# MITIGATIVE CAPACITY – THE MIRROR IMAGE OF ADAPTIVE CAPACITY ON THE EMISSIONS SIDE

*An Editorial*

## 1. Introduction

Integrated analyses of climate change have progressed significantly since the early days when researchers offered aggregate models of economic activity that produced alternative future trajectories for greenhouse gas emissions. Each subsequent innovation has added complication to the analyses. We are, however, just now beginning to realize the true complexity of the climate issue because researchers are starting to come to grips with the notion that climate change is but one of many stresses with which human societies must constantly cope. Researchers are, in fact, beginning to recognize that each society will come to the table with its own unique perspective drawn from its own unique history. Continued progress in developing an understanding of how individuals, communities, nations and the globe might respond to the challenge of climate change and climate variability will therefore be possible only if we learn to cope with diversity across human experience in the context of a myriad of other stresses.

Two principles upon which productive exploration of this diversity might be organized have begun to emerge in the collective psyche of analysts across the globe. One, adaptive capacity, emerged over the past two years on the impacts side of the climate equation; and it has already been used to provide general insight from specific examples, to highlight opportunities for diminishing climate related damage, and to organize research activity. The second, mitigative capacity, is the mirror image of adaptive capacity on the emissions side of the equation. Mitigative capacity is a newer concept; but it is the intent of this editorial to argue that it, too, holds the promise of offering instructive lessons and focused hypotheses.

Figure 1 offers a stylized diagram of climate research that can be used to support this perspective. It shows, for example, how the earliest studies focused on the connection between emissions (designated E EMISSIONS in Figure 1) and climate change (C). Motivated by concerns about impacts that might be 'dangerous', in the parlance that would emerge later in the United Nations Framework Convention on Climate Change, these studies worked on the how economic activity (W1) might be linked to emissions and climate change. Once concerns about impacts of climate change were raised, though, analyses expanded gradually to include mitigation,

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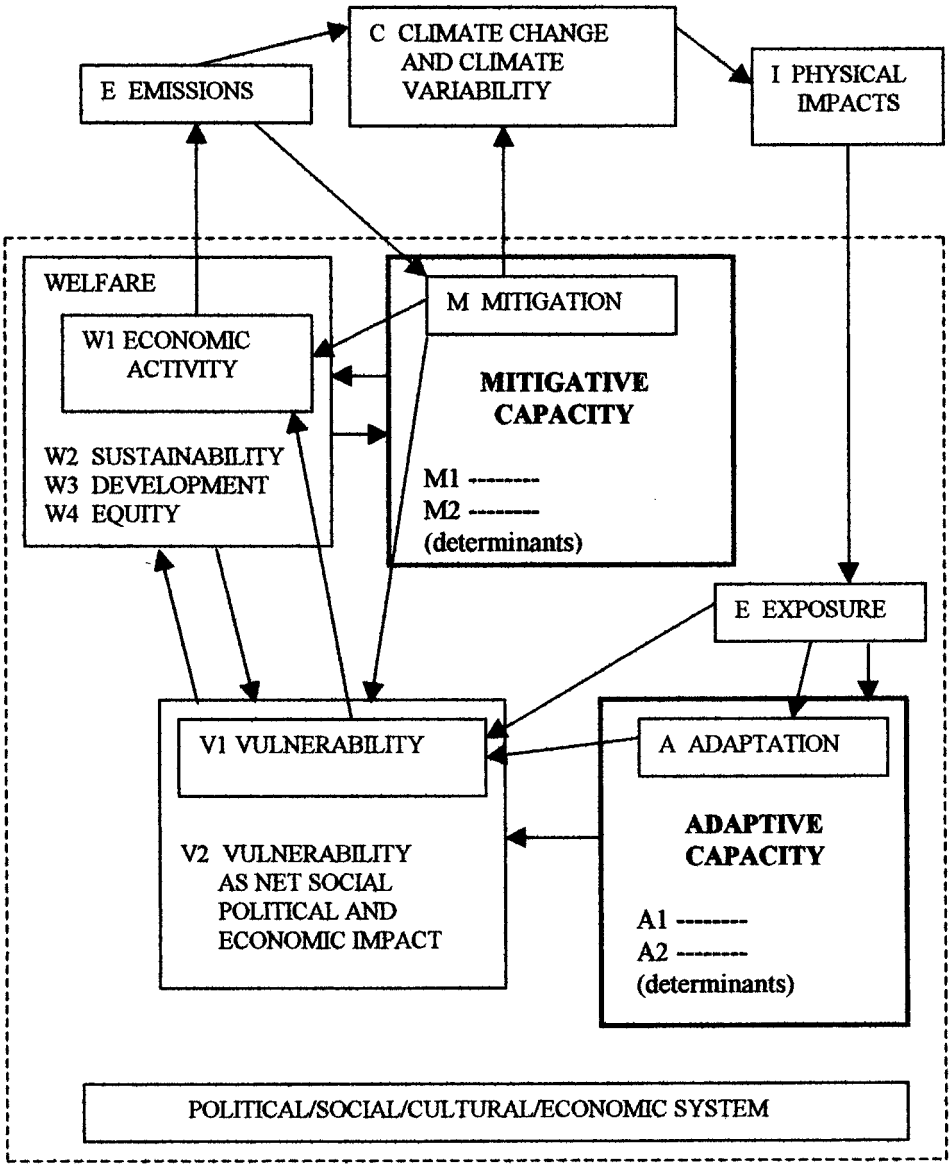


