Pergamon

PII: S0959-3780(98)00011-9

Global Environmental Change, Vol. 8, No. 2, pp. 159–170, 1998

Printed in Great Britain
0959-3780/98 $19.00 + 0.00

Rethinking the role of adaptation in climate policy

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Since the late 1980s, scientists and policy makers have devoted considerable attention and resources to the issue of global climate change. Domestic and international policies in response focus primarily on prevention of future climate impacts on society through the mitigation of carbon dioxide emissions. Academic and political attention is also largely focused on issues of mitigation. Adaptation refers to adjustments in individual, group, and institutional behavior in order to reduce society's vulnerabilities to climate, and thus reduce its impacts. In 1996, the Intergovernmental Panel on Climate Change (IPCC) wrote that adaptation offers a 'very powerful option' for responding to climate change and ought to be viewed as a 'complement' to mitigation efforts. Yet, the IPCC also wrote that 'little attention has been paid to any possible tradeoff between both types of options'. This paper discusses the limitations of mitigation responses and the need for adaptation to occupy a larger role in climate policy. © **1998 Elsevier Science Ltd. All rights reserved.**

Key words: climate change policy, adaptation, mitigation, Framework Convention, IPCC

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In December of 1997, representatives from nations around the world met in Kyoto, Japan, to debate the establishment of international policy in response to human-caused climate change. A problem exists in that the policy cannot succeed according to its own goals.

Since the late 1980s, scientists and policy makers have devoted considerable attention and resources to the issue of global climate change.[2] For instance, from 1989 to 1997, the US Congress appropriated more than $11 billion to study the issue, representing approximately half of worldwide expenditures over this period.[3] The international response is guided by the United Nations Framework Convention on Climate Change (FCCC), which, through June 1996, had been ratified by 149 countries. The development and promulgation of the Framework Convention has depended a great deal upon a series of assessments of the science, impacts, and economics of the global change issue conducted by the Intergovernmental Panel on Climate Change (IPCC), widely considered to be the leading authority on climate change. The IPCC was organized in November 1988 by the World Meteorological Organization in the United Nations Environment Programme, and since that time has published a number of assessments of climate change, most recently in 1996. Together, the FCCC and IPCC largely comprise the international response to the issue of climate change.

Domestic and international policy makers discuss response alternatives in terms of mitigation and adaptation (IPCC, 1996a). Mitigation refers to prevention of future climate impacts on society through the limitation of greenhouse gas emissions. The Framework Convention focuses on mitigation, as does most domestic political attention around the world. Academic attention is also largely focused on issues of mitigation. Adaptation refers to adjustments in individual, group, and institutional behavior in order to reduce society's vulnerabilities to climate. In 1996, the IPCC wrote that adaptation offers a 'very powerful option' for responding to climate change and ought to be viewed as a 'complement' to mitigation efforts (IPCC, 1996b, pp. 187–188). Yet, the IPCC also wrote that 'little attention has been paid to any possible tradeoff between both types of options' (IPCC, 1996b, p. 250). This paper presents a case for adaptation to occupy a larger and more formal role in climate policy and for greater attention by academics and policy makers to it.

As a point of departure, this paper begins with acceptance of the conclusions of the IPCC. Specifically, that

[1] The National Center for Atmospheric Research is sponsored by the National Science Foundation.

[2] On the history of the issue, see Hart and Victor (1993).

[3] According to a 1993 report of the International Group of Funding Agencies Working Group on Resource Assessment, US funding represented about half of the worldwide total for global change research by 20 or so agencies around the world (Helmut Kuehr, personal communication, 1997).

- Greenhouse gas concentrations have continued to increase.
- Anthropogenic aerosols tend to produce negative radiative forcing.
- Climate has changed over the past century.
- The balance of evidence suggests a discernible human influence on climate.
- Climate is expected to continue to change in the future.
- There are still many uncertainties (IPCC, 1996c).

Further, the IPCC finds that changes in climate will likely have negative impacts (costs) to society in a range of areas and sectors (IPCC, 1996b, Chapter 6). In accepting the IPCC conclusions, the point of this paper is to move beyond what has become a contentious and largely unproductive debate over the science of climate change. This is not to say that scientific research on climate is by any means complete or that there are not grounds for legitimate debate. Rather, from the perspective of policy, resolution of the ongoing scientific debate is less important than other factors. To understand those other factors we must move beyond arguing over the science of climate change.

