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DEVELOPMENT AND CLIMATE CHANGE PROJECT:

CONCEPT PAPER ON SCOPE AND CRITERIA FOR CASE STUDY SELECTION

by
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FOREWORD

This document is an output from the OECD Development and Climate Change project, an activity being jointly overseen by the Working Party on Global and Structural Policies (WPGSP), and the Working Party on Development Co-operation and Environment (WPENV). The overall objective of the project is to provide guidance on how to mainstream responses to climate change within economic development planning and assistance policies, with natural resource management as an overarching theme. Insights from the work are therefore expected to have implications for the development assistance community in OECD countries, and national and regional planners in developing countries.

This document, written by Shardul Agrawala and Martin Berg, outlines the analytical framework that was used to establish case studies for the project. It is therefore an interim product that is intended to guide early thinking on the work. The products that eventually emerge from the process may ultimately differ in both scope and content from the orientations described herein.

In addition to delegates to the above-mentioned Working Parties, the authors would like to thank Jan Corfee-Morlot, Tom Jones, Georg Caspary, and Remy Paris of the OECD Secretariat for their comments on earlier drafts.

The paper does not necessarily represent the views of either the OECD or its Member countries. It is published under the responsibility of the Secretary General.

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EXECUTIVE SUMMARY

This document outlines the analytical framework for an OECD project on Development and Climate Change. A three-tier framework is also described for the project case studies that will provide a country-level overview of principal climate change impacts and vulnerabilities, followed by an in-depth analysis at a sectoral or regional/local level on how climate responses could be mainstreamed into particular development policies and projects. The primary emphasis of the case studies will be on adaptation responses, although one or more case studies may also examine mitigation responses that relate to natural resource management.

1. INTRODUCTION

This paper provides the scope, analytical framework, and criteria for selection of case studies for an OECD project on Development and Climate Change. A starting point for the project is that development and climate change policies imply a two-way relationship: choices about development pathways influence climate change as well as the vulnerability of societies to climate change impacts; on the other hand, climate change impacts could influence the rate and level of economic development itself. Examining such linkages would also reinforce understanding about sustainable development – both before the World Summit on Sustainable Development (WSSD) and after.

The overall objective of the project is to provide guidance on how to mainstream responses to climate change within economic development planning, with natural resource management as an overarching theme. There is a particular emphasis on implications for the development assistance community – particularly the Development Assistance Committee (DAC) of the OECD, as well as for national and regional planners in developing countries. As further elaborated in Section 2, the primary focus of the project is on adaptation responses to climate change, although one or more case studies may also examine linkages between mitigation and economic development planning.

The overall objectives of the project will be accomplished through (three to six) country case studies that will:

- Review the principal impacts and vulnerabilities to climate change for the case study country, drawing upon information from international and national assessments.

- Identify national development and environmental plans as well as donor funded projects that bear upon sectors and regions vulnerable to climate change impacts, and assess the degree of current attention to climate change in such plans and projects.

- Conduct one or two in-depth analyses at a thematic, sectoral, regional or project level within each country. This could for example include an assessment of the trade-offs involved in integrating specific anticipatory adaptation measures, such as the modification of infrastructure projects with long life spans to incorporate projected changes in climate. Linkages between regulatory adaptation and development planning could also be examined, for example the costs and benefits involved in altering policies that might otherwise increase the vulnerability to climate change.

The remainder of this paper is organized as follows. Section 2 clarifies key issues concerning the project scope that have emerged from the literature review and feedback from member governments. The framework for analysis is described in Section 3. Section 4 discusses some principles for case study selection, and provides a list of potential case study countries.

