mortality (22/thousand) and illiteracy (3 percent) are both relatively low. Although in terms of adaptive capacity, these figures compare favorably with many other developing countries, Samoa and the other Pacific Island States are very vulnerable due to their high sensitivity to climate change, particularly sea level rise.

Considering Samoa's small size, and its correspondingly small World Bank portfolio, we examined the portfolio for all Pacific Island States together to examine the importance of climate change. Although there are many differences, these states share many of the same vulnerabilities to climate change. That portfolio is limited to 5 projects worth about US$56 million (in FY99). Of these project, three, or 56 percent by value, are possibly vulnerable to climate change, two housing and one road project (once again, we only discuss possible vulnerabilities; the actual vulnerability depends on the exact the location of the investment and nature of the impacts).

Considering this possible vulnerability, and the vulnerability of the countries as a whole, climate change ought to be a major consideration in Bank work in the region. However, most Pacific Island Nations are so small that the scope for Bank lending is also limited. Consequently, no separate CASs are prepared and the Bank's assistance strategy is by and large outlined in the periodic Regional Economic Reports (RERs). Encouragingly, climate vulnerability and adaptation is a major topic in the RER for the year 2000, which is currently being prepared.

B.9 Zimbabwe

Zimbabwe, being landlocked, is safe from sea level rise. However, other impacts of climate change may have serious consequences. The country already suffers from recurring droughts and occasional floods and storms. Small changes in precipitation could have serious consequences for its hydrology, including agriculture, water supply and hydropower.

With a GNP per capita of US$720, Zimbabwe is better off than many other African countries. Agriculture comprises 18.3 percent of the economy and employs 27 percent of the labor force. Average life expectancy is 52 years, child malnutrition 16 percent and infant mortality 55/thousand. Currently, only 36 percent of the population has access to safe water. Illiteracy stands at 15 percent. All these figures indicate a low adaptive capacity.

Zimbabwe has borrowed almost US$900 million, divided between IDA and IBRD. In FY99 there were 10 projects for a total amount of US$512 million. Due to the changing nature of the portfolio, vulnerability to climate change effects has gone down dramatically, from 26 percent by value in 1994, including hydropower, transport infrastructure and irrigation and drainage projects, to zero in 1999. The main reason is the switch from large power and infrastructure projects to projects dealing with, e.g., enterprise and community development . However, considerations of climate change remain possibly relevant to about 17 percent of the project value, including projects dealing with urban development and agricultural services and management.

The CAS does mention vulnerability to climate variability, particularly the recurring droughts:

> *"...drought-proofing the economy is essential for reducing the variability of the country's growth and its impact on poor households in rural areas."*

A large number of actions are proposed to accomplish this. Although climate change is not explicitly mentioned, the drought prevention and mitigation programs will probably address many of the most immediate climate change concerns.

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