Available online at www.sciencedirect.com
SCIENCE DIRECT
Environmental Science & Policy 8 (2005) 579–588
Environmental Science & Policy
www.elsevier.com/locate/envsci

Integrating mitigation and adaptation into climate and development policy: three research questions

Richard J.T. Klein [a,b,*], E. Lisa F. Schipper [c,d,e], Suraje Dessai [d,e]

[a] Potsdam Institute for Climate Impact Research, P.O. Box 601203, 14412 Potsdam, Germany
[b] Stockholm Environment Institute–Oxford, 266 Banbury Road, Suite 193, Oxford OX2 7DL, UK
[c] International Water Management Institute, P.O. Box 2075, Colombo, Sri Lanka
[d] School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK
[e] Tyndall Centre for Climate Change Research, University of East Anglia, Norwich NR4 7TJ, UK

Abstract

The potential for developing synergies between climate change mitigation and adaptation has become a recent focus of both climate research and policy. Presumably the interest in synergies springs from the appeal of creating win–win situations by implementing a single climate policy option. However, institutional complexity, insufficient opportunities and uncertainty surrounding their efficiency and effectiveness present major challenges to the widespread development of synergies. There are also increasing calls for research to define the optimal mix of mitigation and adaptation. These calls are based on the misguided assumption that there is one single optimal mix of adaptation and mitigation options for all possible scenarios of climate and socio-economic change, notwithstanding uncertainty and irrespective of the diversity of values and preferences in society. In the face of current uncertainty, research is needed to provide guidance on how to develop a socially and economically justifiable mix of mitigation, adaptation and development policy, as well as on which elements would be part of such a mix. Moreover, research is needed to establish the conditions under which the process of mainstreaming can be most effective. Rather than actually developing and implementing specific mitigation and adaptation options, the objective of climate policy should be to facilitate such development and implementation as part of sectoral policies. Finally, analysis needs to focus on the optimal use and expected effectiveness of financial instruments, taking into account the mutual effects between these instruments on the one hand, and national and international sectoral investments and official development assistance on the other.

Keywords: Climate policy; Mitigation; Adaptation; Energy; Impacts; Vulnerability; Synergies; Mainstreaming; Instruments

1. Introduction

Human-induced climate change could have major adverse consequences for the world's ecosystems and societies. It is caused by the emission of greenhouse gases, which trap long-wave radiation in the upper atmosphere and thus raise atmospheric temperatures, as well as produce other changes in the climate system. Carbon dioxide is the most important of these gases and its atmospheric concentration has increased exponentially since the beginning of the industrial revolution as a result of fossil fuel combustion and land-use change. In 1800, the atmospheric concentration of carbon dioxide was about 280 parts per million (ppm); today it is about 350 ppm and rising. Similar increases have been observed for other greenhouse gases such as methane and nitrous oxide (Houghton et al., 2001).

Projections of future climate change are based on global scenarios of future emissions of greenhouse gases. These emission scenarios are subject to great uncertainty, as they reflect patterns of economic development, population growth, consumption and other factors that are not easy to predict over a 100-year period. A large number of emission scenarios are used to account for this high degree of uncertainty. The most recent emission scenarios, which formed the basis of the climate projections of the IPCC Third Assessment Report (TAR), were published in the IPCC Special Report on Emission Scenarios

* Corresponding author. Fax: +49 331 2882642.
E-mail address: richard.klein@pik-potsdam.de (Richard J.T. Klein).

1462-9011/$ – see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.envsci.2005.06.010

(SRES; Nakićenović and Swart, 2000) and are known as the SRES scenarios.

By 2100, carbon cycle models project atmospheric carbon dioxide concentrations of 540–970 ppm for the illustrative SRES scenarios, with a range of uncertainty of 490–1260 ppm (Houghton et al., 2001). Based on these projections and those of other greenhouse gases and sulphate aerosols, the IPCC TAR projects an increase in globally averaged surface temperature of 1.4–5.8 °C over the period 1990–2100. These results are for the full range of 35 SRES scenarios, based on a number of state-of-the-art global climate models. The IPCC TAR further states that it is very likely that nearly all land areas will warm more rapidly than the global average, particularly those at northern high latitudes in the cold season (Houghton et al., 2001).

The United Nations Framework Convention on Climate Change (UNFCCC) identifies two options to address climate change: mitigation of climate change by reducing greenhouse gas emissions and enhancing sinks, and adaptation to the impacts of climate change. Mitigation comprises all human activities aimed at reducing the emissions or enhancing the sinks of greenhouse gases such as carbon dioxide, methane and nitrous oxide. Adaptation in the context of climate change refers to any adjustment that takes place in natural or human systems in response to actual or expected impacts of climate change, aimed at moderating harm or exploiting beneficial opportunities.