This paper argues two related main points. First, there is a realistic possibility that mitigation efforts will not succeed according to their own goals. Thus, adaptation responses must occupy a larger and more formal role in climate policy. Second, even with complete faith that mitigation efforts will succeed, a broader justification exists for adaptation responses to occupy a more prominent role in climate policy. As Nordhaus has observed, 'mitigate we might; adapt we must' (Nordhaus, 1994, p. 189).

Climate policy

Society's concern about climate originates in actual or expected climate-related impacts.[4] These impacts could be societal or environmental, and can only sometimes be effectively expressed in monetary terms (IPCC, 1996c). Generally, climate policies are focused on capitalizing on the positive aspects of climate impacts (e.g. a good growing season) and the reduction of future negative impacts (e.g. reduction in vulnerability to floods), subject to considerations of the monetary and nonmonetary costs and benefits associated with alternative courses of action.

How decision makers think about the concept of 'climate change' is an important factor in the climate policies which they adopt. Surprisingly, there is not consensus within the climate community on the meaning of the phrase 'climate change'. On the one hand, the Framework Convention defines climate change as

> a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability over comparable time periods.

On the other hand, the IPCC adopts a broader definition of climate change as 'any change in climate over time whether due to natural variability or as a result of human activity' (IPCC, 1996c, p. 3). The distinction between the definitions is critical to how the problem of climate is viewed by decision makers: Is climate a problem only to the extent that human activities change it in addition to existing variability? Or is climate a problem irrespective of the sources of change?

[4] The phrase 'climate-related impacts' is used to explicitly acknowledge that climate is one factor of many in the relation of society and its broader environment. Throughout the remainder of the paper, the less cumbersome terms 'climate impacts', 'climate policies', etc., are used in recognition of the broader context.

Mitigation and adaptation

Climate policy has focused on two categories of response: mitigation and adaptation.[5] Mitigation refers to efforts to prevent climate change, and thus prevent future climate impacts, through intentional alteration of the climate system. The IPCC states that mitigation

> "or 'limitation' attempts to deal with the causes of climate change. It achieves this action through actions that prevent or retard the increase of atmospheric greenhouse gas concentration by limiting current and future emissions from sources of greenhouse gases and enhancing potential sinks". (IPCC, 1996a, p. 831)

It is generally accepted that humans might intentionally alter climate through one of two ways. Geoengineering refers to attempts to alter climate by physically interfering with the climate system. Recently, there has been discussion of the possibility of seeding oceans with iron in order to alter climate (Broad, 1996; NAS, 1992). Other geoengineering techniques that have been discussed include mirrors in space, increasing oceanic alkalinity, and placing aerosols or reflective balloons into the upper atmosphere (IPCC, 1996a; NAS, 1992). A second way that society might intentionally alter climate is through social policy. That is, policy decisions could be made to alter human behavior in order to modulate the concentration of greenhouse gases in the atmosphere.[6] To date, policy makers have not advocated geoengineering, relying instead on efforts to alter the composition of the atmosphere through policy actions.

Adaptation refers to efforts to reduce society's vulnerabilities to climate. According to the IPCC, adaptation

> "is concerned with responses to both the adverse and positive effects of climate change. It refers to any adjustment – whether passive, reactive, or anticipatory – that can respond to anticipated or actual consequences associated with climate change. It thus implicitly recognizes that future climate changes will occur and must be accommodated in policy". (IPCC, 1996a, p. 831)

For instance, in 1992 a US Government task force completed a comprehensive overview of how the United States might modify its susceptibility to flooding (FIFMTF, 1992). Actions surveyed included structural (e.g. dam building) and nonstructural (e.g. insurance) measures such as regulation, forecasting and warning plans, and flood-proofing and elevation. For any potential climate impact there are a wide range of such adaptive structural and nonstructural measures that might be incorporated to reduce impacts.[7]

Not surprisingly, the Framework Convention implicitly favors mitigation responses because the definition of 'climate change' it uses places emphasis on only those climate impacts attributable to human-caused changes in the composition of the atmosphere.[8] The goal of the Framework Convention is

> "to achieve … 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 definition of 'dangerous anthropogenic interference' is the subject of much debate.[9] Another important aspect of the Convention's objective

[5] For a review of various terms used to describe response to climate change, see Glantz and Ausubel (1988).