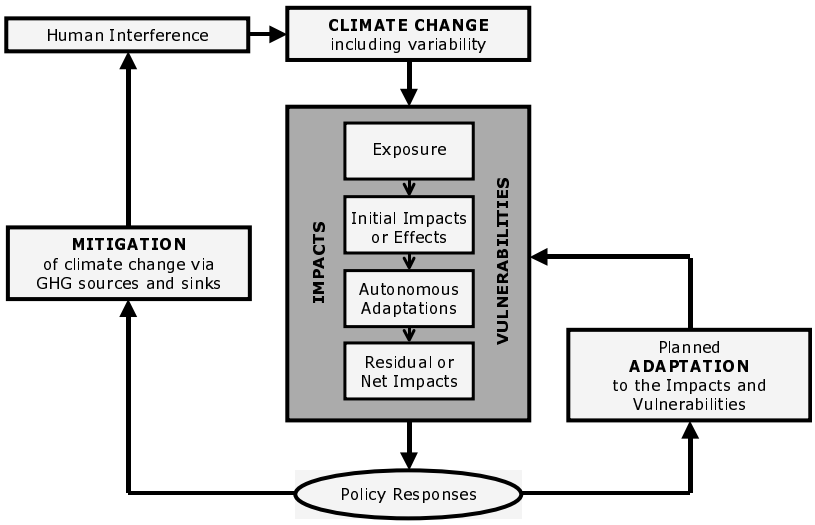
2. KEY ISSUES REGARDING PROJECT SCOPE

This project seeks to build upon, and not duplicate, established efforts such as the climate change impact and vulnerability assessments of the Intergovernmental Panel on Climate Change (IPCC). The national level will be used as the unit of analysis, although in-depth assessment of particular response strategies will also require examination at the sectoral, regional and/or local level. The case studies will include a spectrum of countries in terms of their level of development as well as their vulnerability to climate impacts. In addition, two issues have emerged that require further clarification with regard to the precise scope of the case studies.

2.1 Mitigation and adaptation responses

There are two generic forms of responses to climate change: mitigation and adaptation (Figure 1). Mitigation responses seek to limit climate change through reduction in net greenhouse gas emissions. There are important synergies between economic development planning and mitigation, particularly in the energy sector. These linkages are already the focus of considerable research and analysis, and were also examined in the pilot phase of this project. Adaptation responses meanwhile include biological, technical, institutional, economic, behavioral and other adjustments that reduce vulnerability to the adverse impacts of anticipated climate change (Huq 2002). Effective responses to climate change require an integrated portfolio of responses that that includes both mitigation and adaptation. The primary focus of the case studies in this project however will be on adaptation. One or more case studies may also examine linkages between economic development planning and natural resource management issues that relate to mitigation.

Figure 1. **Mitigation and adaptation responses to climate change (IPCC 2001b)**



Adaptation strategies can be further classified as reactive or anticipatory, depending upon when they are initiated. Both natural and human systems undertake adaptation – although only human systems can engage in anticipatory adaptation. Within human systems, adaptation can be further classified in terms of whether the actions are undertaken by private or public agents (Figure 2). This project will focus on anticipatory adaptation to climate change, primarily by public agents. This narrowing in scope is necessary, given the resources available for the case studies. However, case studies may also give consideration to how economic development planning and assistance might use the forces of the private sector to promote adaptation, and mitigation where appropriate.

Figure 2. **Typology of adaptation responses (IPCC 2001b)**

		Anticipatory	Reactive
Natural Systems			· Changes in length of growing season · Changes in ecosystem composition · Wetland migration
Human Systems	**Private**	· Purchase of insurance · Construction of house on stilts · Redesign of oil-rigs	· Changes in farm practices · Changes in insurance premiums · Purchase of air-conditioning
	Public	· Early-warning systems · New building codes, design standards · Incentives for relocation	· Compensatory payments, subsidies · Enforcement of building codes · Beach nourishment

2.2 Climate variability and anthropogenic climate change

A second set of issues revolves around whether the project would focus on responses to reduce vulnerability to current climate variability or planning responses that specifically address anthropogenic climate change. Human and natural ecosystems have sought to adapt both to climate averages (through diversity in clothing and lifestyles), as well as significant departures from these averages, such as those experienced every few years as a result of the El Niño Southern Oscillation (ENSO). The ENSO signal and impacts are particularly severe in the tropics and extra-tropics that are also home to much of the developing world (Ropelewski and Halpert 1987). It is upon these naturally occurring fluctuations that human activity has now superimposed a relatively recent trend of anthropogenic climate change. The Third Assessment of the IPCC concludes that some of the impacts of anthropogenic climate change on human and natural systems are already discernible, while still others are expected to become more evident with time, as the climate change signal emerges from the background of natural climate variability (IPCC 2001b).

