

1. Introduction

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The increased concentrations of greenhouse gases in the atmosphere threaten to dramatically change the earth's climate in the 21st century. Indeed the climate of the earth already changed in the 20th century, with half of the most recent warming caused by increased greenhouse gas concentrations (Houghton et al., 2001). The Intergovernmental Panel on Climate Change (IPCC) projects that warming in this century could range from 1.4 to 5.8°C (Houghton et al., 2001). Accompanying the warming will be substantial increases in sea level and average precipitation and also changes in climate variability, storms, floods, cyclones, etc. Further climate change is virtually inevitable. The rise in greenhouse gas concentrations to date commits the world to approximately another 1°C of rise in mean global temperature (Hansen et al., 2002). Even the most feasible aggressive emission control measures will still allow for a further rise in greenhouse gas concentrations and additional warming and sea level rise (Metz et al., 2001).

With the climate already changing and further change in climate highly likely to happen, adaptation is a necessary component of any response to climate change. However, mitigation is needed to avoid the worst effects of climate change.

Many countries and specific sectors within these countries are vulnerable to the effects of climate change. Vulnerability is a function of (McCarthy et al., 2001):

- *Exposure*. Exposure is the change in climate and what is affected, e.g., how many people are living in an area that could be inundated by sea level rise or affected by change in coastal storms.
- *Sensitivity*. Sensitivity is the direct effect of climate change on systems, e.g., changes in crop yields or runoff.
- *Adaptive capacity*. Adaptive capacity is the ability of a system to adapt to climate change, reduce adverse effects or take advantage of beneficial effects.

The IPCC (McCarthy et al., 2001) concluded that developing countries are much more vulnerable to climate change. Some of this vulnerability has to do with greater exposure to climate change, e.g., having large populations in low lying coastal areas exposed to sea level rise. Some of it has to do with greater sensitivity, e.g., having crops closer to thermal thresholds beyond which yields decline. It is fair to say that most of the relatively greater vulnerability of developing countries is a function of their more limited adaptive capacity.

The IPCC (Smit et al., 2001, p. 879) also states,

Adaptation to climate change has the potential to substantially reduce many of the adverse impacts of climate change and enhance beneficial effects—though neither without cost nor without leaving residual damage. . . . Adaptation depends greatly on the *adaptive capacity* or adaptability of an affected system, region or community to cope with the impacts and risks of climate change. The adaptive capacity of communities is determined by their socioeconomic characteristics. Enhancement of adaptive capacity represents a practical means of coping with change and uncertainties in climate, including variability and extremes. In this way, enhancement of adaptive capacity reduces vulnerabilities and promotes sustainable development. . . . Enhancement of adaptive capacity is a necessary condition for reducing vulnerability, particularly for the most vulnerable regions, nations and socioeconomic groups.

The IPCC further states that adaptive capacity is a function of:

- wealth
- access to technology
- stable and effective institutions
- systems in place for dissemination of information
- equitable distribution of power
- well-functioning social systems (e.g., Adger, 1999).

Developing countries generally possess less of these attributes of adaptive capacity than do developed countries. In particular,

- Developing countries are poorer than developed countries. For example, the countries belonging to the Organisation for Economic Cooperation and Development, generally the most developed countries, contain 1.1 billion people, or 19 percent of global population, but have 81 percent of global product (WRI, 2000). The remaining countries, which account for over four-fifths of the world's population and include all of the developing countries, account for less than one-fifth of the world's income.
- Developing countries generally have less access to technology.
- Institutions in developing countries tend to be less stable (although democracy has spread to many countries). Many have limited or no democracy.
- Information dissemination systems in developing countries are less advanced.
- Finally, developing countries have less equality in income distribution¹ (WRI, 2000).

Clearly, based on these indicators of adaptive capacity, developing countries have much less of it than developed countries.

The question arises of how best to help developing countries adapt to climate change. Should the focus be on specific adaptations to climate change? This would mean investing in such measures as planning for sea level rise, enhancing evacuation procedures, developing heat or drought resistant crops and enhancing robustness of water supply systems so that the capability to cope with specific impacts on climate sensitive sectors is enhanced. Reading Chapter 18 of the IPCC Working Group II (Smit et al., 2001), one might ask, How successful would such specific adaptations be if adaptive capacity is limited? Can specific adaptations be successfully

implemented, maintained and made permanent if income, access to technology and information and stability of institutions are limited?

The alternative is to invest in enhancing adaptive capacity, e.g., increasing wealth and improving education, income distribution, institutions and health care so that society is better prepared to cope with climate change and other stresses. These can be thought of as investments in development. Would such investments enhance adaptive capacity and reduce vulnerability of developing countries?

Ultimately, the question becomes whether it is more prudent to invest in specific adaptations or enhancements of adaptive capacity. These questions are quite relevant because the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) has set up several funds to support adaptation to climate change (www.unfccc.int). How should those funds be most effectively disbursed to support adaptation to climate change? How can those funds most effectively reduce vulnerability?