[6] There are certainly other important factors in the relation of human behavior and the atmosphere (e.g. land use). To date, however, discussion of climate change has focused almost exclusively on greenhouse gases.

[7] An anonymous reviewer notes that 'a distinction should be made between what the IPCC terms 'autonomous adjustment', which is (usually low cost) adaptation that takes place automatically in response to a climate event (e.g. stomatal closure in plants during droughts) and adaptive responses requiring deliberate policy decisions. Autonomous adjustments are frequently examined and accounted for in impact assessments. It is the policy-related adaptive responses that are poorly investigated in these studies, although there is a rich literature on adaptation to climate variability based on historical case studies'. Indeed, the focus of this paper is on deliberate policy decisions and seeks to integrate the rich literature on 'adaptation' to historical climate variability with a future-looking policy of adaptation to climate change.

[8] According to Burton (1994), the FCCC mentions 'adaptation' in only five places.

[9] For example, Moss (1995) and Parry *et al.* (1996).

is that it focuses on stabilization of greenhouse gas concentrations, rather than on emissions.

Compared to mitigation, adaptation has not received the same level of attention from either policy makers or researchers. It has been called 'an unacceptable, even politically incorrect, idea' (Burton, 1994, p. 14). There are at least four reasons why consideration of adaptation responses has been discouraged by the climate change community.

The first reason is a perception that discussion of adaptation 'could make a speaker or a country sound soft' on mitigation (Burton, 1994, p. 14). In other words, talk of adaptation could lend an impression, rightly or wrongly, that one was against mitigation activities and in a broader sense anti-environmental. A second reason is the difficulty of incorporating adaptation measures in an international negotiation process. According to Burton (1994, p. 14), 'it was not clear how effectively some of the developing countries would be able to use adaptation as a bargaining tool'. Adaptation raises further complications in a negotiation process. For instance, what obligation does a country have to participate in the negotiations if it expects to be able to largely adapt to expected impacts and is not viewed as one of the more significant causes of the problem?[10]

A third reason is that adaptation has been associated with 'passive acceptance' or 'fatalism' about human effects on the environment. Then-Senator Al Gore espoused this view 'believing that we can adapt to just about anything is ultimately a kind of laziness, an arrogant faith in our ability to react in time to save our skin' (Gore, 1992). Burton (1994) finds this weak view of adaptation, i.e., 'passive, resigned, accepting' present in the Framework Convention, compared with its strong presentation of mitigation as 'active, combative, controlling'. A final reason is a perception that future climate impacts must be known with some degree of specificity before it is possible to plan adaptation responses. As a Framework Convention report notes, 'few studies have been attempted to compare the costs of adaptation strategies with the cost of greenhouse gas mitigation strategies because it is difficult to assess adaptation costs accurately when the regional impacts of climate change are highly uncertain' (FCCC, 1996, p. 16). Presently, global circulation and integrated assessment models do not have the capability to accurately predict climate impacts at regional or local scales.[11]

There is little wonder that adaptation has been out of favor: who wants to be viewed, at best, as working prematurely on adaptation studies and, at worst, as obstructionist, lazy, arrogant, and anti-environmental? A close look at the logic of mitigation suggests that dismissals of adaptation are misplaced. Adaptation deserves a larger and more formal role in climate policy.

Mitigation logic

Mitigation has the following scientific underpinnings: (i) human activities, particularly the use of fossil fuels, have increased greenhouse gas concentrations in the atmosphere; (ii) these greenhouse gases are associated with changes in climate, and (iii) these changes in climate will result in negative impacts (e.g. costs) to society. The logic of response is as follows: (a) mitigation activities, i.e. reduction of greenhouse gas emissions and increase of greenhouse gas sinks, will lead to a reduction in the increase of greenhouse gas concentrations (or, more optimistically, a stabilization of

[10] An anonymous reviewer notes that 'fundamentally, mitigation measures are conducted locally but affect everyone (i.e. their effect is global). In contrast, adaptation measures are conducted locally and their effect is generally local'. This is a prevailing view of adaptation as every-one-for-themselves. This need not be so, as is argued in the conclusion to this paper.