Most industrialised countries have committed themselves, as signatories to the UNFCCC and the Kyoto Protocol, to stabilising greenhouse gas emissions at 1990 levels by the year 2000 and to reducing their overall greenhouse gas emissions by an average of 5.2% compared to 1990 by the period 2008–2012. However, because of the lag times in the global climate system, no mitigation effort, no matter how rigorous and relentless, is going to prevent climate change from happening in the next few decades (Wigley, 1998; Pittock and Jones, 2000; Dessai and Hulme, 2001). In fact, the first impacts of climate change are already being observed in natural systems (e.g., Parmesan and Yohe, 2003; Root et al., 2003). Adaptation is therefore a necessity (Parry et al., 1998). On the other hand, reliance on adaptation alone could well lead to a magnitude of climate change to which effective adaptation is only possible at very high social and economic costs. Thus, it is no longer a question of whether to mitigate climate change or to adapt to it. Both mitigation and adaptation are essential in reducing the risks of climate change.

Nonetheless, and despite the fact that the UNFCCC refers to both mitigation and adaptation, until recently national and international climate policy focused mainly on mitigation. On the one hand this reflected the concern of some that a stronger focus on adaptation would weaken society's willingness to mitigate climate change, on the other hand it signified the belief of others that the ''invisible hand'' of natural selection and market forces will bring about adaptation without the need for policy intervention. It also reflected the limited understanding of what constitutes adaptation to climate change, which in turn resulted from the limited attention given to adaptation by the scientific community (Kates, 1997). Since the IPCC TAR established that humans are – at least in part – responsible for climate change and that some impacts can no longer be avoided, academic and policy attention for adaptation has increased sharply (Burton et al., 2002).

Notwithstanding this increase in attention, the science of adaptation to climate change is still in its infancy. Interestingly, most work to date has all but ignored the fact that adaptation has been studied extensively in fields as diverse as ecology, psychology and anthropology. As a result, most of the recent work has focused on understanding the concept of adaptation to climate change without benefiting from work done in other disciplines; more research is now needed to understand its process. The concept of adaptive capacity has been introduced, reflecting an awareness that the mere existence of adaptation options does not mean that every vulnerable community, sector or country has access to these options or is in a position to implement them (Smit et al., 2001). It has brought to light the importance of development policy and natural hazard management to adaptation. It has also helped to demonstrate that adaptation is not a new activity only relevant in the context of climate change, but instead an ongoing process to reduce vulnerability to natural climate variability as well as human-induced climate change.

It is not yet possible to distinguish between human-induced climate change and natural climate variability on a regional scale (Scheraga and Grambsch, 1998; Hulme et al., 1999). Adaptation in the context of the UNFCCC refers only to climate change, yet it is clear that many societies are not well adapted to current climate variability. Ribot et al. (1996) suggest that by addressing vulnerability to climate variability a buffer can be developed against vulnerability to future consequences of climate change. Along the same lines, Smithers and Smit (1997) suggest that for current variability, an improved understanding of individual and societal adaptation not only provides insights for estimating future adjustment, but also helps to address current problems of sustainable development in light of variable and uncertain environments. This explains the existence of ''no-regret'' adaptation: adaptation that would reduce vulnerability to climate change but which also has immediate benefits from reducing vulnerability to climate variability.

At the seventh Conference of the Parties to the UNFCCC (COP-7) in 2001, recognition of the high vulnerability of some developing countries to climate change and the consequent need for adaptation led to the establishment of three funds that are mainly dedicated to adaptation (Barnett and Dessai, 2002; Huq, 2002). A Least Developed Country fund and a Special Climate Change fund were created under the UNFCCC and an Adaptation fund under the Kyoto Protocol. These funds represent a major breakthrough for adaptation, yet a number of problems remain: (i) contributions

to the funds remain essentially voluntary and contributions to date are insufficient to meet adaptation needs; (ii) the "incremental cost" and "global benefits" criteria of the Global Environment Facility (GEF; UNFCCC's financial mechanism) do not match the nature of adaptation; and (iii) the current layout of the funds supports sector-specific adaptations rather than societal adaptation, which could bring about more benefits. Furthermore, the terms of these funds have not yet been fully negotiated, and the amount of money available from the Adaptation fund will depend on the success of international emission trading under the Kyoto Protocol, as well as on the price of carbon.