*Figure 1.* A schematic representation of climate change analyses.

adaptation, geoengineering and research so that the impact of mitigation on welfare could be considered alongside the impact of climate. Climate change and climate variability (C) both have physical impacts (I) that produced exposure (E EXPOSURE), and so both could work through vulnerability in the absent adaptation (V1) to influence economic activity and, eventually, other aspects of welfare. The next step was to consider adaptation, of course, so emissions worked through adaptation (A) to V2, a new measure of vulnerability that represented damage net of the be-

nefits of adaptation but including the cost of adaptation. Indeed, PAGE (see Hope et al., 1993) was the first integrated assessment model to include adaptation costs explicitly in the analysis.

The current crop of analysts is beginning to recognize that even this perspective is too restrictive. Attention is now turning to the multiplicative determinants of adaptive capacity with respect to multiple stresses, of which climate change is just one. It follows that the determinants of adaptive capacity must be considered within the largest box of Figure 1 – the political-social-cultural-economic context within which adaptation (and mitigation) decisions will be made. Although climate change vulnerability studies now usually do consider adaptation, for example, only the most recent go beyond identifying adaptation options. There is currently precious little research on the dynamics of adaptation in human systems, the processes of adaptation decision-making, the conditions that stimulate or constrain adaptation, and the role of non-climatic factors.

There are also serious limitations in existing evaluations of adaptation options. Economic benefits and costs are important criteria, but they are not always sufficient to determine adequately the appropriateness of all adaptation measures. Little research to date has concentrated attention on the roles and responsibilities in adaptation of individuals, communities, corporations, private and public institutions, governments and international organizations. Given the scope and variety of specific adaptation options across sectors, individuals, communities and locations and given the variety of private and public participants involved in most adaptation initiatives, though, it is probably infeasible systematically to evaluate lists of particular adaptation measures. That is why focusing on the determinants of adaptive capacity holds so much promise.

The same list of caveats can be applied to studies of mitigation. Surely responses to the climate challenge on the emissions side will be influenced by the same sorts of factors. We must therefore begin to cast our analyses of mitigative capacity in the same frame as our analyses of adaptive capacity. But how? One suggestion notes simply that the boxes in Figure 1 that highlight the determinants of mitigative capacity and adaptive capacity stand out along the connecting paths of causality; the dotted arrows depict a proposed evolution of analytical concentration. Perhaps both can be explored outside of the linear (ultimately circular) connections and free of concerns about the specifics of what baseline might evolve. They cannot be explored independently, of course; and focusing attention on their content does not imply scrapping approaches that are tied to baselines and scenarios in an effort to see the big picture. Investigating the determinants of mitigative and adaptive capacity can complement the big picture approach and add richness to the interpretation and applicability of its results.