[11] For example, Henderson-Sellers (1996). There is debate as to whether such models can *ever* accurately predict impacts. See, for example, Brunner (1996).

atmospheric concentrations). (b) Fewer greenhouse gases will lead to fewer (less) changes in climate, and thus (c) society and the environment will experience less adverse impacts. Debate over climate change has focused almost exclusively on (i)–(iii). The IPCC working groups roughly map onto these three assertions, focusing on science, impacts, and economics of climate change. In contrast, very little attention has been paid to evaluation of (a)–(c).

Mitigation responses evaluated

Why do policy makers and scientists expect that mitigation activities can succeed? One important answer to this question is the lessons that have been distilled from the precedent of international policy responses to ozone depletion, which is often used to justify the present course of climate policy (Gore, 1992). Ozone depletion refers to the effects of human-produced chemicals on the earth's ozone layer, which were addressed through international negotiations leading to the Montreal Protocol in 1987. There is reason to believe that the ozone precedent has been *mis*applied to the case of climate change. While a full elaboration of this issue goes well beyond the scope of this paper, four important differences between the two cases are as follows: (1) The science of ozone depletion was 'simpler' (Darmstadter and Edmonds, 1989); (2) fewer political and economic actors were involved (Haas, 1991); (3) the issue was socially easier to deal with, e.g. ease of finding substitutes (Doniger, 1988); and (4) a framework for policy action appeared early on (Pielke and Betsill, 1997). The ozone precedent is widely viewed as a success story. However, its success may be less relevant to the climate issue than many have suggested. Beyond the ozone precedent, a close look at the logic of mitigation suggests that success may be difficult to achieve. (The following sections follow the discussion of mitigation logic presented in the previous section.)

Will societies be able to institute the mitigation activities needed to reduce increases in greenhouse gases?

Recent experience in seeking to limit the growth of greenhouse gas emissions provides a sobering lesson in the difficulties of that task. Political and technical obstacles to successful implementation of mitigation activities coupled with recent experience provide a reason for restrained optimism at best, and outright pessimism at worst, about the likelihood of mitigation activities actually resulting in emission reductions of the sort agreed to in Kyoto. An even more dismal outlook is warranted for proposed future actions of the Framework Convention that go beyond existing proposals.

The experience of the United States is a cautionary tale. On Earth Day 1993, President Clinton announced that

> "We must take the lead in addressing the challenge of global warming that could make our planet and its climate less hospitable and more hostile to human life. Today, I reaffirm my personal and announce our nation's commitment to reducing our emissions of greenhouse gases to 1990 levels by the year 2000". (FCCC, 1995)

In October 1993, the US Government released its Climate Change Action Plan (CCAP), detailing the means to be employed to reach the emission goal, which would have required a 7% cut in emissions from

what was expected for 2000 (Paarlberg, 1996). Within little more than a year, the United States stated that it would not meet the goal of reducing emissions to 1990 levels by the year 2000 because the economy had grown faster than expected, the price of oil fell sharply, and the Action Plan was not fully funded (FCCC, 1995; cf. Cushman, 1997; CAR, 1994). Another report notes that, 'regardless of whether the CCAP is successful in meeting the year 2000 target, and despite the fact that the CCAP will affect net greenhouse gas emissions well beyond that date, emissions are expected to be at least 10% above 2000 levels in 2010' (FCCC, 1996, p. 14).

At the core of the Clinton administration's plan to meet its emission reduction goal was an energy tax proposed during the President's first term. The tax was proposed primarily as a means to achieve deficit reduction and not in terms of climate policy. It focused on all energy uses, greenhouse gas producing or not, in order to mollify the band of the political spectrum that relied on coal production and use (Paarlberg, 1996; Muller, 1996). The Democratic Congress quickly rejected the proposal for a number of reasons, including a middle class who had been promised a tax cut during the election and a number of exemptions granted to certain industries and not others (Muller, 1996). In its place, the President proposed, and Congress enacted, a modest gasoline tax (4.3¢ per gallon). The gasoline tax became an issue in the Presidential election of 1996, when Republican candidate Bob Dole promised to rescind the tax if elected. Senator Dole's proposal received much popular support, including that of President Clinton (Mitchell and Rosenbaum, 1996). To place in broader global context the Clinton administration's failure to meet its reduction target, consider that had the goal been met that total global emissions of greenhouse gases would have been reduced by only 1.4% (Paarlberg, 1996).

