ADAPTATION AND MITIGATION: TRADE-OFFS IN SUBSTANCE AND METHODS

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1. Introduction

For a long time, it was politically incorrect to speak about adaptation to climate change, because it presumably implies accepting defeat in the battle against evil emissions (Burton, 1994). This has changed, perhaps because scientists repeatedly pointed out that climate change cannot be altogether avoided even if we try very hard (Parry *et al.*, 1998; Wigley, 1997), and perhaps because George W. Bush made it blatantly clear that not everybody is going to try equally hard to reduce greenhouse gas emissions.

As a consequence, adaptation has now established itself at the political agenda with a vengeance. A flurry of consultants and academics are advising governmental and international bodies on what to do about adaptation, typically treating adaptation as something novel. However, adaptation to change is an everyday fact, as is adaptation to weather variability (Burton *et al.*, 1993). Adaptation of climate change is an historical and pre-historical fact (Lamb, 1982). Self-serving consultants also kept adaptation, together with mitigation, at the national and international agenda. This has led to demands for an integrated analysis of and policy for mitigation of greenhouse gas emission and adaptation to residual climate change.

This paper argues that adaptation and mitigation should be kept largely separate. It also looks at a few exceptions where adaptation and mitigation should be integrated, and warns that the results are even more politically incorrect than seeing adaptation as accepting defeat in mitigation; in fact, we should embrace adaptation in triumph.

This argument is build up as follows. Section 2 briefly reviews the literature on impacts and adaptation. Section 3 discusses adaptation in more detail, particularly focusing on its role in decision analysis. Section 4 treats of facilitative adaptation. Section 5 looks at the trade-off between mitigation and facilitative adaptation. Section 6 concludes.

2. Impacts and adaptation

One cannot study the impacts of climate change without also studying, or at least making assumptions about adaptation. Adaptation matters, reducing impacts in many cases, and frequently turning negative impacts positive; however, adaptation may also increase impacts, and turn positives into negatives (Rosenzweig and Parry, 1994; Darwin and Tol, 1998). Tol *et al.* (1998) review the impacts literature, attempting to distinguish between adaptation and residual impacts. They classify studies as to their assumptions about adaptation. Surprisingly,

there are still many studies that do not consider adaptation. Essentially, these studies assume that the impacted system does not respond to climate change, an assumption that may well be fairly unrealistic. Other studies include arbitrary adaptation. Essentially, adaptation is included in a "what if" scenario, such as, "what if planting dates are a week earlier than before" (e.g., Iglesias *et al.*, 1996) or "what if we build dikes everywhere" (e.g., Hoozemans *et al.*, 1993). Adaptation is *arbitrary* because there is no evaluation of the realism or desirability of the level and type of adaptation. A few studies include a behavioural model of adaptation, postulating either motives or rules of behaviour and using these to assess how a system would respond to the impact (e.g., Fankhauser, 1994; Yohe *et al.*, 1995, 1996). Yet other studies, again only a few, include statistical models of adaptative behaviour, measuring rather than postulating motives or behavioural rules (e.g., Mendelsohn *et al.*, 1994; Yohe and Tol, 2002). Finally, a small but increasing number of studies looks at past and current adaptation, using the rich yet descriptive methods of anthropology, sociology, political science and history (e.g., Cohen *et al.*, 2000; Downing *et al.*, 1996; Miller et al., 1997; Tol and Langen, 2000; Tol *et al*., 2003).

Tol *et al.* (1999) also estimate the share of adaptation costs in total economic damages, the remainder being residual damages. Depending on the study, adaptation covers some 7-25% of total damages for a doubling of the atmospheric concentration of carbon dioxide. The total economic damage ranges from 1% to 2% of world income (Pearce *et al.*, 1996), so adaptation costs ranges from 0.1% to 0.5% of GDP.

3. Adaptation in decision analysis

Estimates of the total economic impact of climate change are useful input to, among others, global cost-benefit analysis (CBA) of greenhouse gas emission reduction. Global CBA (e.g., Manne et al., 1995; Nordhaus, 1991, 1993; Peck and Teisberg, 1992; Tol, 1999) addresses the question "If the world were ruled by a benevolent dictator, a philosopher-queen who is in control of the entire planet and is up to speed with the latest scientific insights, what would she do about climate change?" On the one hand, this is a silly question as there is no such dictator. On the other hand, real politics can impossibly deliver a better result, so CBA provides a useful yardstick to measure policies against. Our philosopher-queen, if she is a utilitarian in the broad sense of that word, would balance the marginal costs of emission reduction with the marginal benefits of reducing climate change; the marginal benefits would result from balancing the marginal costs of adaptation to climate change with the marginal residual damages.[1] So, a global CBA, or a national CBA for that matter, yields insights into the trade-offs between adaptation and mitigation, at least in principle. Hope *et al.* (1993) are among the very few to implement this in a model.

