Adapting to Climate Change: An International Perspective
The Growth of Adaptation Capacity: Practice and Policy

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Abstract

Countries can strengthen their capacity for adaptation to climate change and variability and develop appropriate public policy. Six reasons for developing and adopting adaptation strategies now are provided. Adaptation to extreme events (natural hazards) can reduce long-term vulnerability to climate change. A framework for identifying and classifying adaptations is presented and applied to the adaptation options described in Intergovernmental Panel on Climate Change reports. It is found that some major categories of adaptation, such as insurance, disaster assistance, and changes of land use and location, receive little or no attention.

Introduction

Efforts to prevent the impacts of climate change require the stabilization of levels of greenhouse gases in the atmosphere. Stabilization in turn requires substantial reductions in the emissions of greenhouse gases (especially carbon dioxide [CO2]) from human activities. It is becoming increasingly clear that such reductions will be difficult to achieve. Beyond the first gains from improving energy efficiency, the costs rise sharply; however, cost is not the only factor. Other factors include access to proprietary technology and unresolved political debates (i.e., how much and how rapidly should emissions be reduced, how should nations share responsibility for such reductions).
In signing the U.N. Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro in June 1992, representatives from developed countries (Annex I countries) committed to attempt to stabilize emissions at 1990 levels by the year 2000. Progress reports presented at the First Conference of the Parties in Berlin in April 1995 clearly show that many countries are failing to reach this modest target (U.S. Climate Action Network and Climate Network Europe 1995).

In weighing the need for action to limit the emissions of greenhouse gases, countries are finding that economic considerations are becoming increasingly important. Thus, governments would like to determine the impacts of global warming more precisely. Parties to the UNFCCC want to compare the costs of action vs. the costs of inaction. Clearly, the costs of inaction (i.e., let global warming proceed) can be reduced to some extent by taking adaptive measures. Hence, it is meaningful to assess the potential contribution of adaptive measures in reducing the impacts caused by climate change. For this reason, adaptation assessments are needed, especially assessments of the costs of adaptation and the amounts of reduction of adverse impacts.

The practical science of adaptation to climate change is new, whereas the practice of adaptation to climate is very old. Currently, few adaptation policies for climate change are in place. Research on adaptation is therefore urgently needed, and it is encouraging that researchers are beginning to examine these issues. However, people have always adapted to climate, and many policies and practices are already in place (i.e., building design standards, agricultural practices, laws dealing with water use and allocation). These policies generally treat climate as though it were constant over decades. The new challenge is to take the vast array of adaptations to climate and make them appropriate for climate change.

The capacity for adaptation varies considerably, and it can be changed in a conscious and planned fashion. Also, adaptive capacity can decrease as well as increase. In adaptation assessments, it is important therefore not to assume certain levels of adaptation and what they might achieve. It is also crucial to consider how adaptive capacity might be increased and prevented from decreasing. The study of adaptation is an empirical and practical science. It is possible to go into the field and observe adaptation at work, to recognize the consequences of the lack of adaptation, or worse, maladaptation.

The main purpose here is to suggest ways by which countries can strengthen their capacity for adaptation at the practical level and develop public policy to facilitate and support adaptation. However, before these objectives can be addressed, the widespread neglect (and even opposition) to the idea of adaptation must be recognized. From the outset, it is necessary to make a case for adaptation and show why it should form an integral part of a comprehensive climate policy.

Limitations of Adaptation

The debate on climate policy initially focused on limitation and adaptation issues. These issues were seen as complementary approaches, and the question was quantitative: how much of each would be needed to be effective. This social construction into a simple dichotomy of responses has proved unfortunate because under the political pressures for action, the complementarity between limitation and adaptation has changed. They are now too often perceived as substitutes rather than as mutually supportive. Fear has increased that a successful demonstration (or a mere argument about the potential for successful demonstration) of adaptive capacity may weaken the resolve on the part of governments and others to reduce greenhouse gas emissions. Evidence shows that society can readily adapt to climate and has been doing so successfully for some time (Ausubel 1991). However, adaptation to climate change is a more complicated and urgent matter.

An important assessment by a panel of the U.S. National Academy of Sciences (NAS 1992) concluded that in most areas of climate impact, adaptation could be successfully achieved “at a cost.” By implication, these costs were considered to be low or at least manageable within the United States (Table 1).

Others argued that the potential impacts of global warming were so catastrophic that greenhouse gas emissions should be reduced quickly and substantially. Thus, the Toronto Conference of 1988 recommended a 20% reduction in emissions by 2005 using 1988 as the base year (World Meteorological Organization 1989).