There has been growing recognition in recent years that adaptation responses to climate change and climate variability are indeed linked (Agrawala and Cane 2002). Adapting to current climate fluctuations is already sensible in an economic development context, given direct and certain evidence of adverse impacts of such phenomena. Such adaptations are also likely to enhance resilience of societies to cope with many adverse impacts of climate change, as many human induced changes in climate will manifest themselves through enhanced or altered climate variability. However, there is already a wealth of accumulated knowledge as well as several ongoing projects that examine short-term responses to climate fluctuations across regions, sectors, and spatial scales. These initiatives include a cadre of several hundred researchers, government agencies, specialized seasonal climate prediction and forecast application

institutions, as well as international food security, disaster management, and development aid agencies[1]. The enhancement of societal capacity to cope with current climate risks resulting from such efforts will doubtless contribute to the ability of societies to cope with the additional risks that might be posed by anthropogenic climate change.

It would nevertheless be premature to preclude – without adequate analysis – the possibility that anthropogenic climate change might also require forward looking investment and planning responses that go beyond short-term responses to current climate variability. Not all climate changes are uncertain at the spatial and temporal scales at which planning decisions are made. While climate projections of precipitation and streamflow tend to be highly uncertain (particularly at high spatial resolution), temperature and sea level rise are two variables where climate change trends are more secular and robust. Even in the absence of a clear precipitation signal, temperature increase alone can have wide ranging impacts, from permafrost melt in high latitudes to the melting of tropical glaciers to reduced water-use efficiency of rivers and irrigation systems, particularly in semi-arid areas. Permafrost melt and the melting of tropical glaciers have already been documented. Mount Kilimanjaro in fact is expected to lose all of its snow cover by as early as 2015 (Thompson 2001). Furthermore, not all decisions made during the normal course of economic development are short term and therefore out of step with responses to climate change. In fact, many routine investment and infrastructure decisions leave a footprint for several decades or more. This might include infrastructure related to housing or gas pipelines in the Arctic tundra that might be vulnerable to permafrost melt; investments related to coastal infrastructure, tourism, and wetland protection that might need to account for sea level rise; and planning for water supply, irrigation and hydropower power systems that might be critically dependent on snow melt from tropical glaciers.

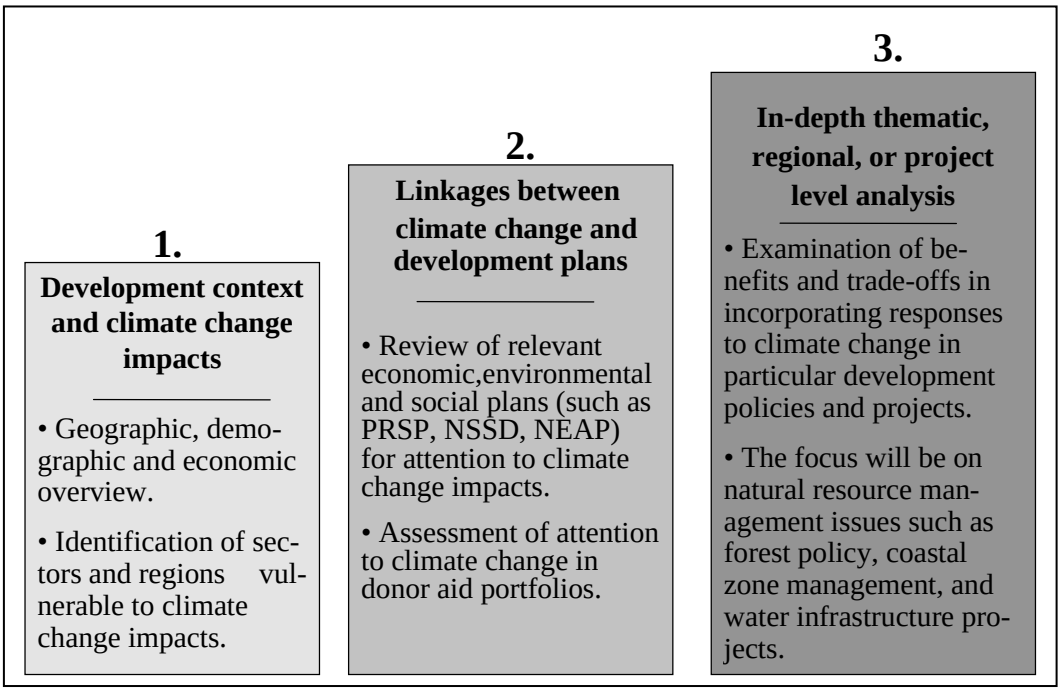
This project therefore takes as its focus the linkages between economic development planning and climate responses over the medium term, from several years to a few decades. This includes: (i) development policies and projects that have a "locked-in"character, in that they might enhance or constrain the ability of societies to cope with climate variability and change over the medium term; and (ii) new planning responses that might be necessitated to cope with the impacts of climate changes that might manifest themselves in the coming years, such as sea-level rise, melting of tropical glaciers, increasing temperatures, and changes in precipitation and streamflow. The results are likely to have relevance for OECD governments in their development assistance activities, as well as for the development planners in countries where case studies will be conducted.