This editorial argues this point in three steps. The first step offers a review of adaptive capacity, highlights its determinants and demonstrates how their consideration can inform specific research initiatives. The second provides a similar list of determinants for mitigative capacity before it highlights some derivative hypo-

theses that warrant further examination. Conclusions are then advanced to bring insights from both into the realm of policy negotiation and design.

## 2. Adaptive Capacity

Adaptive capacity began to emerge as a fundamental organizing concept during a Workshop on Adaptation, Climate Variability, and Change organized by the Intergovernmental Panel on Climate Change (IPCC) in San Jose, Costa Rica, in April of 1998. Smit et al. (1999), for example, provided the participants of the workshop with a concise description of adaptation and how it might be evaluated in a multiplicity of contexts. Yohe and Moss (2000) subsequently offered a synthesis of this and other work at an IPCC Expert Meeting on Climate Change at its Linkages with Development, Equity, and Sustainability held in Colombo, Sri Lanka at the end of April in 1999. It was there that a tentative list of determinants of adaptive capacity was offered in support of the IPCC Third Assessment Report (TAR). Kane and Yohe (2000) also used adaptive capacity as a unifying concept in the organization of a Special Issue of *Climatic Change* on Adaptation.

This line of work has made it clear that a system's vulnerability to climate change and climate variability (be it a community, nation, region or whatever) is determined by:

- its exposure to the impacts of climate change and
- its adaptive capacity.

Exposure depends upon location specific parameters and the way in which the impacts of climate change are felt. Yohe and Moss (2000) suggested in their Table I that adaptive capacity depends upon a wide range of similarly specific characteristics:

- the range of available technological options for adaptation,
- the availability of resources and their distribution across the population,
- the structure of critical institutions and the derivative allocation of decision-making authority,
- the stock of human capital, including education and personal security,
- the stock of social capital including the definition of property rights,
- the system's access to risk spreading processes,
- the ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-makers, themselves, and
- public perception of attribution.

Smit et al. (2000) also address adaptive capacity, and its synonym adaptibility, in connection with vulnerability; and they note a similar list of determinants. These characteristics, and no doubt others, fill in the determinants portion of the 'Adaptive

Capacity' box in Figure 1. Taken together, they can offer a range of hypotheses around which 'orthogonal research' designed to uncover generally applicable insights can be conducted. They can also be used to highlight issues that must be confronted in organizing research on how specific systems or communities might be expected to adapt to climate change as well as how their capacity to adapt might be improved.

### 2.1. HYPOTHESES DRAWN FROM THE DETERMINANTS OF ADAPTIVE CAPACITY

As noted above, adaptive capacity has been the focus of extensive discussion among the Lead Authors of Chapter 18 of the TAR (Working Group II). It has served them well in their efforts to organize their assessment of the current literature; but it has done more than that. Thinking about the determinants of adaptive capacity has led them to hypotheses that take their assessment beyond the narrow confines of list of adaptation options and well into the interface between climate change and climate variability, on the one hand, and issues of equity and sustainable development, on the other. For purposes of illustrating this expanded role as well as underscoring the significance of the adaptive capacity box in Figure 1, this subsection will review briefly some of their thoughts.

Viewing the determinants of adaptive capacity in the context of a system's social, cultural, political and economic context has suggested, first of all, that adaptation to changing climatic conditions is likely to be implemented only if it is, at least, consistent with programs designed to cope with non-climatic stresses. The facts of life are simple. Vulnerabilities associated with climate change are rarely experienced in the absence of non-climatic stresses. Climate stimuli are felt as economic or social stresses, and adaptations to climate (by individuals, communities and governments) will be evaluated and perhaps undertaken in light of the manifestations of these stresses. The costs of adaptation can therefore often be incidental when compared to other management or development costs. To be effective, proposals about how to adapt to climate change need to be considered in the context of non-climatic stresses and they need to be consistent with existing policy criteria, development objectives, and management structures. This hypothesis seems to apply best along smooth trajectories where climate issues are likely to have such a low priority in social decision-making that they will only be considered as an 'add-on' to something else. It is probably not as applicable along irregular climate scenarios, because sudden and unexpected change will bring climate to the fore as an issue unto itself in need of some response.