Scientific and economic debate about the impacts of climate change and their likely costs, and the costs of limitations and the potential for adaptation, quickly became polarized. It became increasingly difficult to keep policy and politics out of science. Complementary approaches — part of a mixed strategy — now became mutually antagonistic. Those carrying out research on adaptation were seen as proponents of adaptation and as supporters of the cause of those whose interests led them to oppose limitation actions. This group included the fossil fuel industry and the oil exporting countries and (by implication at least) those nations and societies with high per capita energy use.

Many scientists and scientific institutions carrying out research on limitations saw themselves as “saviors,” trying to reduce greenhouse gas emissions to protect the global environment, to save small island states from the rising sea, and to protect the development interests of poorer countries with (as yet) low per capita energy use.

It became unpopular at an international level to advocate adaptation to climate change. While the UNFCCC recognizes adaptation, it is relegated to a
To some extent, a similar conflict has occurred at the national level, especially in larger countries with highly developed regional and sectoral interests. This conflict has prevented the formulation of comprehensive response strategies that give significant weight to adaptation.

A compelling case can be made for adaptation, not as an alternative or substitute for reducing greenhouse gas emissions, but as a necessary tool that can be used by the global community as countries collectively proceed with the difficult task of managing the potential impacts of climate change.

### Adaptation Now

A number of reasons can be given for taking adaptive measures at this time. Six reasons are given in Table 2.

The first and most compelling argument that supports adaptation causes the most misgivings. Adaptation is necessary because limitation cannot totally succeed. It is too late to prevent some effects of climate change. Countries expect some climate changes in the atmosphere because greenhouse gas concentrations have increased and will continue to increase. Emissions from developing countries have been increasing and will continue to grow as their populations and economies expand and per capita energy use increases. Developed (Annex I) countries have not stabilized their emissions, and although they have agreed

<table>
<thead>
<tr>
<th>Subject</th>
<th>Class</th>
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<tbody>
<tr>
<td>Farming</td>
<td>Sensitive; can be adapted at a cost</td>
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<tr>
<td>Managed forests and grasslands</td>
<td>Sensitive; can be adapted at a cost</td>
</tr>
<tr>
<td>Natural landscape</td>
<td>Sensitive; adaptation is questionable</td>
</tr>
<tr>
<td>Marine ecosystems</td>
<td>Sensitive; adaptation is questionable</td>
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<tr>
<td>Water resources</td>
<td>Sensitive; can be adapted at a cost</td>
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<tr>
<td>Industry and energy</td>
<td>Low sensitivity</td>
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<tr>
<td>Tourism and recreation</td>
<td>Sensitive; can be adapted at a cost</td>
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<tr>
<td>Settlements and coastal structures</td>
<td>Sensitive; can be adapted at a cost</td>
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<tr>
<td>Health</td>
<td>Low sensitivity</td>
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<td>Human migration</td>
<td>Sensitive; can be adapted at a cost</td>
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<td>Domestic tranquility</td>
<td>Sensitive; can be adapted at a cost</td>
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Climate is assumed to change gradually by 1.5°C when the planet reaches equilibrium with an equivalent of a doubling of CO₂.


The overwhelming emphasis is on limitations. For example, Article II of the UNFCCC states:

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The UNFCCC aims to respond actively to achieve stabilization. Moreover, although adaptation is viewed positively, the Convention wants it to occur "naturally."

This neglect or opposition to proactive adaptation has primarily been driven by the politicization of the climate debate at the international level. This factor has continued up to and including the First Conference of the Parties to the Convention held in Berlin in March-April 1995.
to the Berlin Mandate to negotiate the amount of reductions after 2000, it is clear that progress is likely to remain slow (U.S. Climate Action Network and Climate Network Europe 1995). Adaptation therefore has become a necessity, not a matter of policy choice.

A second reason to develop adaptation strategies and policies is that early anticipatory adaptation will prove less costly than forced adaptive measures if delays continue. For example, adaptation to anticipated sea-level rise presently involves avoiding construction of hotels and residences and making other fixed investments in zones likely to be inundated or subject to more severe, higher, and possibly more frequent storms. Protecting or abandoning such investments later is likely to prove more costly than restraining development now and redirecting or relocating to less vulnerable sites. Similarly, farming systems, including irrigation works and so on, will be more sustainable if they are developed to withstand future changes in climate (i.e., more frequent, severe, prolonged drought) than if their design criteria assume the climate will remain stable.

A third reason to consider adaptation seriously today is that climate may change more rapidly than General Circulation Models suggest. There is considerable uncertainty in the relationships of emissions to concentrations, and in the relationships of concentrations to climate change. The climate system is complex and nonlinear and is certain to have unknown threshold levels. At this time, it is impossible to predict when these levels will be crossed. However, experience with other atmospheric issues (e.g., ozone layer depletion, acid precipitation) indicates that surprises are possible and likely. This logic also supports stronger attempts to stabilize and reduce emissions.