More broadly, of the nations participating in the Earth Summit in 1992 in Rio de Janeiro that voluntarily agreed to limit global greenhouse emissions by the year 2000 to 1990 levels, on two, Germany and the United Kingdom, were expected in 1996 to meet the target (White, 1996).[12] The shortfall reveals technical obstacles to meeting emissions targets.

> "Meeting a target is technically tricky because future emissions and the consequences of policy actions are not perfectly predictable. Modelers and scientists are marked by different, incompatible core assumptions.... Yet much is at stake depending upon the view adopted because different forecasts and models imply vastly different policy actions, costs, and benefits". (Victor and Salt, 1994, pp. 8–9)

Perhaps more importantly, the shortfall also reveals that domestic politics often limits what can be achieved:

> "no single government agency – not even the head of a delegation – speaks for the full interests of the state. Translating broad international objectives into domestic plans that can be implemented requires complicated and time-consuming coordination across ministries and interests". (Victor and Salt, 1994).

Recent experience, including that of Kyoto in 1997, does not lend optimism to future efforts to limit or reduce global greenhouse gas emissions (Malakoff, 1997; Muller, 1996).

Some have suggested that future climate impacts will provide the impetus necessary to overcome such obstacles. However, Ungar (1995) is less sanguine, documenting a decrease in public and political concern

[12] Only the 24 so-called Annex I (developed) countries agreed to emission limits. Under the FCCC, developed and developing countries follow different rules. It remains unclear how many European nations will meet their 1992 commitment (Economist, 1997).

about climate change during a period of extreme climate impacts around the world, 'if weather impacts of this magnitude are barely newsworthy, revitalizing global warming as a celebrity social problem may take more extreme events than one would like to countenance'.

Steps actually needed to stabilize greenhouse gas concentrations at levels lower than are present in 1997 dwarf those currently proposed. It has been estimated that stabilization of greenhouse gas concentrations in the atmosphere at *current levels* would require reductions of 60–80% in greenhouse gas emissions (IPCC, 1994). One economist has estimated that reductions of that magnitude might cost $30 trillion (in 1989 US$, over 120 years) (Nordhaus, 1992). Others have proposed that reductions could be achieved with relatively modest emissions reductions in the near term and more drastic ones in the future (Wigley *et al*., 1996). Discussion of such steps has predictably garnered the attention of a range of economic interests.

A further point of concern in the implementation of the Framework Convention is rapid development in many countries around the world. Because many developing countries view the industrialized world as the cause of the climate change problem, they suggest that industrialized countries should bear the burden of greenhouse gas reductions while simultaneously providing energy-efficient technologies to lesser developed countries to allow continued growth and development (White, 1996). These issues complicate negotiations. They also only thinly mask a more fundamental issue for many developing countries: the relative benefits of development and increased energy use associated with higher standards of living versus the costs expected from climate change. For many countries, such a calculus may not swing in the favor of the Framework Convention.

Will a reduction in greenhouse gases mean less change in climate?

For the purposes of conducting a thought experiment, assume that implementation of the Framework Convention is successful (that is, countries stabilize concentrations of greenhouse gases in the atmosphere at levels agreed upon to prevent dangerous interference with the atmosphere). Under this 'success scenario', there are at least two reasons why the problem of climate change will not have been solved. One involves the inevitability of climate change, based on the IPCC projections, and the second is related to changes in climate independent of human causes.

Under the analysis conducted by the IPCC, concentrations of greenhouse gases in the atmosphere will not for the foreseeable future be reduced to pre-industrial levels. Thus, the IPCC (IPCC, 1996b, p. 188) notes that 'even with the most ambitious abatement policy, some climate change seems likely to occur'.[13] In short, even under a scenario of aggressive mitigation most experts expect climate change. Thus, mitigation efforts alone cannot completely deal with the problems associated with human-induced changes in climate, as projected by the IPCC.