Practice is different, however. As noted above, the treatment of adaptation in climate change impact studies is far from perfect. But there are deeper difficulties as well. The first is a mismatch of scale. Mitigation is primarily a matter of national governments in the context of international negotiations. Adaptation is primarily a matter of local managers of natural resources, and individual households and companies, in the context of a regional economy and society. Even though individuals will mitigate their emissions, the incentives to do so are to be provided by their governments. A CBA on mitigation should therefore resolve the national and international scale well. On the other hand, the incentives to adapt are already in place, although they may be distorted, and need not be created by governments. A CBA on adaptation should therefore resolve the local scale well. At the local scale, an analysis about

[1] All studies estimate that optimal emission abatement is fairly small. There are a few apparent exceptions to this, but these studies are either technically flawed (Azar and Sterner, 1996; Hasselmann *et al.*, 1997) or assume unrealistically high impacts (Manne and Richels, 1998). See Tol (1998) for a further discussion.

how much to abate is pointless, as only a tiny share of emissions can be reduced.[2] The implication is that models that support decisions for mitigation and models that support decisions about adaptation necessarily operate at different resolutions.[3] This holds for CBA as well as for other forms of decision support.

The second difficulty is a mismatch of client. A CBA on mitigation addresses, first and foremost, the Ministry of Energy and Finance and, to a lesser extent, the Ministries of Transport, Agriculture, Forestry and, perhaps, Environment. A CBA on adaptation is addressed at local water managers, farmers, health officials, coastal zone managers, tourist suppliers, architects, or energy suppliers; decision makers on a national level would only sideways be involved. This implies that decision criteria, parameters and reporting are different for a CBA on adaptation than for one on mitigation. Again, this holds for other forms of decision support as well.

The third difficulty is a mismatch of time scale. A CBA on mitigation looks at short term action because of potentially detrimental long-term developments. A CBA on adaptation looks at short term action in the context of short- to medium term developments. Again, this implies that, in practice, a CBA on mitigation would be done very differently than one on adaptation.

It is therefore not practical to look at the trade-offs between adaptation and mitigation, as no study can do right to both.

4. Facilitative adaptation

The exception to this is the trade-off between mitigation and *facilitative* adaptation. The "adaptation science" literature (Burton, 1997; Fankhauser *et al.*, 1997; Kelly and Adger, 2000; Klein et al., 2001; Smith and Lenhart, 1996) distinguishes many forms of adaptation, including anticipatory and reactive adaptation[4] and planned and autonomous adaptation, where planning is supposed to happen at the level of analysis, typically governments and multilateral organisations, while adaptation below the analysis level is taken for granted.[5] Facilitative adaptation is probably a form of planned, anticipatory adaptation but, instead of the central government going in and telling farmers when and what to plant, or doctors what pills to proscribe, or households how high to turn on their air conditioners, facilitative adaptation are those government actions that allow households, companies and lower authorities to adapt better. As a self-confessed neo-liberal, I believe that, in most cases, this implies the government doing less, not more. For instance, a water market is inherently a more flexible and therefore more adaptable way of allocation water than a system of seniority rights. Another example, subsidies reduce the incentives of farmers to switch crops, as it severs the link between productivity and profitability.

Facilitative adaptation is often referred to as enhancing adaptive capacity (Smit *et al.*, 2001). Adaptive capacity is the ability of a system to respond to a change (in this case, climate change). Adaptive capacity is generally believed to be determined by technological options, economic resources and their distribution, human and social capital, and governance. Although there is a wealth of anecdotic evidence, this hypothesis has yet to be rigorously tested, and the relative strengths of the determinants of adaptive capacity have yet to be estimated (cf. Yohe and Tol, 2002).

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[2] Local mitigation is often defended under the slogan "think global, act local"; the equivalent slogan for adaptation would be "think local, act local" (which really is not much of a slogan).
[3] Public health is an exception.
[4] even though before and after is hard to define in a continues process such as climate change
[5] again, it is hard to define the level of decision making in all but the most centrally organised countries

Facilitative adaptation is done at the national level, in developing countries often with support of multilateral organisations. The scale is therefore similar to that of mitigation. The client is different, but one could argue that cabinet and parliament decide both mitigation and facilitative adaptation. A comparison of the two is therefore meaningful.