These reasons may not be sufficient to convince governments faced with other imminent problems to address adaptation to climate change. It is tempting to delay action until the need for action is apparent. However, three additional reasons (if carefully presented) should be more appealing to governments, even those governments severely constrained because of poverty and lack of development.

Adaptation to climate involves more than a gradual rise in sea level and increase in mean temperature. As global warming advances, changes can affect the frequency and magnitude of extreme events. Adaptation to climate is driven more by climate extremes than by climate norms. Damage caused by extreme atmospheric hazards has risen sharply in recent years (Figure 1 and Table 3). Adaptation is needed now to reduce the vulnerability to present-day climate extremes. Society and the economy stand to gain immediate benefits. Moreover, steps to improve adaptation to present-day extreme events provide a testing ground for the stronger adaptive measures that may be subsequently required.

Another feature of present-day relationships between socioeconomic and climate systems is maladaptation. Many policies and practices in place increase vulnerability to atmospheric events. Examples include agricultural policies that encourage risky farming decisions in regions prone to drought, or subsidized insurance and public relief and rehabilitation programs that encourage development on flood plains and in exposed coastal zones.

Paradoxically, the least welcome argument for adaptation is that climate change brings opportunities as well as threats. As global climate patterns change, some places will benefit from more favorable conditions. Most economies will have winners and losers within the same city or region (Burton 1992). While consensus is widespread that the net effects of climate change will be negative (i.e., the losses will outweigh the gains), it is nevertheless clear that
both opportunities and potential gains will occur as well as adverse impacts. Adaptation plays a role in both.

Therefore, a proactive stand toward adaptation is justified; that is, develop an approach that will seek potential adaptive strategies, find ways to choose among them, and remove obstacles to their implementation. It is important to perform these activities without suggesting that less effort is required to reduce greenhouse gas emissions.

Adaptation Options

Identifying adaptation options is Step 3 in the Technical Guidelines developed under the Intergovernmental Panel on Climate Change (Carter et al. 1994) (Table 4).

On the assumption that policy- and decision makers have been persuaded to include adaptation as part of climate policy, how do countries develop suitable options or measures for climate adaptation? One approach is to survey the literature and collect examples and suggestions. A survey conducted in Canada by D. Herbert (Smir 1993) produced a list of 226 possible adaptation options described as an "inventory of adaptation strategies." Although the list covers a wide range of options, it is admittedly incomplete.

Another approach, developed some years ago under the auspices of the International Geographical Union, involved an international network of researchers who sought to better understand the process of adapting (or as they called it "adjusting") to atmospheric extremes, such as droughts, floods, tropical cycles, and other natural hazards (Burton et al. 1993). A series of 120 case studies was carried out in 23 countries (White 1974). In each case, field interviews were conducted with government officials and planners responsible for public safety and damage reduction. The field interviews resulted in lists of all adaptations in use, as well as those known to have been used in the past. The interviews also asked about potential new adaptations that might be available in the future. The empirical field approach resulted in a rich diversity of adaptive measures. These measures ranged from traditional agricultural practices of mixed cropping and intertilling to provide insurance against total crop failure in times of drought, to advanced engineering methods of water management, and government-sponsored insurance policies. An analysis of these data suggests that adaptations to extreme events can be grouped into six broad classes (Figure 2).

At one extreme (Choice 6), people do nothing and simply bear the loss. A conscious choice to take no anticipatory action may be appropriate if the consequences are likely to be trivial or if the probability of an event is extremely remote.

Where anticipated or experienced losses are higher, society often takes steps to share the losses (Choice 5). In traditional societies and in the past, informal arrangements were made to spread the losses over large numbers of people within extended family groups or within a village, tribe, or community-level institution. In modern states, private or publicly sponsored insurance can serve a similar purpose. Losses can also be shared by compensating the victims and providing emergency disaster relief and, subsequently, assisting in rehabilitation and recovery. The costs of this type of sharing come from general revenues in

Table 4. Development of an Adaptation Strategy

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<th>Define objectives</th>
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<tr>
<td>Specify important climatic impacts</td>
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<td>Identify adaptation options</td>
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<tr>
<td>Examine constraints</td>
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<tr>
<td>Quantify measures/formulate alternative strategies</td>
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<tr>
<td>Weight objectives/evaluate trade-offs</td>
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<tr>
<td>Recommend adaptive measures</td>
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Source: Carter et al. (1994).

Figure 2. A Choice Tree of Adjustment to Extreme Events
the regions or countries affected. Also, on an international scale, disaster relief is now common (NAS 1994).