A second scenario, mentioned by the IPCC, is the possibility that climate might change in surprising and unpredictable ways, independent of any human-induced changes (Kates and Clark, 1996). The recent historical record is full of such surprises such as changes in the frequency and intensity of El Niño-Southern Oscillation (ENSO) events and for particular locations variation in periods of drought, precipitation, and extreme events.[14] Over much longer periods of centuries, millennia, and eons, the climate record has shown significant variability, all of it essentially prior to

[13] On this, Kauppi (1995) concludes that 'climate will change, there will be dangerous effects, and the [Framework] Convention objective will be attainable'.

[14] Some have suggested that recent changes in ENSO frequency might be attributable to climate change. See, for example, Trenberth and Hoar (1996).

the industrial age. Thus, the possibility exists that mitigation activities would succeed yet climate would still change.

Will less change in climate mean fewer (less) adverse impacts?

For purposes of extending the thought experiment, assume that mitigation activities succeed in stabilizing concentrations of greenhouse gases and also that as a result there are fewer changes in climate. Under this scenario, there remains significant cause to expect *more* rather than less adverse impacts to environment and society, as many actions taken by society are increasing vulnerabilities of people and the environment to climate impacts.[15] Such actions include development of marginal lands (e.g. Glantz, 1994), development of land at greater risk to extreme events (e.g. IRC, 1995), dependence upon highly technical, interdependent systems (e.g. Quaranelli, 1996), increased need around the world for food, clean water, health care, etc. (e.g. WRI, 1996). Most, if not all, of these trends are driven by population growth and technological change. It is certainly possible to imagine a scenario under which the frequency and magnitude of climate events remains constant, yet societal impacts (in terms of economic and other measures) increase because more people and property have put themselves (or been placed) in harm's way (cf. Pielke and Landsea, 1998). A number of measures of climate impacts exhibit such a trend (e.g., Swiss Re, 1997). In short, the problem of climate change might be successfully dealt with without positively affecting the majority of society's climate problems because societal change will continue to increase vulnerability.

It is an interesting thought experiment (and indeed an ongoing focus of research) to study various climate phenomena around the world and examine to what degree mitigation efforts would address climate-related problems. A working hypothesis is that there are *no* situations in the climate/society relation, existing or predicted, in which some type of adaptive measures do not make sense. Further, to the extent to which societies around the world are maladapted to climatic variability, these adaptive measures will almost certainly provide benefits under the entire spectrum of climate change scenarios offered by the IPCC (IPCC, 1996a, Chapters 1–18).

Implications and recommendations

To summarize, there are a number of reasons to believe that mitigation responses will not or can not succeed with respect to their own goals, including

- political and technical obstacles in the way of cutting emissions in developed and developing countries;
- inevitable climate changes as projected by the IPCC;
- changes in climate due to factors other than human-induced climate change;
- increasing climate impacts due to the increasing vulnerability of society due to population growth and technological change.

Any one of these reasons supports the need for adaptation to occupy a larger and more formal role in climate policy. However, in spite of various observations made from time to time that adaptation has been neglected and subsequent calls for more attention, it remains to be viewed

[15] It is often observed by proponents of mitigation that the *rate* of change is as important as the change itself, citing estimates of future rates of change greater than any in the past 10 000 years. But from the standpoint of climate impacts, a more appropriate point of reference might be the broader context of change in which climate change occurs, i.e., as compared to other human influences on society and environment.

as a necessary and fundamental element of climate policy (see e.g. IPCC, 1996b; Smith *et al*., 1996; Carter *et al*., 1994; FIFMTF, 1992; White, 1996; Meyer-Abich, 1980).[16]

If one accepts the possibility that mitigation efforts might possibly fall short of the goal of preventing future climate impacts, then it is prudent and precautionary that climate policy reflect that possibility. Current climate policy is conducted under a success-oriented strategy, i.e. all eggs in one basket. It would make more sense to adopt a back-up strategy that would provide complementary benefits even if mitigation efforts do succeed. Adaptation responses provide such a complementary approach. Further, even if one believes that mitigation activities are certain to succeed adaptive measures are needed independent of concern about climate change, as society is in many respects poorly adapted to certain aspects of documented climate variability.