Against this background of recent developments in research and policy on adaptation to climate change, this paper reviews an emerging issue in climate policy: the desire to consider mitigation of and adaptation to climate change in tandem. It discusses the call for creating and exploiting synergies between mitigation and adaptation, and it evaluates the desirability of exploring the optimal mix of mitigation and adaptation. The paper then describes the evolving and newly emerging roles and objectives of climate policy. Finally, within this context, three policy-relevant research questions concerning the interlinkages between mitigation and adaptation are presented.

2. Synergies between mitigation and adaptation

Set out in the UNFCCC as the two response options to human-induced climate change, mitigation and adaptation represent two fundamentally dissimilar approaches. The differences and potential conflict between the two approaches are now well documented, and have been seen as an important characteristic of the climate change literature (Cohen et al., 1998). The two options differ from each other in at least three important ways. The first difference between mitigation and adaptation is related to the spatial and temporal scales on which they are effective. Whilst they may well be implemented on the same local or regional scale, mitigation has global benefits, whereas adaptation typically works on the scale of an impacted system, which is regional at best, but mostly local. In addition, the benefits of mitigation activities carried out today will be evidenced in several decades because of the long residence time of greenhouse gases in the atmosphere, whereas many adaptation measures would be effective immediately and yield benefits by reducing vulnerability to climate variability. As climate change continues, so will the benefits of adaptation increase.

The second difference between mitigation and adaptation is the extent to which their costs and, in particular, their benefits can be determined, compared and aggregated. Irrespective of the diversity of mitigation options, they all serve to reduce greenhouse gas emissions and in view of its global benefits it is irrelevant where in the world the mitigation takes place. Expressed as CO_2-equivalents, the emission reduction achieved can be compared with that of other mitigation options and if the implementation costs are known, the cost-effectiveness of these options can be determined and compared (Moomaw et al., 2001). The benefits of adaptation are more difficult to express in a single metric, impeding comparisons between adaptation options. Adaptation benefits can be in terms of monetary damage avoided, human lives saved, losses to natural and cultural values avoided, and so on. Moreover, as a result of the local or regional nature of adaptation, benefits of adaptation will be valued differently depending on the social, economic and political contexts within which they occur.

Even when focusing only on the monetary benefits of adaptation, there are practical challenges to their assessment. Fankhauser (1998) and Callaway et al. (1998) show that, in principle, the benefits of adaptation are the climate-related damage costs one avoids by taking adaptation measures (assuming that climate change would have adverse consequences). Thus, if one quantifies the potential impacts of climate change on a system assuming no adaptation, as well as its residual impacts assuming adaptation, the benefits of adaptation are given by the difference between the two. From the value thus obtained one can subtract the costs of implementing the adaptation options to arrive at the net benefits of adaptation. However, as argued by Klein (2003), the practice of assessing and comparing the benefits of adaptation to climate change is fraught with difficulties, for a number of reasons. Most important in the context of this paper is the difficulty, if not impossibility, of distinguishing between adaptation to climate change and adaptation to climate variability. Both types of adaptation are very similar by nature and they can mutually reinforce each other. For example, both types of adaptation would include protection against weather extremes and related hazards. Weather extremes occur independently of climate change but their magnitude and frequency of occurrence is likely to be affected as a result of climate change.

The third difference between mitigation and adaptation concerns the actors and types of policies involved in their implementation. Mitigation primarily involves the energy and transportation sectors in industrialised countries, and to an increasing extent the energy and forestry sectors in developing countries. In addition, the agricultural sector plays a role in mitigation. Compared to adaptation, the number of sectoral actors involved in mitigation is limited. Moreover, they are generally well organised, linked closely to national planning and policymaking, and used to taking medium to long-term investment decisions. Over the past decade, incentives and opportunities created by national and international climate policy have increasingly stimulated mitigation activities by the energy and forestry sectors.

In contrast, the actors involved in adaptation represent a large variety of sectoral interests, including agriculture, tourism and recreation, human health, water supply, coastal management, urban planning and nature conservation. Whilst these sectors have in common that they are

potentially impacted by climate change, decisions as to whether or not to adapt are taken at different levels, ranging from individual farmers to national planning agencies. For these actors, climate change is typically not of immediate concern. Moreover, in spite of the potential magnitude of climate change they often have little incentive to incorporate adaptation into decision-making, either because policy and market failures do not encourage medium to long-term planning, because responsibilities for action are unclear or because adaptation is concerned with collective goods such as safety, human health and ecosystem integrity.