At the other extreme, decisions may be made to avoid the danger altogether by changing locations (Choice 1). For example, people have migrated from drought regions (i.e., the American Great Plains in the 1930s and Northeast Brazil intermittently). Mass migration usually occurs in response to major events, and this could happen in the case of climate change and sea-level rise. More routine locational choices include avoiding flood plain locations or removing people from flood plains after floods.

In Choice 2, people remain in the same place, but use their land for less vulnerable activities. For example, parks, golf courses, and parking garages may replace houses, hospitals, and schools on flood plains or exposed coastal sites. Farmers may plant crops less vulnerable to drought, hail, forest, or other atmospheric hazards.

Choices 3 and 4 include steps to prevent or reduce effects. Examples are (1) applying irrigation water to prevent drought, (2) modifying events by building a flood control dam, or (3) constructing a seawall to keep out storm surges. Examples of prevention include designing or operating structures to resist atmospheric extremes. Houses are commonly designed to withstand extreme winds, in some cases up to and including tornado velocity, and can be elevated on stilts to keep out flood water.

This typology has been applied more recently to the draft chapters of the forthcoming Intergovernmental Panel on Climate Change (IPCC) Working Group II report on Impacts and Adaptations to Climate Change (Smith et al., forthcoming). This exercise suggests continuing to refine the typology by expanding the “prevent the effects” category into five kinds (Figure 3) and adding research and education as separate responses, making eight major categories.

The IPCC draft report suggests 105 adaptive measures (Carter et al. 1994). The distribution of responses is shown in Figure 3. Of particular note is that some categories of adaptation seem to be totally or largely neglected in the literature summarized by IPCC. These include bearing and sharing the losses, and avoiding impacts by changing land or resource use or changing location. The frequency of adaptations in the legislative, regulatory, financial, institutional, and administrative categories is markedly higher than in structural/technological adaptations or market-based options. The category of on-site operations also seems remarkably low.

These observations should be treated with caution. They may reflect the way in which categories have been defined and the lack of detailed description in the IPCC reports, which sometimes makes classification arbitrary. It seems likely that if the IPCC Working Group II had received support at the outset of the study with a typology of adaptation options, they would have reported more specific options. The possibility is open for a more thorough canvass of adaptation options in the third IPCC assessment.

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Any such canvass of adaptation options in relation to climate change should distinguish between anticipatory and reactive options. As suggested in Figure 2, many actions can be taken before, as well as during and after, specific hazardous events. Climate change provides an opportunity to begin anticipatory adaptation now by improving response to present-day climate variability. In effect, the natural atmospheric hazards experienced today are a testing ground and a preparatory exercise for the more severe conditions that will develop as the climate regimes change.

Adapting to present-day climate variability also provides an opportunity to choose post-event adjustments that will not simply rehabilitate and restore pre-event conditions, but will reduce future vulnerability. For example, damaged buildings would not be reconstructed on flood plains or coastal locations in the same places and in the same way. Rather, they would be relocated or redesigned to be less vulnerable in the future.

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Who Adapts?

An examination of the range of adaptation options shows that responsibility for adaptation is dispersed through all levels of government, the private sector, as well as individuals, families, and communities. To strengthen adaptive capacity requires developing a comprehensive and strategic view of adaptation in which relative roles and responsibilities are well defined. In particular, action at senior government levels is needed to facilitate and encourage adaptation at lower lev-
els of government, among individuals, communities, and the private sector. Ill-considered government action can destroy adaptive capacity, which may help explain some current outstanding examples of maladaptation.

An examination of the national reports prepared for the UNFCCC’s First Conference of the Parties suggests that no country has developed a comprehensive and strategic program for adaptation, and many countries have not started to consider such an idea. Given the current heavy focus on the means to reduce greenhouse gas emissions, it is not surprising that such adaptation programs have not been developed.

Without detracting from the limitation effort, scientists can make a case for adaptation today. The development of policies for adaptation should take into account the reasons for adaptation given in Table 2.

At the level of individual behavior and on-site operations, human ingenuity is likely to lead to much spontaneous adaptation, especially as the signals of climate change become more distinct. At the government level and, in particular, where major costs are to be incurred, adaptive capacity is likely to depend largely on available resources. Thus, the more highly developed and prosperous countries — whatever their experience in climate change — are more likely to be able to afford the costs of adaptation. The UNFCCC recognizes this circumstance in Article 4, Section 4: “The developed country Parties... shall also 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” (U.N. Environmental Programme/World Meteorological Organization 1992).

A prerequisite for such assistance is the identification of adaptive options and the development of the capacity to adapt through both practice and policy initiatives. But the case for adaptation should not rest on the prospect of international assistance. Unlike the benefits of emission reductions, which are shared globally, the benefits of adaptive options are likely to fall more heavily in those countries and locations where the adaptation occurs.

References