Acceptance of the need for adaptation as complement to mitigation to occupy a larger and more formal role in climate policy has at least four implications for conceptualization of the climate problem. First, with a greater focus on adaptation, debate over whether or not climate will change in harmful ways need not stand in the way of effective action, as most adaptation measures make sense under any climate scenario. Second, the issue of tradeoffs between mitigation and adaptation cannot be avoided. Rather than being viewed as a cost of climate change (IPCC, 1996b, p. 411), adaptation measures should be viewed as actions that will result in benefits independent of climate change, and marginal benefits in the case of climate change. Indeed, because adaptation has been viewed as a cost of climate change, mitigation has been viewed preferentially in comparison (IPCC, 1996b, pp. 411–412). Third, the goals of climate policy must continue to be discussed and refined. Climate policy may have recently undergone a period of goal substitution, i.e. when means become ends. As happens often in institutions, high-order goals become largely forgotten in efforts to meet the objectives supporting attainment of the goals. The need for climate policies was at first motivated by concern above the adverse impacts of climate on society and environment. Mitigation activities were put forth as a means to meet the goal of limiting adverse impacts ('dangerous interference' in the language of the FCCC). Today, most discussion and debate is focused on mitigation as an end in itself, rather than as a means to a higher-order goal of reducing climate impacts. Finally, for those who wish to reduce society's vulnerabilities to weather and climate, they must be prepared to face the possibility that there does not exist a single global solution to the problem of climate change.

What might a reconsideration of adaptation look like in practice? Experience suggests three guiding principles:

(1) Adaptation proceeds in a procedurally rational fashion (cf. Brunner, 1996). Adaptation is not a 'response' but instead a portfolio of responses. Within this portfolio some will make better decisions than others. This will allow for learning based on experience, as well as meaningful evaluation with respect to criteria of reduction in actual impacts and vulnerability. Mitigation cannot easily be evaluated with respect to impacts, leaving its success or failure as an open question for many years into the future.

(2) Adaptation is a shared responsibility. Adaptation should not be thought of as every-country-for-itself. Rather, nations should build upon the framework of shared governance developed under the FCCC. A guiding principle of adaptation should be that the climate

[16] The IPCC (Carter *et al*., 1994) does have in place means to oversee adaptation studies; however, 'to date, few studies have been performed' (Carter, 1996, p. 41). Smith *et al.* (1996) is one of the few studies focusing significant attention on adaptation.

'winners' of the world bear some responsibility to support and aid the climate 'losers' of the world (cf. Glantz, 1995). As climate changes, today's 'winners' and 'losers' might shift in such a way that the flow of support and aid changes in its intensity and direction.

(3) Adaptation links the documented needs of today with the expected problems of tomorrow. One frequently involved criticism of the current response is that in focusing on future climate change, we put the needs of future generations ahead of those in today's generation who suffer climate impacts. Adaptation encourages the refinement of existing policies in response to climate variability in a manner which will reduce future vulnerabilities to climate fluctuations, thereby serving the needs of today and tomorrow (cf. Jamieson, 1998).

Under these three guiding principles, adaptation can be thought of in a manner that is every bit as ethical, responsible, global, and comprehensive as mitigation has been by its proponents (cf. Burton, 1994).

For the ongoing research agenda, a greater focus on adaptation means that more systematic attention must be paid to at least three areas. First, policy makers would benefit from a more systematic understanding of the costs and benefits of adaptation, (a) compared to the costs and benefits of mitigation and (b) in the context of existing climate-related problems. As is noted by the IPCC (1996b, pp. 249–250), very little work has been done in this area, and some working under the auspices of the IPCC are currently working to change this situation. Second, attention must be paid to society's vulnerability to *climate* (vs society's vulnerability to climate change), where climate refers to the entire range of society/climate interactions (e.g. variability, extreme events, etc.), not just climate change. For most decision makers, the problem of climate change is a matter of degree, not of kind, with respect to the sorts of climate-related problems that they typically face. Conceptually, it may be possible to draw a distinction between climate impacts and climate change impacts. In practice, there is less significance and it may, in fact, be impossible to make the distinction in any meaningful scientific manner. How much sense would it make to inform a decision maker with, say, flood-related concerns that mitigation responses will help them to deal with only those floods caused by climate change, not those resulting from other climate variabilities? Finally, with a greater commitment to adaptation, research will be needed to assess how far reducing society's vulnerabilities to climate goes toward reducing society's vulnerability to climate change. This information would allow decision makers to better assess which sorts of mitigation responses to adopt, and could thus actually enhance the possibilities that mitigation activities would actually succeed.

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