Notwithstanding these differences between mitigation and adaptation, opportunities are being sought to develop synergies between the two options. This seems sensible in light of the fact that the level of climate change impacts, and whether or not this level is dangerous (cf. Article 2 of the UNFCCC; Section 4), is determined by both mitigation and adaptation efforts. Moreover, the UNFCCC explicitly refers to both options and, as indicated in Section 1, both are now essential in reducing the risks of climate change.

Synergies in climate policy are created when measures that control atmospheric greenhouse gas concentrations also reduce adverse effects of climate change, or vice versa. Such measures have ancillary benefits, which produces win–win situations (Kane and Shogren, 2000). A classic example is the planting of trees in urban areas: they sequester carbon as they grow and they reduce urban heat stress in summer (albeit not until the trees are big enough to create a sizeable area of shade; this is one example where adaptation does not have immediate benefits). More synergies between mitigation and adaptation have been explored during the past few years; most combine the protection or development of forests with improved land use and watershed management, nature conservation and agroforestry. For example, the Noel Kempff Mercado Climate Action Project in Bolivia has the triple aim of sequestering CO_2, preserving one of the richest and most biologically diverse ecosystems in the world and fostering sustainable development in local communities. The USD 11 million project, which spans over 1.5 million hectares, is a partnership of the Government of Bolivia, the Friends of Nature Foundation, the Nature Conservancy and three energy companies (American Electric Power, PacifiCorp and BP Amoco).

The development of synergies is sought because of the intuitive appeal of implementing climate policy by carrying out mitigation and adaptation activities simultaneously. In addition, it connects mitigation and adaptation with natural resource management, biodiversity conservation and measures to combat desertification. Thus, synergies can be created not only between mitigation and adaptation, but also between measures to implement the UNFCCC and the other international environmental agreements produced at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992: the Convention on Biological Diversity, the Convention to Combat Desertification and the Forestry Principles (UNDP, 1997).

Whilst it is clear that climate policy cannot and will not be implemented in isolation of other environmental and economic policies, there are risks involved in focusing too strongly on creating synergies. First, in view of the different actors involved in mitigation and adaptation, the implementation of synergetic measures will encounter greater institutional complexity, both nationally and internationally, which could limit the efficacy of the measures. Second, it is doubtful that sufficient opportunities for synergies can be identified to achieve the levels of mitigation and adaptation deemed required. Third, even for those opportunities that are identified it is unclear whether they represent a wise investment in terms of the mitigation and adaptation benefits accrued. The net effect of investing in synergetic measures – in terms of reducing damages – may well be smaller than when half the money is invested in more efficient mitigation options and the other half in more efficient adaptation options.

The current emphasis on developing synergies may provide perverse incentives to project managers to portray their projects (which may well have very laudable goals in their own right) as combined mitigation and adaptation projects, even though they were not intended as such and do not make the most efficient use of available resources for mitigation and adaptation. There is a risk that mitigation activities will simply be labelled adaptation activities and vice versa so as to make them eligible or increase their attractiveness for funding. This could diminish the effectiveness of the limited funds available for climate policy and be at the cost of vulnerable communities whose only opportunities to adapt to climate change come without mitigation benefits (e.g., coastal communities threatened by sea-level rise).

In conclusion, there appear to be good reasons not to focus on creating (limited and sometimes far-fetched) synergies between mitigation and adaptation, as this could lead to projects that are difficult to implement and administer, are cost-ineffective and, when taken together, produce insufficient mitigation and adaptation benefits. Instead, it is encouraged to seek ancillary benefits of mitigation and adaptation outside climate policy, as long as it is recognised that these are different for the two options. For example, ancillary benefits of mitigation can include reduced air pollution (Cifuentes et al., 2001) and increased opportunities for forest-based recreation, whilst adaptation can have the ancillary benefit of reducing development challenges associated with today's climate variability, such as natural hazards and food insecurity.

3. The optimal mix of mitigation and adaptation

Having established the differences between mitigation and adaptation, this section will examine the call for identifying the optimal mix of these options. As stated before, the UNFCCC refers to both options and both are now essential. Recognising the finitude of funds and the need to make trade-offs between the long-term global benefits of

mitigation and the immediate local benefits of adaptation, the question has arisen as to exactly how much mitigation and adaptation would be optimal, and in which combination. In fact, the Global Analysis, Integration and Modelling Task Force of the International Geosphere–Biosphere Programme has included this question in its list of 23 Hilbertian questions,[1] which set the agenda for earth system research (GAIM Task Force, 2002; see also Michaelowa, 2001).