Secondly, it is clear from the literature reviewed in the preparation of the TAR that adaptive capacity varies considerably among regions, countries and socio-economic groups. The ability to adapt and cope with climate change impacts is a function of wealth, technology, information, skills, infrastructure, institutions, equity, and empowerment. These are the determinants of adaptive capacity. Groups

and regions with capacities that are limited along any of these dimensions are more vulnerable to climate change just as they are more vulnerable to other stresses. Indeed, concern about climate change may be dwarfed by other social objectives.

Taking this second notion further, it would seem that differences among people living in developed countries with respect to adapting to smooth climate change are probably not as severe as they are in developing and transition countries. Developed countries have constructed elaborate safety nets in response to non-climate stresses – safety nets that have been designed specifically to spread risks from multiple stresses across entire populations. Some of these programs, of course, create perverse effects when people exploit their structure for their own personal gains. When it comes to sudden change, though, the need to adapt will fall more fully on individuals who will then tend to their own problems. During extreme events, as a result, differences across regions and socio-economic groups could then be critical even in developed countries.

It follows from these hypotheses that enhancing adaptive capacity could play a critical role in reducing vulnerability, particularly for the most vulnerable regions, nations and socio-economic groups. Systems or communities that are deficient in any of the determinants listed above are likely to face climate-related and other stresses with low capacities to adapt, but care needs to be taken in designing means of improving the situation. Simply put, programs designed to enhance one component of the adaptive capacity of one system may not work for other systems where diminished capacity can be attributed to deficiencies in different sets of determinants. These notions again make most sense along smooth scenarios of change; they could easily be undermined along irregular trajectories along which sudden change could overwhelm any capacity to adapt, especially in developing and transition countries were other stresses are already enormous.

The scope and variety of specific adaptation options across sectors, individuals, communities and locations as well as the variety of private and public participants involved in most adaptation initiatives is overwhelming. The authors of TAR Chapter 18 noted this diversity at COP-5 and suggested that it is probably infeasible systematically to evaluate lists of particular adaptation measures in a generally applicable fashion. Improving and applying knowledge on the constraints and opportunities for enhancing adaptive capacity is, instead, necessary for reducing vulnerability on a case by case basis. Their final hypothesis seems to undermine the confidence with which researchers can attack the circular linkages portrayed across the whole of Figure 1, but only when it is read on a superficial level. This last insight really speaks to the ability to predict precise adaptations instead of the ability to anticipate some sort of response. Its content, therefore, is that the research community should focus on understanding the prerequisites for building strong adaptive capacity across varied social, cultural, political, and economic systems. Using this understanding to enhance adaptive capacity will increase the likelihood of effective adaptation to multiple stresses even if we cannot predict exactly the form of that particular adaptation.

### 2.2. USING THE DETERMINANTS OF ADAPTIVE CAPACITY TO FRAME SPECIFIC RESEARCH INITIATIVES

A recent workshop hosted in May of 2000 by Kenneth Strzepek and Mohamed El Raey in Alexandria, Egypt, illustrated this point by using the determinants of adaptive capacity as an organizing tool. Discussions that moved deliberately down the list of determinants stimulated participants to explore the potential for adaptation to climate change by fishing communities located along the regions's northern coastline under two distinct, but 'not-implausible' economic scenarios. Table I describes both scenarios. Both of these scenarios were, it should be noted in passing, framed during discussions held during another workshop held the day before in Cairo; they are broadly categorized as 'High Growth' and 'Low Growth'.

Rising seas and reduced sedimentation from the Nile would both threaten traditional methods under even scenarios of modest climate change because both would work to change the composition of the local fish population. Exploiting the resulting alternative fishery in deeper water would, in turn, require that individuals invest in different types of fishing boats and new technologies and that consumers adjust their tastes in fish. Table II reflects this adaptation option in its first row – adaptation that would be expensive if the switch to the new technology were not undertaken at the natural pace of investment. It would, however, be relatively inexpensive if the switch to a new technology were made as individuals' existing capital investment in boat and technology depreciated to the point of needing replacement.