[1] For a review of ongoing initiatives, see *Coping with Climate* (IRI 2001), and *An Experiment in the Application of Climate Forecasts* (NOAA-Office of Global Programs 1999).

3. FRAMEWORK FOR ANALYSIS

The overall unit of analysis will be at the national level, although analysis of particular adaptation responses will have a sectoral or regional/local focus. Climate change impacts and vulnerabilities do not follow political boundaries, but economic planning, development assistance, and adaptation responses typically do. It is proposed to base the analysis on case studies, each with a three-tier format (Figure 3). The first tier will provide a contextual (geographical, demographic, economic) overview, and summarize available knowledge on climate change impacts and vulnerabilities for the country. This synthesis will draw upon IPCC assessments; reports produced under the UNEP, US, and the Dutch country studies programs; national communications to the UNFCCC; and research articles. A number of countries, particularly many least developed countries are lacking in such assessments and will therefore not be included among the case studies. This may limit the generalizability of case study findings. Within each case study country, the focus will be on parameters and regions where the climate change signal is more robust.

Figure 3. **Three-tier framework for case studies**



The second tier will review relevant economic, environmental and social plans as well as multilateral and development assistance portfolios to assess the extent to which concerns related to climate change impacts are reflected in such documents. Synergies and trade-offs involved in better integration of

climate responses in such plans will be examined. National policies could include multi-year economic plans, Poverty Reduction Strategy Papers, National Strategies for Sustainable Development, and National Environmental Action Plans. Evaluation of development assistance portfolios meanwhile will build upon three recent efforts. The first was an analysis by Burton and van Aalst (1999) on "Integrating Climate Change Vulnerability and Adaptation into (World) Bank Work". A second analogous study by Klein (2001) examined "Adaptation to Climate Change in German Official Development Assistance". Both these studies examined a cross-section of projects across countries and did not explicitly examine the state of knowledge on climate change impacts and vulnerabilities in the region to assess whether there was enough certain knowledge to incorporate adaptation concerns in project planning. The third study, a World Bank analysis on "Bangladesh: Climate Change and Sustainable Development" has a country focus and examines climate change impacts, adaptation options, and whether or not they were being incorporated in relevant development projects (World Bank 2000). In terms of scope, this analysis is most directly related to the present project.

The project will examine the extent to which climate change issues are taken into account in development assistance portfolios across principal donors for the case study country. Previous studies were limited to only one donor. Information available from the OECD-DAC will be used to identify principal donors and their portfolios for particular countries. For illustration, Figure 4 shows the break-up of Official Development Assistance for Bangladesh.

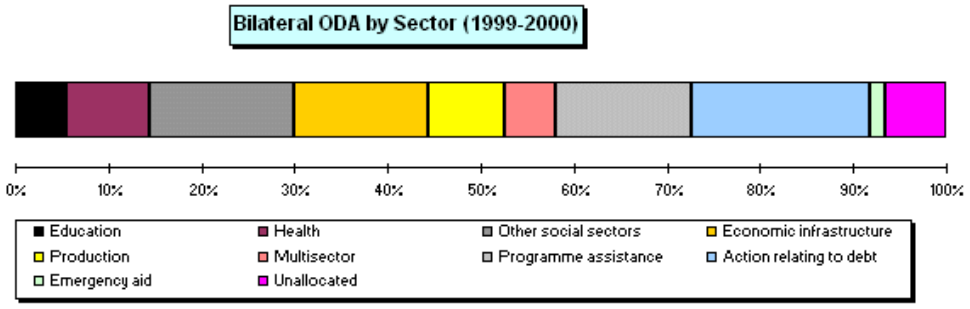
Figure 4. **Sources and portfolio of development assistance flows to Bangladesh**

Bangladesh

Receipts	1998	1999	2000
Net ODA (USD million)	1 263	1 215	1 172
Bilateral share (gross ODA)	50%	48%	51%
Net ODA / GNI	2.8%	2.6%	2.4%
Net Private flows (USD million)	150	- 105	53

For reference	1998	1999	2000
Population (million)	125.6	127.7	129.8
GNI per capita (Atlas USD)	360	370	380

Top Ten Donors of gross ODA (1999-2000 average)	(USD m)
1 IDA	385
2 JAPAN	354
3 AS. D B SPECIAL FUNDS	267
4 UNITED STATES	110
5 UNITED KINGDOM	104
6 EC	66
7 GERMANY	42
8 DENMARK	38
9 NETHERLANDS	34
10 CANADA	34



Source: OECD/World Bank.