It is doubtful whether it is sensible to refer to "the" optimal mix of mitigation and adaptation. As concluded by the IPCC TAR, striking the appropriate balance between mitigation and adaptation will be a tedious process and the optimal mix of response options will vary by country and over time, as local conditions and costs change. Striking the balance will be particularly challenging because of some unique characteristics of the problem; long time horizons; non-linear and irreversible effects; the global nature of the problem; social, economic, and geographic differences amongst affected parties; and the fact that institutions needed to address the issue have only partially been formed (Arrow et al., 1996; Tóth et al., 2001). Given these characteristics, as well as the widely differing interests, values and preferences within and between societies, there is no single optimal mix of mitigation and adaptation. In addition, uncertainty about climate and socio-economic change strongly affects the outcome of any optimisation exercise. As soon as new information becomes available, the optimal mix will be different (Lempert et al., 2000).

Finally, the optimal mix will vary depending on the decision criteria and framework that are applied to determine it. Tóth et al. (2001) provide a number of examples of such frameworks, including cost-benefit analysis, cost-effectiveness analysis, tolerable windows approach, game theory and multi-criteria analysis. Each framework differs in the way assumptions, criteria and value judgements are handled and the choice for a particular decision framework is essentially a policy decision. Nonetheless, there is some consensus that under conditions of deep uncertainty, robustness, as opposed to optimisation, is a better decision-making criterion (Lempert and Schlesinger, 2000).

Given these constraints to determining the optimal mix of mitigation and adaptation, a more useful question is what would constitute a mix that is justifiable from a social, environmental and economic perspective, which elements would be part of such a mix and how it can be determined.

4. The roles of climate policy

Traditionally, climate policy has been largely synonymous with energy policy, with little attention being given to enhancing sinks or to adaptation. Energy policy has been the logical entry point for mitigation, as energy supply is dominated by fossil fuels, the main source of anthropogenic greenhouse gas emissions. This was also reflected in the IPCC Second Assessment Report, which was heavily biased towards addressing climate change by way of mitigation, in particular by pursuing energy options (Kates, 1997). The IPCC TAR, on the other hand, provided a more balanced treatment of mitigation and adaptation, illustrating the increased interest in adaptation. Even greater emphasis on adaptation is expected for the forthcoming IPCC Fourth Assessment Report, due in 2007.

Both in the academic arena, as well as in climate policy, adaptation is now receiving the recognition that many adaptation scholars have been advocating (e.g., Burton, 1994, 2000; Pielke, 1998). Until recently, adaptation was contained in a single COP decision (decision 11/CP.1), which set out three stages of adaptation that some believe were drafted in a manner to enable further decisions on adaptation to be delayed (Burton et al., 2002). Additional decisions have since been taken, most importantly decisions 5/CP.7, 6/CP.7 and 28/CP.7, the latter introducing the opportunity for least-developed countries (LDCs) to prepare National Adaptation Programmes of Action (NAPAs). As stated in Decision 28/CP.7:

"The rationale for developing NAPAs rests on the low adaptive capacity of LDCs, which renders them in need of immediate and urgent support to start adapting to current and projected adverse effects of climate change. Activities proposed through NAPAs would be those whose further delay could increase vulnerability or lead to increased costs at a later stage."

It is recognised that climate change poses a threat to important development issues such as water supply, food security, human health, natural resources and protection against natural hazards. This recognition has moved adaptation from being the "handmaiden to impacts research in the mitigation context" (Burton et al., 2002) to an activity that is considered crucial within the broader context of sustainable development. The link between adaptation and sustainable development is particularly relevant when seeking to enhance the capacity of countries and communities to adapt to climate change, which is often limited by lack of resources, poor institutions and inadequate infrastructure, amongst other things (Smith et al., 2003).

Thus, over the past decade climate policy has evolved from being synonymous to energy policy to sharing a large interface with sustainable development. At present, three roles can be identified for climate policy: (i) to control the atmospheric concentrations of greenhouse gases; (ii) to prepare for and reduce the adverse impacts of climate change and take advantage of opportunities; and (iii) to address development and equity issues.

The objective of the UNFCCC, as stated in Article 2, is

"to achieve ... stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent

[1] Named after David Hilbert, who presented a list of 23 mathematical problems to the International Congress of Mathematicians in Paris in 1900.

dangerous anthropogenic interference with the climate system ... 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.''