Rows 2 through 7 in Panels A and B of Table II report impressions of the degree to which Egypt might present the determinants of adaptive capacity for how we must simply recognize that the determinants of mitigative capacity at any point in time should include a variety of country-specific characteristics that are themselves determined by both history and a range of 'not-implausible' futures. fishing communities under the two growth scenarios. It is clear that Egypt's ability to support an adequate capacity to adapt is highly dependent upon the assumed economic scenario. The impressions recorded in Table II also reflect the observation that modern-day Egyptians look to the government for planning and assistance when stresses appear, but they do so with a significant degree of skepticism. As a result, anticipatory investment in boats that would accommodate new fishing techniques in deeper water should not be expected even in the High-Capital scenario (unless demonstration projects and education make a dent in cultural inertia).

## 3. Mitigative Capacity

Mitigative capacity can now be motivated as the mirror image of adaptive capacity on the emissions side of the climate problem. Properly defined, mitigative capacity should bring comparable insight into our ability to envision how communities, nations, corporations, international NGO's, and so on might respond to the challenge of climate change. To see how, it is sufficient simply to recognize that the

TABLE I

Qualitative descriptions of political/economic scenarios for Egypt[a]

*High growth – high capital scenario*

1. The government allocates public capital efficiently in ways that complement private investment.
2. Business and industry is sufficiently privatized to foster domestic private investment.
3. Cultural changes that allow the population to accept responsibility for the social opportunity cost of their consumption (e.g., in water).
4. Attractive investment opportunities for foreign capital in tourism, trade zones, etc…
5. Perhaps Egypt's joining an international economic trade cartel within which the potential of free trade is enhanced (but Egypt still confronts the world as a price taker).

*Low growth – low capital scenario*

1. The government continues to allocate public capital to 'mega-projects' that pay off slowly if at all; the result is a crowding-out of private (and other public) domestic investment.
2. Privatized is hampered by cultural reluctance so that domestic private investment is further discouraged.
3. Cultural barriers continue so that the population declines responsibility for the social opportunity cost of their consumption (e.g., in water) and continues to be reluctant to move in response to anything but absolute necessity and/or crisis.
4. Egypt confronts the world marketplace as a price taker.

[a] High and low population growth might be assumed for each general scenario and selected variants.

determinants of mitigative capacity at any point in time should include a variety of characteristics that are themselves determined by both history and a range of 'not-implausible' futures. For each decision unit, like a country, at each point in its past, present, and future, then, mitigative capacity would depend upon:

- the range of viable technological options for reducing emissions,
- the range of viable policy instruments with which it might effect the adoption of these options,
- the structure of critical institutions and the derivative allocation of decision-making authority,
- the availability and distribution or resources required to underwrite their adoption and the associated, broadly defined opportunity cost of devoting those resources to mitigation,
- the stock of human capital, including education and personal security,
- the stock of social capital including the definition of property rights the country's access to risk spreading processes, and

TABLE II
Adaptive capacity in fishing along the northern coastline of Egypt

| Determinant of Capacity | Evaluation |
|---|---|
| *A. High growth scenario* | |
| 1. Adaptation options | Adopt new technologies for deeper waters; invest in new methods and new boats; enact demonstration projects |
| 2. Resource availability | Anticipated increase in investment from private, public and international sources likely |
| 3. Institutions | Adequate with appropriate evolution |
| 4. Human capital | Adequate |
| 5. Social capital | Adequate at the state level; limited at the micro-level |
| 6. Risk spreading | Experience based on old technology; limited with new technology and methods |
| 7. Information and credibility | Adequate at the state level; education and demonstration required at the micro-level |
| *B. Low growth scenario* | |
| 1. Adaptation options | Same as above |
| 2. Resource availability | Low investment from private and public sources likely only in response to a crisis |
| 3. Institutions | Inadequate with appropriate evolution less likely |
| 4. Human capital | Adequate |
| 5. Social capital | Limited at the state level; severely limited at the micro-level |
| 6. Risk spreading | Experience based on old technology; extremely limited with new technology and methods |
| 7. Information and credibility | Adequate information at the state level; little if any credibiity at the micro-level |

- the ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-makers, themselves.