In addition to looking at one donor, existing studies have also largely restricted themselves to observations of whether or not mention is made of climate change responses in project documents. More detailed analysis is necessary to explore exactly *how* such concerns can be better incorporated in development planning.

The third and final tier will therefore consist of one or two in-depth thematic, regional, or project level analyses within each country that systematically examine the benefits and trade-offs involved in incorporating climate responses within economic development planning. The project will also draw upon other ongoing initiatives, including the National Adaptation Programs of Action (NAPAS), the Adaptation Policy Framework that is currently being developed by UNDP-GEF (2002), as well as a set of guidelines on how to incorporate adaptation into development policies and projects in Pacific Island States (Campbell and de Waet 2000).

At a more generic level, Titus (1990) has proposed the following criteria to consider when evaluating potential responses to climate change[2]:

- *Economic efficiency*: Will the initiative yield benefits substantially greater than if the resources were applied elsewhere?
- *Performance under uncertainty*: Is the strategy reasonable for the entire range of anticipated changes in climate?
- *Urgency*: Would the strategy be successful if implementation were delayed 10 or 20 years?
- *Cost:* Does the strategy require minimal resources?
- *Equity:* Does the strategy avoid the problem of unfairly helping some at the expense of others regions, generations, and economic classes? Does it give people ample time to adjust?
- *Institutional feasibility*: Is the strategy acceptable to the public? Can it be implemented under existing institutions and laws?
- *Unique or critical resources:* Would the strategy decrease the risk of losing unique environmental or cultural resources?
- *Consistency:* Does the policy support other national, state, community, or private goals?

Exploring answers to such questions necessarily requires a diversity of tools and approaches. The choice of a particular approach must await the specifics of particular case studies and consultation with project partners who will be engaged in implementing them. At its most descriptive this could for example involve a case study on the trade-offs faced by a country in incorporating adaptation or particular mitigation concerns within its land-use and forestry plans and policies. More analytically rigorous tools could be employed when looking specific scenarios for climate change impacts, screening of relevant adaptation options, and the costs and benefits associated with incorporating different adaptation responses within economic planning. A listing of potential tools and methods is provided in Box 1.

[2] An additional criterion could examine whether there are benefits or trade-offs to adding greenhouse gas mitigation action, where relevant along with the adaptation responses under evaluation.

Box 1. **Tools and methods**

1. Cost Benefit Analysis (CBA)
Cost Benefit Analysis (CBA) is one well-known example of a single valued approach, which seeks to assign economic values to the various consequences of a proposed activity. The resulting costs and benefits are combined into a single decision making criterion like the net present value (NPV), internal rate of return (IRR), or benefit-cost ratio (BCR). Useful variants include cost effectiveness, and least cost based methods. Both benefits and costs are defined as the difference between what would occur *with and without* the project being implemented. The economic efficiency viewpoint usually requires that shadow prices (or opportunity costs) be used to measure costs and benefits. All significant impacts and externalities need to be valued as economic benefits and costs. However, since many environmental and social effects may not be easy to value in monetary terms, CBA is useful mainly as a tool to assess economic and financial outcomes.

2. Cost Effectiveness Analysis (CEA)
Cost Effectiveness Analysis (CEA) is another example of a single valued approach and identifies the least-cost measure for achieving a specific goal. CEA is particularly useful when benefits can not be explicitly valued. The most widespread application to the climate change problem is perhaps where one seeks to identify the least-cost option to achieve given levels of GHG emission reductions, without any explicit attempt to specify what the *benefits* of the level of emission reduction may be.

3. Multi-Criteria Analysis (MCA)
Multi-Criteria Analysis (MCA) or multi-objective decision making is particularly useful in situations when a single criterion approach like CBA falls short – especially where significant environmental and social impacts cannot be assigned monetary values. In MCA, desirable objectives are specified and corresponding attributes or indicators are identified. Unlike CBA, the actual measurement of indicators does not have to be in monetary terms. In other words, different environmental and social indicators may be developed, side by side with economic costs and benefits. Thus, more explicit recognition is given to the fact that a variety of both monetary and non-monetary objectives and indicators may influence policy decisions. MCA provides techniques for comparing and ranking different outcomes, even though a variety of indicators are used.