At first sight, this objective only refers to the first role of climate policy, which explains the initial focus on energy policy. However, taking a closer look, the extent to which anthropogenic interference with the climate system can be considered dangerous is also determined by the ability of communities and sectors to adapt to potential impacts, which relates to the second and third of the above-mentioned roles. As for the third role (i.e., to address development and equity issues), climate change is not the primary reason for poverty and inequality, yet addressing these concerns is seen as a prerequisite for successful climate policy in many developing countries.

Linkages between climate change and development are increasingly recognised. Climate change is largely the result of human-induced greenhouse gas emissions that are driven by socio-economic development patterns characterised by economic growth, technology, population and governance. These socio-economic development patterns, in turn, determine vulnerability to climate change and the human capacity for mitigation and adaptation. The impacts of climate change on human and natural systems in turn influence socio-economic development patterns and thereby greenhouse gas emissions.

The World Summit on Sustainable Development (WSSD) in Johannesburg (August/September 2002) has provided a strong impetus to the discourse supporting links between climate policy and (sustainable) development. There is substantial academic and political support for this link (e.g., Cohen et al., 1998; Metz, 2000; Beg et al., 2002; Markandya and Halsnæs, 2002; AfDB, 2003; Klein and Smith, 2003) and several UNFCCC articles set out the provision for considering sustainable development. However, it raises the question as to whether greater emphasis on development and equity issues is justified within the UNFCCC context. Vulnerability to climate change is reduced not only when climate change is mitigated or when adaptation to the impacts takes place, but also when the conditions for those experiencing the impacts are improved. On the other hand, promoting development and equity is not a direct objective of the UNFCCC, and there is concern that scarce funds for mitigation and adaptation will be diverted into more general development activities.

In developing countries, this concern may be fuelled by the fact that climate change is often perceived as a long-term issue, where other challenges, including food security, water supply, sanitation, education and health care, require more immediate attention. The impetus provided by the WSSD has given rise to exploring and developing the concept of ''mainstreaming''. Mainstreaming involves the integration of policies and measures to address climate change into ongoing sectoral and development planning and decision-making, so as to ensure the long-term sustainability of investments as well as at reduce the sensitivity of development activities to both today's and tomorrow's climate (Klein, 2002; Huq et al., 2003). The concept is borrowed from the development discourse, where the mainstreaming of gender issues has long been understood as an effective way to ensure gender equity in development policies. By its very nature, energy-based mitigation (e.g., fuel switch and energy conservation) can only be effective when mainstreamed into energy policy. For adaptation, however, this link has not appeared as self-evident until recently.

Mainstreaming is seen as making more efficient end effective use of financial and human resources than designing, implementing and managing climate policy separately from ongoing activities. For example, the Caribbean project Mainstreaming Adaptation to Climate Change (MACC) aims at building national and regional capacity and facilitate governments' efforts to incorporate climate change considerations into planning and policymaking. The total budget of the project is USD 10.95 million, USD 5 million of which comes from the GEF and can be seen as the climate change component of the project. The remainder comes from the 12 Caribbean countries participating in the project, the Canadian International Development Agency (CIDA) and the United States National Oceanic and Atmospheric Administration (NOAA).

The objective of MACC illustrates the key challenge in climate policy: to build capacity and to facilitate action. Mitigation and adaptation are not merely the implementation of options; successful implementation depends on the availability of various types of resources to create an enabling environment for mitigation and adaptation, including the capacity to adapt and mitigate (Klein, 2001; Smit et al., 2001; Yohe, 2001). Moreover, the actual implementation of options, be they technical, institutional, legal or behavioural, would best be done by sectoral planning and management agencies ''on the ground'' (e.g., energy and water companies, agricultural planners, coastal management agencies), as well as private companies and individuals.

Thus, in addition to the three roles of climate policy identified at the beginning of this section, a fourth and perhaps more important role can be identified: to facilitate the successful integration and implementation of mitigation and adaptation in sectoral and development policies. This requires the building of mitigative and adaptive capacity, both on the micro and the macro-scale (Klein and Smith, 2003), as well as creating mechanisms and incentives for mainstreaming. It does not require developing synergies between mitigation and adaptation, but rather between building mitigative and adaptive capacity, and thus with development.

5. Three research questions

Mainstreaming is based on the premise that human vulnerability to climate change is reduced not only when

climate change is mitigated or when successful adaptation to the impacts takes place, but also when the living conditions for those experiencing the impacts are improved. Thus, the apparent conflict between development policies aimed at immediate issues and climate policy aimed at long-term livelihood protection is not a genuine one when it comes to reducing human vulnerability. However, where government budget allocation and donor funding are concerned, this conflict is very much a genuine one; indeed it is a real impediment to the implementation of effective and efficient measures to reduce vulnerability.