This is, essentially, the same list of determinants that was recorded above for adaptive capacity. The results of their application on the emissions side of the climate issue need not be same, however.

### 3.1. HYPOTHESES DRAWN FROM THE DETERMINANTS OF MITIGATIVE CAPACITY

The capacity to reduce emissions of greenhouse gases can vary dramatically from nation to nation, from sector to sector, from region to region, from group to group, and from timeframe to timeframe. This is a corollary of the analogous hypothesis expressed in terms of adaptive capacity. It follows immediately that aggregating mitigation responses to the climate challenge across nations and across time can be a dangerous business.

It is quite possible for one country simultaneously to display high adaptive capacity and low mitigative capacity (or visa versa) even though both capacities share the same list of determinants. To see how, note that a nation's capacity either to mitigate or to adapt can be low if it is weak in any one of the underlying determinants. Consider, then, a wealthy nation like the United States where the damages associated with climate change can be focused on a small but well-connected group of people while the cost of a wide range of adaptation options can, through a well-established tax system, be distributed across the entire population. Property owners along the south shore of Long Island have, for example, convinced their legislators to use state and federal money to nourish the barrier islands that protect their homes from coastal storms and rising seas. Adaptive capacity could be high, in such cases, because the people at risk from climate change have a strong incentive to push for adopting one or more of the available adaptation options while the people paying the bills would see almost no effect on their own well-being. Their taxes might be slightly higher, or existing revenues might be redirected in a complicated appropriations process that few follow and fewer understand.

The population of the United States does, on the other hand, include another small group of people who see themselves threatened by most, if not all, of the wide range of available mitigation options and/or policies available to its government. The benefits of mitigation would meanwhile be marginal for most people. They would surely be distributed widely across the country and spread far into the future. Mitigative capacity in the United States could then be small, not because lists of technological options or mitigative policies were short and not because resources were lacking. Rather, a collective will to mitigate might be undone because the potential losers had effective access to the governance structure in the United States Senate through which they could block any attempt to do so.

Thirdly, countries that are the most vulnerable to climate change may have the smallest mitigative capacity. Vulnerability to climate change results from high exposure to climate impacts, low adaptive capacity, or both. In the first case, the objective of adapting to change could join with other objectives designed to mitigate other stresses to make mitigating climate change a low priority. In short, the opportunity cost, broadly defined, of expending resources to reduce greenhouse gas emissions could simply be too high. In the second, the same factors that diminish adaptive capacity could work to diminish mitigative capacity. And in the third, both deleterious correspondences could work to amplify one another.

The very same arguments apply to countries that are most vulnerable to the social and economic stresses imposed by low development, weak sustainability, serious equity problems, and the like. These countries already face challenges imposed by widespread poverty, malnutrition, poor education, poor sanitation, significant economic weakness, or severe strains on resources. They could therefore be expected to exhibit small mitigative capacities in part because the opportunity costs of devoting resources to mitigation would again be too high. These connections appear as severe constraints in all of the components of mitigative capacity; but they also appear in the definition of the context within which mitigative capacity must be judged.

It follows that enhancing any one component of mitigative capacity may (or may not) reduce the (marginal) cost of mitigation either because it would expand the set of possible mitigative options or because it would reduce the constraints that stand in the way of their efficient application. Looking at the determinants of mitigative capacity makes it clear that this cost-reducing potential could be activated in many ways. Adding to the list of available technological options could lower the cost implementing a specific policy designed to accomplish a specific objective, of course, but serious constraints could stand in the way. The additions would have to be less expensive than the existing alternatives. They would have to be structurally, socially, politically, and culturally feasible; and their informational requirements could not exceed the informational capacity of the host. Adding to the list of policy designs could similarly reduce costs, but only if the new additions were not precluded by the same set of constraints.