4. Sustainable Development Assessment (SDA)
Sustainable Development Assessment (SDA) is an important tool to ensure balanced analysis of both development and sustainability concerns. The 'economic' component of SDA is based on conventional economic and financial analysis (including cost benefit analysis, as described earlier). The other two key components are environmental and social assessment (EA and SA) – see for example World Bank (1998). Poverty assessment is often interwoven with SDA. Economic, environmental and social analyses need to be integrated and harmonised within SDA. Since traditional decision making relies heavily on economics, a first step towards such integration would be the systematic incorporation of environmental and social concerns into the economic policy framework of human society.

5. Decision Analytic Tools
Decision Analytic Tools focus expressively on how to make decisions under conditions of uncertainty. There are a number of sector specific or integrated decision support techniques, methodologies, spreadsheets, and computer-based tools that are relevant for this stage of analysis, like the decision matrixes (DM) which have been proposed by Benioff and Warren (1996) as well as by Smith (1996). Respectively Smith, Ragland and Pitts (1996) developed a DM to screen and select for climate change adaptation options in Water Resource Management and Forestry, although both examples are hypothetical. Two among many computer based packages include Coastal Resources Management Role-play (CORONA) that examines adaptation within the broader context of coastal zone management (Rijsberman et. al. 1995), and Tools for Environmental Assessment and Management (TEAM) that helps evaluate issues such as equity and flexibility when screening for adaptation options (Smith et al. 1996).

6. Action Impact Matrix (AIM)
The Action Impact Matrix (AIM) proposed by Munasinghe and Cruz (1995) and Munasinghe (2002) is a special type of decision analytic tool to evaluate economic, environmental and social interactions of various policies by a multi-attribute scoring system. The AIM approach can help identify 'win-win' policies and projects, which not only achieve conventional macroeconomic objectives (like growth), but also make local and national development efforts more sustainable. With respect to climate change, the approach can identify central intersections between development efforts and climate change issues like vulnerability, impacts and adaptation. AIM itself promotes an integrated view, meshing development decisions with priority economic, environmental and social impacts. Usually, the rows of the table list the main development interventions (both policies and projects), while the columns indicate key sustainable development issues and impacts (including climate change vulnerability). AIM could potentially help identify development paths that embed national climate change policies in the overall sustainable development strategy.

4. PRINCIPLES FOR CASE STUDY SELECTION

Selection of case study countries is contingent upon scientific, socio-political, and pragmatic considerations. From a scientific perspective, a primary consideration is to select countries that are likely to be adversely impacted by reasonably robust signals in climate change. This includes sea level rise and temperature increases along with associated first and higher order impacts on natural systems that include coastal inundation, loss of wetlands and agricultural land, melting of permafrost and tropical glaciers, and reduced water use efficiency. Sensitivity of systems to changes in precipitation will be considered where there is reasonable confidence in such projections across ensemble runs from various climate models.

From a socio-political perspective, the choice of case study countries will include a spectrum from low- to middle income countries, given the focus of this project on climate change and economic development. Economic development is viewed as a continuum and not as a state, and so the project scope is not limited to least developed countries. Given the focus on long-term planning, case study countries will also be screened for stable governance and economies; pre-existence of long term economic, social, and environmental planning initiatives; as well as reasonably strong institutions that might facilitate the translation of such long-term plans into action.

Finally, there are a number of pragmatic considerations, including the project budget, a time frame of about one year between initiation and completion of case studies, as well as the institutional context of the OECD under which these case studies will be conducted. Pre-existence of extensive national and sub-national information on climate change scenarios and potential impacts and vulnerabilities is therefore critical. Synergies with ongoing or recently completed projects will be an added advantage. This is also related to the identification of qualified researchers and institutions to partner with in the implementation of the case studies.