This conflict was brought to the fore at the workshop ''Enhancing the Capacity of Developing Countries to Adapt to Climate Change'', which was part of the First Sustainability Days in Potsdam in 2001. This workshop identified the conundrum that in those countries where adaptation is most needed (i.e., those that are particularly vulnerable to climate change), investment in adaptation may not necessarily be most effective. In fact, investments are likely to be most effective (in terms of reducing vulnerability) where adaptive capacity is highest. This highlights the important and complementary roles of development policy and climate policy in reducing vulnerability, not only to tomorrow's climate change but also to today's climate variability.

Based on these insights, the climate research and policy communities are increasingly studying opportunities to enhance adaptive and mitigative capacity, as this would increase the efficiency and effectiveness of adaptation and mitigation measures. Adaptive and mitigative capacity are believed to have great similarities and be determined by the same set of factors, including economic wealth, technology and infrastructure, information, knowledge and skills, institutions, equity and social capital. However, a better understanding of the two concepts is required to establish exactly how enhancing adaptive and mitigative capacity is different from or similar to development policy, how it would contribute to the process of mainstreaming and whether potential synergies exist between enhancing adaptive and mitigative capacity.

This paper has evaluated the role of climate policy to date, and argues that rather than at actually developing and implementing specific sectoral mitigation and adaptation options, climate policy should be aimed at facilitating such development and implementation as part of sectoral policies. However, at least three important questions arise from the discussion presented here, which need to be addressed for climate policy to take on this role effectively and efficiently. The three questions are as follows:

1. What constitutes a socially, economically and environmentally justifiable mix of mitigation, adaptation and development policy and how can it be achieved?

   As argued in Section 3, for a number of reasons it is impossible to determine the optimal mix of mitigation and adaptation options. Whatever mix is optimal will depend on local conditions, values, preferences, uncertainty and the choice of decision framework, as well as other factors. In the absence of perfect information, a number of alternative mixes may be proposed, which differ in their social, economic and environmental effects. For example, whilst one option may be equitable and environmentally sound, it may be less cost-effective than another option, which could, however, be less socially and environmentally acceptable. To determine which mix or mixes are justifiable, some multi-criteria framework needs to be designed with which one can capture, quantify and compare the direct and ancillary effects of implementation on each of these (and possibly other) criteria.
2. How can capacity be developed in order to seize opportunities and overcome constraints on implementing mitigation and adaptation options as part of sectoral policies?

   Section 4 introduced the concept of mainstreaming climate policy into sectoral and development planning and decision-making, and argued that climate policy should be aimed at facilitating the development and implementation of mitigation and adaptation options. The actual development and implementation of options is the responsibility of public and private sectoral actors. Research is needed to establish the conditions under which the process of mainstreaming can be most effective. In connection to this, there is a need to investigate how best to build and use capacity for mitigation and adaptation, in particular in developing countries.
3. How can existing financial instruments for climate policy best be used in a broader context of sectoral investments, official development assistance and other policies aimed at risk reduction and sustainable development?

   The current funding arrangements for climate policy have not been designed to facilitate adaptation and mainstreaming. In particular, the GEF eligibility criteria of incremental cost and global benefits impede investments in adaptation. In addition, the issue of additionality of funds raises questions when climate policy is to be integrated and co-funded with sectoral and development policies. There is a need to analyse the optimal use and expected effectiveness of the various bilateral and multilateral financial instruments that are available for climate policy, taking into account the mutual effect between these instruments on the one hand, and national and international sectoral investments and official development assistance on the other. In addition, financial instruments for climate policy need to be analysed in conjunction with those aimed at natural hazard reduction and sustainable development.

6. Discussion and conclusions

The United Nations Framework Convention on Climate Change identifies two strategies to address climate change:

mitigation of climate change by reducing greenhouse gas emissions and enhancing carbon sinks, and adaptation to the impacts of climate change. For over a decade, climate policy has been largely synonymous with energy policy, with little attention being given to enhancing sinks or to adaptation. The international climate policy community is now becoming aware that energy policy alone will not suffice in the quest to control climate change and limit its impacts. Climate policy is being expanded to consider a wide range of options aimed at sequestering carbon in vegetation, oceans and geological formations and at reducing the vulnerability of sectors and communities to climate change impacts.