More subtle means of reducing mitigation costs might also be possible, especially when multiple cost metrics are included in the calculus. Improving the definition and distribution of property rights could, for example, reduce costs by broadening access to and interest in environmental decision-making processes. Doing so would hold the potential of bringing more technologies and policy options into the set of feasible alternatives (i.e., by removing some of the social constraints that might have been blocking their consideration). Programs that successfully reduced poverty and/or distributed resources more equitably could elevate environmental concerns in the social agenda across a wider portion of the population and thereby be equally effective in expanding the set of feasible technologies and policies. Social insurance programs that redistributed the losses and gains of different approaches could accomplish the same thing. The list is nearly endless, as soon as the diversity of the determinants of mitigative capacity is recognized.

A nation, region, or community's context in the domestic and international scene plays a significant role in determining its ability to exercise its mitigative capacity because outside entities could influence the effectiveness of technological options and/or domestic policy alternatives. External forces could, therefore, have a secondary but nonetheless significant effect on the likelihood that mitigation might occur. The contextual setting for evaluating mitigative capacity notes explicitly that international trade policies could play a role, for example. Trade policies, be they

global or the domestic policies of significant trading partners, directly influence the national incomes of developed and developing countries. They influence the distribution of income with countries, and they influence the degree to which specific countries' development plans put pressure on their stocks of social, human, and natural capital. Each of these factors subsequently affects the constraints that determine the set of feasible mitigation technologies and policies.

It is widely recognized that technology is an important component of mitigative capacity. Looking across the list of other determinants, however, it is clear that the proper insight to be drawn from this work is that technology may matter. It is not enough simply to have a long list of technologically feasible mitigative options. Other factors, some related to development, equity, and sustainability and others related to social, political, cultural and economic constraints, could work to reduce mitigative capacity even if the list of technological options is long. Similarly, sequestration has attracted enormous attention for its potential to reductions in greenhouse gas concentrations. Looking through the lens of mitigative capacity, though, it is clear that the proper reading of this literature is that sequestration may work effectively to reduce climate change. Sequestration might be technically feasible in one region or another, but mitigative capacity instructs us to look further to see if undertaking sequestration initiatives in those regions might run counter to other social, political, cultural, development, or economic objectives. A country pursuing an objective of food independence could, for example, be expected to resist allocating possible farmland to sequestration. Sequestration could, through its allocative implications, exacerbate income inequality by diminishing the opportunities available to the poor. This list can be extended, too, but the point is that placing sequestration into the mitigative capacity framework highlights requirements that extend well beyond notions of technological and economic feasibility.

### 3.2. USING THE DETERMINANTS OF MITIGATIVE CAPACITY TO FRAME RESEARCH INITIATIVES

Contemplating the complexity of mitigative capacity reveals that the uncertainties that cloud our understanding of mitigation extends far beyond the boundaries of the uncertainties that distort our perceptions of how various technologies might be applied and how various policy designs might function. The same determinants of mitigative capacity that bring other social, cultural, political and economic issues into play add to the list of these sources just as they do on the impacts side of the climate change calculus. In short, therefore, our vision of exactly how mitigation might evolve, how much it might cost, how effective it might be, and how costs and benefits might be distributed is just as clouded as our vision of how systems might adapt to the impacts of climate change and climate variability.

Every challenge represents an opportunity, though. In this arena, working with the determinants of mitigative capacity offers a way of organizing not only the analysis of mitigation, but also negotiation over the how to meet the mitigation challenge. Indeed, enhancing mitigative capacity can be a policy objective in and of itself in the same way that enhancing adaptive capacity can be. Indeed, the means by which this enhancement might be accomplished can be drawn directly from an understanding of how the determinants work in one country or another, how they might complement one another, and how they might conflict.

The opportunity cost of implementing any capacity enhancement initiative must be measured broadly to include

- their implications along multiple dimensions,
- the sensitivity of these implications to alternative designs,
- the availability of credible information and the ability to monitor critical factors in the face of uncertainty,
- the definition of a wide range of policy objectives and the degree to which they complement the objective of climate mitigation,
- the credibility of the policies and the legitimacy of the policy makers,
- social, cultural, political and economic constraints to the implementation of their policies and initiatives, and
- the structure of the decision-making process, itself.