Between three to six national case studies are envisaged as part of this project. A preliminary scoping analysis, relying largely on scientific (and to some extent socio-political) criteria, has led to the identification of sixteen countries. As shown in Table 1, this initial shortlist encompasses considerable diversity in location, size, incomes and development contexts. There is also scientific basis for projections of significant climate change that go beyond impacts experienced from current climate variability. Peru and Tanzania have tropical glaciers that are expected to disappear in the coming decades with attendant impacts on natural ecosystems, agriculture, water supply, and hydropower. Many countries have high vulnerability to sea-level rise – from small island states at one extreme where adaptation concerns need to be incorporated in planning across a range of sectors, to Egypt where sea level rise also threatens half of the country's agricultural land, and Uruguay where overall vulnerability is moderate, but loss of wetlands might be irreversible (Nicholls 1994). Sea-level rise and/or melting of glaciers could in fact be crosscutting themes for comparative analysis of adaptation responses across a wide range of geographic and economic contexts.

Table 1. **List of potential case study countries**

Region/ Country	Population July 2001 est.	Area in km^2	HDI* rank	GDP per capita†	Illustrative climate change impacts
Island States:					
Fiji	844,330	18,270	67	7,300	High percentage of the population affected by sea level rise, significant capital value at risk, loss of wetlands and mangrove fringes.
Kiribati	94,149	717	NA	850	Critical impacts on the highly populated islands of Betio and Buota. Sea level rise projections however are uncertain due to lack of baseline data.
Tuvalu	10,991	26	NA	1,100	Low lying atoll with critical vulnerability to sea level rise. Land-loss due to sea-level rise has already been reported (IPCC). In addition IPCC predicts greater chances of cyclones, critical impacts on water resources and the threatening of unique traditional heritage sites.
Asia:					
Bangladesh	131,269,860	144,000	132	1,570	Critical vulnerability to sea level rise due to low elevation and high population density. Critical impacts on wetlands and crop production.
Bhutan	2,049,412	47,000	130	1,100	Significant melting of Himalayan glaciers (including on Mt. Everest) documented by UNEP study, with major impacts such as bursting of glacial lakes, downstream flooding, and loss of tourism revenues.
Nepal	25,284,463	140,800	129	1,360	
Philippines	82,841,518	300,000	70	3,800	Expected increase in the frequency of severe weather distortions with impacts on agriculture (rice/corn production) and on mangroves/coral reefs. Coastal inundation and salt-water intrusion will lead to land loss (small islands); the displacement or relocation of around 5 million inhabitants is expected.
Vietnam	79,939,014	329,560	101	1,950	Vulnerable to accelerated sea level rise, particularly in the Red River Delta in the north and in the Mekong Delta. Sea level rise threatens about 20,00 km^2 as well as the cities Haiphong, Danang and Vungtau.
Africa:					
Egypt	69,536,644	1,001,450	105	3,600	Sizeable portion of the lower Nile delta threatened from sea level rise with implications on human settlements and agriculture. Economic sectors, especially around Alexandria also critically vulnerable. Irrigated agriculture inland might also suffer due to reduced water use efficiency as a result of significant projected increases in temperatures.
Ghana	19,894,014	238,540	119	1,900	Accelerated sea level rise will cause important changes including inland migration of wetlands and losses of existing wetlands. Beach erosion threatens historic forts and castles.
Senegal	10,284,929	196,190	145	1,600	High economic vulnerability to sea level rise as low lying coastal zones home to 90% of industry and over half the population.
Tanzania	36,232,074	945,087	140	710	Mount Kilimanjaro expected to lose snow cover as early as 2015 with attendant impacts on tourism, water resources, and coffeee production. Sizeable loss of land and beaches due to sea level rise.
The Americas:					
Belize	256,062	22,966	54	3,200	Sea level rise threatens the largest coral reefs of the western hemisphere with economic implications on tourism.
Mexico	101,879,171	1,972,550	51	9,100	Model projections show consistent declines in summer and winter precipitation alongwith increases in temperatures, with serious implications on agriculture and water resource management. Moderate vulnerability to sea level rise, except Tabasco where inland penetration of up to 50km expected for a 0.5m sea level rise (Conde 1999).
Peru	27,483,864	1,285,220	73	4,550	Steady retreat of the Quelccaya glacier has critical impacts on the Rimac river that is mainly responsible for the water supply to the 8 million residents of Lima, as well as hydropower generation in dry seasons. Sea level rise threatens the population and infrastructure of the low-lying areas of Chucuito y La Punta, Pisco and Ilo.
Uruguay	3,360,105	176,220	37	9,300	Critical sea level rise vulnerabilities in terms of wetlands loss and capital value with implications for tourism. Also offers an interesting case study on how carbon-sequestration is already being integrated with forestry, economic development, and agricultural policies.