As a result, climate policy has become an amalgamation of policies directed at various sectors, such as energy, water, agriculture, forestry and nature conservation. Decisions as to whether or not to mitigate or adapt are taken at different levels, ranging from individual farmers to national planning agencies. For these actors, climate change is typically not of immediate interest. In developing countries in particular, other challenges than climate change, including food and water security, sanitation, education, health care, environmental degradation and natural hazards, require more immediate attention.

Thus, given the current uncertainty and institutional arrangements for climate policy, the recent focus on establishing synergies between mitigation and adaptation and on identifying the optimal level and mix of these two elements of climate policy appears contrived. In view of the potentially close links between climate policy and development policy, it might be more promising to establish links between adaptation and development policy and between mitigation and development policy, as well as to identify some desirable level and mix of climate policy and development policy.

Linkages between climate change and development are increasingly recognised. Climate change is largely the result of human-induced greenhouse gas emissions that are driven by socio-economic development patterns characterised by economic growth, technology, population and governance. These socio-economic development patterns, in turn, determine vulnerability to climate change and the human capacity for mitigation and adaptation. The impacts of climate change on human and natural systems in turn influence socio-economic development patterns and thereby greenhouse gas emissions.

The diversity of sectoral actors and the interconnectedness of climate and development present a challenge to international climate policy. At present, three roles can be identified for climate policy: (i) to control the atmospheric concentrations of greenhouse gases; (ii) to prepare for and reduce the adverse impacts of climate change and take advantage of opportunities; and (iii) to address development and equity issues. As for the latter role, climate change is not the primary reason for poverty and inequality, yet addressing these concerns is seen as a prerequisite for successful climate policy in many developing countries.

A fourth role of climate policy is emerging: to facilitate the successful integration and implementation of mitigation and adaptation in sectoral and development policies. For climate policy to take on this role effectively and efficiently, research is required to provide answers to at least three important questions:

- What constitutes a socially, economically and environmentally attractive portfolio of mitigation, adaptation and development policy and how can it be achieved?
- How can capacity be developed in order to seize opportunities to and overcome constraints on implementing mitigation and adaptation options as part of sectoral policies?
- How can existing financial instruments for climate policy best be used in a broader context of sectoral investments, official development assistance and other policies aimed at risk reduction and sustainable development?

Acknowledgements

Earlier versions of this paper were presented at the workshop ''Mitigation and Adaptation: Towards a Mutual Agenda'' (Institute for Advanced Study in the Humanities, Essen, Germany, 15–16 May 2003) and distributed at the IPCC Expert Meeting on Adaptation and Mitigation (Geneva, Switzerland, 21–23 May 2003). The authors thank the participants in both meetings for their helpful comments, as well as Anthony Patt, Pedro Martins Barata, Axel Michaelowa and three anonymous reviewers for their constructive criticism. Suraje Dessai is currently supported by a grant (SFRH/BD/4901/2001) from Fundação para a Ciência e a Tecnologia in Portugal.

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Richard J.T. Klein is a senior researcher at the Potsdam Institute for Climate Impact Research (PIK) and an associate fellow of the Oxford office of the Stockholm Environment Institute. He is a principal investigator in a number of international research projects on societal vulnerability and adaptation to climate change. He has been a lead author in the IPCC Second and Third Assessment Reports, and a co-ordinating lead author in the Special Report on Technology Transfer and, currently, the Fourth Assessment Report. Richard holds a PhD in environmental geography from the University of Kiel and master's degrees from the Vrije Universiteit in Amsterdam and the University of East Anglia in Norwich.

E. Lisa F. Schipper is a Post-Doctoral Fellow at the International Water Management Institute (IWMI) in Sri Lanka, where she studies water management for agriculture for responding to climate variability and change, particularly drought. Lisa completed her PhD, entitled 'Exploring Adaptation to Climate Change: A Development Perspective', at the School of Development Studies, University of East Anglia (Norwich) with funding from the Tyndall Centre for Climate Change Research, where she is honorary fellow. From 2000 to 2005, Lisa was an active writer and team leader for the International Institute for Sustainable Development's *Earth Negotiations Bulletin*, primarily covering UNFCCC negotiations.

Suraje Dessai is currently a doctoral student in the School of Environmental Sciences at the University of East Anglia where he will complete his dissertation on Probabilities, Climate Change Scenarios and Adaptation Decision-Making in 2005. Trained as an interdisciplinary environmental scientist, he has worked on climate change research in the UK, US, Portugal, Australia and East Timor. He has authored and co-authored over a dozen articles on different aspects of climate change from the science to the policy. He is also the recipient of several awards, including the second national prize for the Ninth International Young European's Environmental Research Competition.