This is an emerging topic and one on which there is little research. A critical need is to improve our understanding of how best to help developing countries adapt to climate change and how to best enhance their adaptive capacity.

To address these questions, Stratus Consulting and the Potsdam Institute for Climate Impact Research (PIK) organized a workshop of leading researchers on adaptation and representatives from developing countries, donor countries, multilateral agencies and nongovernmental organizations. The goal of the workshop was to develop a research agenda on the question of how best to enhance the adaptive capacity of developing countries.

The workshop (and a subsequent meeting of authors) was funded through the generous sponsorship of the following organizations:

- Canadian International Development Agency
- Climate Change Unit, Environment Division, World Bank
- Electric Power Research Institute, USA
- Federal Ministry for Economic Co-operation and Development/
Gesellschaft für Technische Zusammenarbeit, Germany
- Organisation for Economic Cooperation and Development
- United Nations Development Programme.

In addition, the following organizations cosponsored the workshop:

- Adaptation and Impacts Research Group, Environment Canada
- Netherlands Climate Change Studies Assistance Programme
- United Nations Environment Programme.

The workshop was held on PIK's campus in the Telegrafenberg section of Potsdam, Germany, from September 30 to October 2, 2001. Forty-five individuals (including two by telephone) attended the workshop. An agenda and list of participants are included in the appendix.

A number of topics were addressed at the workshop and in commissioned papers, including the following:

- Is vulnerability to climate change reduced more by investing in specific adaptations or in broader development?
- To what degree do differences in risks of climate change, nonclimate stresses and levels of development lead to differences in adaptation requirements across countries and regions?
- How can adaptation assistance be tailored to be appropriate for local needs?

The workshop began with overview papers on analytic and methodological issues. These papers addressed such topics as social aspects of adaptive capacity. Following that, papers on links with nonclimate issues were presented. These papers covered such topics as lessons from natural hazards management and famine early warning and food security. Then, a series of case studies addressed country and even community specific vulnerabilities to climate variability and change in the context of adaptive capacity. The workshop concluded with a series of panel discussions on research needs. There were three panels, consisting first of researchers, then representatives from nongovernmental organizations, then representatives from multilaterals and donor institutions.

The 13 chapters in this book are based on papers presented at the workshop. The first set of chapters addresses analytic and methodological issues. These give an overview of issues to be considered in addressing enhancement of adaptive capacity. Chapter 2, by Barry Smit and Olga Pilisofova, reviews Chapter 18 of the IPCC Working Group II report (Smit et al., 2001) and lessons it gives for the questions raised in the workshop. Chapter 3, by W. Neil Adger, examines the role of social capital in adaptation to climate variability and climate change.

A second set of chapters addresses links with nonclimate issues, drawing lessons from sectors already addressing similar risks. Chapter 4, by John Handmer, concerns the lessons that management of natural hazards offers to adaptation to climate change. Indeed, much of adaptation to climate change will be adapting to changes in extreme climate events that the natural hazards management community is already addressing (e.g., Mileti, 1999). Chapter 5, by Thomas E. Downing, focuses on food security and how conventional assessment approaches have not identified vulnerability at different scales. Appropriate adaptations can differ, depending on whether national, regional, individual or household levels are being considered. Chapter 6, by Gary Yohe, Kenneth Strzepek, Tammy Pau and Courtney Yohe, quantitatively analyzes how potential future changes in socioeconomic conditions can affect adaptive capacity, considering Egypt. Chapter 7, by Ian Burton, examines the ability of countries to apply their adaptive capacity. Possessing adaptive capacity is no guarantee that it will be used wisely. Chapters 8 and 9, by Roda Verheyen, explore the legal framework in the UNFCCC and subsequent agreements for support by developed countries of adaptation activities and funding in developing countries.

The third set of chapters presents case studies from developing countries. They give a flavor of the issues and challenges in enhancing adaptive capacity as well the differences in physical and human elements that are present across the world. Chapter 10, by Rosa T. Perez, examines the relative roles of the national and regional governments in addressing adaptation to climate variability and climate change in the coastal resources of the Philippines. Chapter 11, by Cecilia Conde and Hallie Eakin, focuses on how recent socioeconomic trends, such as the North American Free Trade Agreement, have affected the capacity of farmers in one Mexican state to cope with variability from the El Niño/Southern Oscillation and with climate change. Chapter 12, by Chris H. D. Magadza, explores how the government and political environment in Africa can affect the ability of countries to address climate change impacts and adaptation. Chapter 13, by Shaheen R. Khan, addresses how political developments in Pakistan affect its capacity to implement specific natural resources management measures to reduce risks from climate variability and climate change.

The final chapter contains a summary of the discussion and recommendations from the workshop.

Endnotes

¹ This is determined by examining the Gini coefficient, a measure of the distribution of wealth. Developing countries typically have less equitable distributions of wealth. However, there is a wide distribution of Gini coefficients and a number of developing countries have more equitable distributions of wealth than a number of developed countries (WRI, 2000).

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