5. Trade-offs between mitigation and facilitative adaptation

One question such a comparison could address is how much the need for facilitative adaptation falls if mitigation is increased. That question is difficult as climate change is so uncertain. Moreover, facilitative adaptation has many other benefits. A society that is more robust to climate change is probably also more robust to climate variability, and a society that can adapt to climate change is probably also better in adaptation to socio-economic change. Facilitative adaptation is about making society more robust and more flexible – and even if there were no climate change, societies have to be robust and flexible to withstand other changes, many of which are more rapid than global warming. In most cases, climate change is only a minor co-benefit to facilitative adaptation. For example, one does not want to develop a malaria vaccine because of climate change, but because malaria is a nasty disease; and even though climate change is an additional reason to invest in a malaria vaccine, one would hardly invest less if climate change would not be there. Similarly, one does not want to use drought resistant crops because of climate change, but because drought is a current problem in many places of the world; climate change is only a minor reason to invest in further developing such crops.

A more interesting question is whether mitigation would help or hinder facilitative adaptation. Could it be that mitigation, which presumably strives to reduce climate change impacts, in fact increases them? Adaptation may, of course, also affect mitigation. An example is air-conditioning, which alleviates the indoor effects of summer heat but increases emissions of CO_2 as well as HCF-134a. Tol and Dowlatabadi (2001) look into the first question, focusing on malaria in Africa. As Africa has no obligations to reduce greenhouse gas emissions under the Kyoto Protocol, and is indeed unlikely to accept emission abatement targets any time soon, this may seem to be a peculiar analysis. However, economic agents typically export economic hardship: If a company gets into trouble, it protects its employees at the expense of its suppliers. Similar things happen internationally. Economic agents lower in the value chain are weaker, and they receive a disproportional part of the hardship. Internationally, at the bottom of the value chain are exporters of primary commodities, including most African countries. A reduction in economic growth in the OECD, caused by emission abatement, would have negative effects on the economic growth rate of Africa as well (Babiker *et al.*, 2000).[6] And, lower economic growth would imply that there is less money to spend on health care. Figure 1 shows the trade-off, according to Tol and Dowlatabadi (2001). Annual emission reduction in the OECD is given on the y-axis, varying from zero to the average Kyoto targets. The reduction in total climate-change-induced malaria is on the y-axis. In one scenario, there is no influence from OECD growth on African growth. The Kyoto Protocol reduces climate-change-induced malaria deaths by some 4%. In the other scenario, OECD growth does affect Africa. Climate-change-induced malaria falls for moderate abatement policies, but increases for more aggressive emission reduction; Kyoto would increase malaria deaths by some 4%. Obviously, these numbers are very uncertain, but the qualitative result – greenhouse gas emission reduction may increase climate change impacts – is what matters.

[6] Emission reduction in the OECD would also lead to a reallocation of investments in energy-intensive production. However, the likely beneficiaries of this are found in Latin America and Asia, not in Africa (Tulpule *et al.*, 1999).

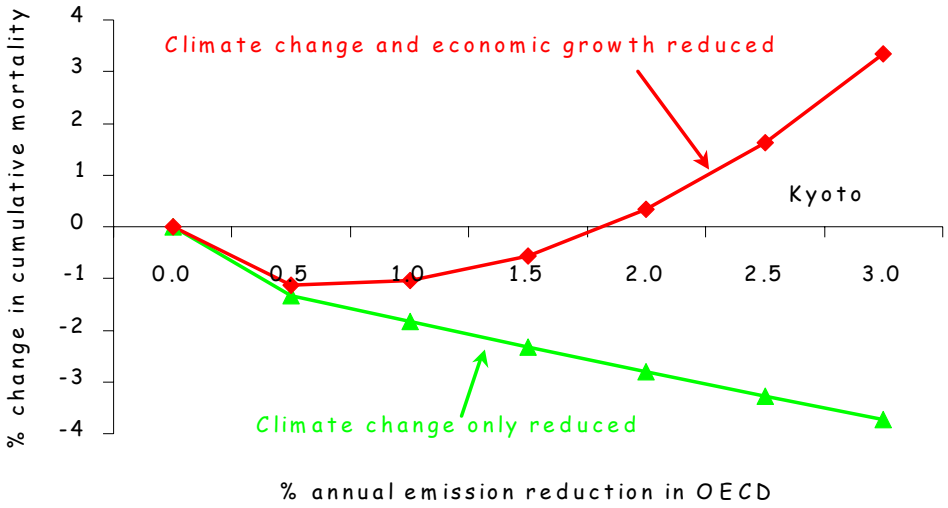

Figure 1. The change in malaria mortality due to climate change in the 21st century as a function of emission reduction in the period 2001-2010 (as an annual percentage from baseline) in the countries of the OECD with (red line) and without (green line) trade and investment effects from the OECD on developing countries. Source: Tol and Dowlatabadi (2001).