* UNDP Human Development Index 2001 (HDI). The HDI ranks countries on a regressive scale from 1 to 162, with higher values of the index associated with countries that have lower levels of development measured in terms of life expectancy, educational attainment, and real income.

† Based on purchasing power parity in US dollars

REFERENCES

Agrawala, S. and Mark.A. Cane. 2002. "Sustainability: Lessons from Climate Variability and Climate Change", *Columbia Journal of Environmental Law*, Vol. 27 No. 2, pp. 309-321.

Benioff R, and J. Warren (eds.) 1996. *Steps in Preparing Climate Change Action Plans: A Handbook*. Washington DC: US Country Studies Program. 300pp.

Burton, I. and M. van Aalst. 199*9. Come Hell or High Water: Integrating Climate Change Vulnerability and Adaptation into Bank Work*. World Bank Environment Department Papers No. 72.

Campbell, J.R.C. and N.D. de Wet. 2000. *Adapting to Climate Change: Incorporating climate change adaptation into development activities in Pacific Island Countries - a set of guidelines for policy makers and development planners*. South Pacific Regional Environment Programme (SPREP), Apia, Samoa. 35pp.

Conde, C. 1999. "Impacts of climate change and climate variability in Mexico", *Acclimations*, September-October.

Huq, S. 2002. Literature review on climate change and sustainable development: With emphasis on vulnerability and adaptation in developing countries. Draft report for the OECD.

IPCC 2001a. *Climate Change 2000: The Scientific Basis*. Cambridge University Press, 881pp.

IPCC 2001b. *Climate Change 2000: Impacts, Adaptation, and Vulnerability*. Cambridge University Press, 1032pp.

IRI 2001. *Coping with climate: A way forward.* A multi-stakeholder review of Regional Climate Outlook Forums concluded at an international workshop October 16 - 20, 2000, Pretoria, South Africa. International Research Institute for Climate Prediction (IRI), Columbia University.

Klein, R.J.T. and R.J. Nicholls. 1999: Assessment of coastal vulnerability to climate change. *Ambio*, 28(2), 182–187.

Klein, R.J.T. 2001: *Adaptation to Climate Change in German Official Development Assistance—An Inventory of Activities and Opportunities, with a Special Focus on Africa.* Deutsche Gesellschaft für Technische Zusammenarbeit, Eschborn, Germany, 42 pp.

Munasinghe, M. and W. Cruz. 1994. *Economywide Policies and the Environment*. The World Bank, Washington DC.

Munasinghe, M. 2002. *Framework for analyzing the nexus of sustainable development and climate change.* Draft report for the OECD.

Nicholls, R.J. 1994. *Synthesis of vulnerability analysis studies.* Proceedings of World Coast '93. Rijkswaterstaat, The Netherlands.

NOAA – Office of Global Programs. 1999. *An Experiment in the Application of Climate Forecasts*. Washington D.C.

Rijsberman, F.R., R.S. Westmacott, and D. Waardenburg. 1995. *CORONA: Coastal Resources Management Roleplay*. National Institute of Coastal and Marine Management, The Hague.

Ringius L., T.E. Downing, M. Hulme, D. Waughray, and R. Selrod. 1996. *Climate Change in Africa – Issues and Challenges in Agriculture and Water for Sustainable Development.* CICERO Report 1996:8, Oslo.

Ropelewski, C.F. and M.S. Halpert 1987. "Global and Regional Scale Precipitation patterns associated with the El Niño/Southern Oscillation". *Monthly Weather Review* 115, 1606-1626.

Smith, J.B. 1996. "Using a decision matrix to assess climate change options" in J.B. Smith et al. (eds.) *Adapting to Climate Change*. Springer Verlag. 474pp.

Smith, J.B., S.E. Ragland, and G.J. Pitts. 1996. "A process for evaluating anticipatory adaptation measures for climate change". *Water, Air, and Soil Pollution* 92, pp. 229-238.

Thompson, L. 2001. Paper presented at AAAS annual meeting, San Francisco.

Titus, J.G. 1990. "Strategies for adapting to the greenhouse effect", *Journal of the American Planning Association,* Summer: pp. 311-323.

World Bank. 1998. *Environmental Assessment Operational Directive*, (EAOD4.01). Washington D.C.

World Bank. 2000. *Bangladesh: Climate Change and Sustainable Development.* Report No: 21104 BD. World Bank South Asia Rural Development Unit, Dhaka.