Different policy designs for the same objective can, for example, have different distributional impacts – different sets of winners and losers across space and time who all come to the table with differential access to decision-making authorities. Moreover, the opportunity cost of any policy should be measured not only in terms of economic cost, but also in terms of non-economic metrics that measure progress or regression across a wide range of critical variables and against an equally large range of social, cultural or political objectives. Finally, differences in the flexibility of alternative policy designs can also mean differences in long-term sustainability from one country to another. Flexibility in response to one mitigation policy that adds efficiency and reduces costs in one place may threaten the very existence of critical systems in another.

## 4. Conclusions

The determinants of the capacity to adapt to climate change or to mitigate its development include the availability of technological and policy options with which to effect either strategy as well as access to resources with which to undertake those options. The lists of determinants are, however, longer than this. Both capacities

also depend upon nation-specific characteristics: the distribution of resources, the relative empowerment of various segments of the population, the credibility of empowered decision-makers, the degree to which climate objectives complement their other objectives (that might include development and equity, for example), access to credible information and the will to act on that information, the ability to spread risk intra- and inter-nationally, and so on. Recognizing these multiple determinants of adaptive and mitigative capacity helps to identify the relevant policy domains so that policy makers can see clearly how each might help nations and the globe meet the climate challenge over the short, medium and long terms. Design issues will play a critical role in the short run, but other issues like sustainability and equity assume more central roles as the decision timeframe expands. Indeed, over the very long run, visions of alternative development pathways and means of achieving them could dominate.

The determinants of adaptive or mitigative capacity are not unique to the stresses caused by a changing climate. Indeed, individuals, communities, nations, and institutions respond to multiple stresses by trying to reduce their influence (mitigation) and by trying to cope with the residual consequences (adaptation). Exploring the capacity to mitigate many different stresses can highlight the approaches to be included in a broadened policy domain; and so it will offer insight into how the capacity to mitigate against climate change can be enhanced.

Enhancing each of the determinants of both capacities can be policy objectives in and of themselves. It follows that the set of determinants goes a long way in defining the degree to which the set of policy domains can profitably be expanded. Understanding their interaction, per the mode of inquiry highlighted above, can provide insight into when and under what circumstances enhancing one or another determinant might pay the most dividends and/or when it might prove ineffective because of deficiencies in other areas. Enhancing capacity over the long run can involve thorough integration of climate issues with other social and political objectives, but policies and initiatives designed to advance any one of these objectives can influence the efficacy of policies and programs designed to promote any other. Indeed, these interactions are highly dependent on the overall development trajectory that any nation chooses, so exercising vision over the very long run can pay enormous dividends. Equally important is the realization that the long run is really comprised of a series of short runs. The efficiency-based determinants of adaptive and mitigative capacity can play a central role in each short-run segment when incremental progress across multiple domains is the goal. But thorough integration over the determinants of both makes it clear that short-run policies should also be judged in terms of their abilities to accelerate (or at least not to impede) progress toward multiple long-term objectives.

The factors that determine mitigative capacity may interact differently than they do in determining adaptive capacity, especially if the equity and distributional implications of mitigation and adaptation are not the same. Focusing research and policy attention on the same list of determinants can, nonetheless, show when,

where, and how synergies and conflicts between mitigation and adaptation might arise. Focusing research on these determinants also makes it clear that policy-making in either sphere can be matched by complementary action in the other. This is the point of Kane and Shogren (2000), but it is reinforced here by looking carefully at the coincident lists of determinants for mitigative and adaptive capacity. Coping with the climate problem is not a question of mitigating and then adapting. Nor is it a question of adapting and then mitigating. It is a more holistic question of doing both at the same time, and focusing attention on the common determinants of mitigative and adaptive capacities can lead productively to understanding of exactly how to meet these coincident challenges. Indeed, even a cursory look at the determinants of mitigative and adaptive capacity make it clear that the best climate policies for some nations over the foreseeable future may have nothing specific to do with climate. From a pedagogical perspective, then, there is a need to expand integrated assessments of global change to more fully capture multiple factors by including other stresses and wider ranges of coping strategies.

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