Another interesting question is which part of the budget to allocate to mitigation and which part to facilitative adaptation. Tom Schelling (1992, 1995) has long argued that greenhouse gas emission abatement would primarily benefit the grandchildren and great-grandchildren of the people living in currently less developed countries. He has wondered whether there are no better ways of helping them.[7] Tol (2002) analyses this question from the narrow perspective of climate change impacts. Does a dollar spent on emission abatement reduce impacts more than a dollar spent on facilitative adaptation (read: development aid)? Table 1 shows the results for an emission abatement policy costing $1/tC, which is roughly the price of the Kyoto Protocol without the USA but with Russian hot air (Buchner *et al.*, 2002). Clearly, Africa and Latin America would prefer money to be spent on development rather than on emission reduction – that is, their climate change impacts fall further if money is invested in development rather than in abatement. Asian countries do not share this view. Figure 2 shows sensitivity analyses around this issue for Africa. In most cases, Africa would prefer development to abatement, but not in all. The reason has to do with the relative sensitivity of different climate change impacts, and the relative speed at which these are affected by development. This is also why different regions have different preferences. For instance, climate change has negative effects on both vector-borne diseases and heat-related cardiovascular and respiratory disorders. However, development would reduce the impact of vector-borne diseases – through improved health care and environmental management – but would increase the impact of cardiovascular and respiratory diseases – through changes in diet, urbanisation, and air pollution. As another example, climate change may decrease agricultural production and increase energy demand for cooling. Development would make agriculture less important, and air conditioning more important. The relative importance of the two impacts, and the relative pace with which they fall or rise with development

[7] Schelling also wondered why we seem to be so concerned about them but largely indifferent to the fate of their grandparents and great-grandparents.

determines whether development increases or reduces vulnerability, and the trade-off between development and abatement.

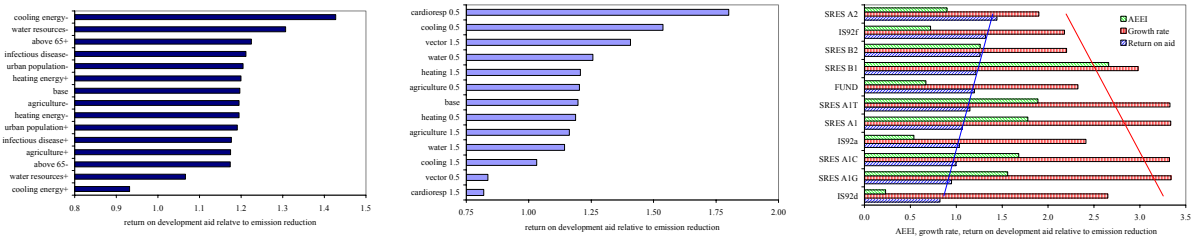

Figure 2. The ratio of the net present value of the reduction in climate change impacts due to a small increase in development aid and due to equivalent spending on emission reduction. The left panel shows a sensitivity analysis around the sectoral impact of climate change; the middle panel around the growth factors of impact categories; the right panel around the development scenarios. Source: Tol (2002).

6. Conclusion

This paper makes three arguments. First, most adaptation is local. National governments and international organisation have little to do with adaptation, and should not try. Second, adaptation cannot be readily compared to mitigation, because most adaptation is done by different people, at a different scale than mitigation. Although researchers like to talk about multi-scale, multi-stakeholder research of immediate policy relevance, reality is different. Third, mitigation takes resources away from adaptation; for health-related impacts in poor countries, money is better spent on adaptation than on mitigation.

These three arguments may seem a bit trivial to the novice in the climate policy debate. Yet, an international bureaucracy for adaptation is emerging, calling for the establishment of national focus points for adaptation and even adaptation ministries. Funding agencies have calls for proposals to study integrated policy strategies for adaptation and mitigation. The international adaptation fund is to be filled by a tax on mitigation. Greenhouse gas emission reduction, particularly through the clean development mechanism, is paid for by reducing development aid. If the analysis in this paper is correct, the recent developments on adaptation policy will be ineffective at best, but may do more harm than good.

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