18.2 Summary of relevant knowledge in the IPCC Third Assessment Report

Compared to the SAR, two of the Working Groups preparing the TAR were restructured. The scope assigned to Working Group II (WGII) was limited to impacts of climate change on sectors and regions and to issues of vulnerability and adaptation, while Working Group III (WGIII) was commissioned to assess the technological, economic, social and political aspects of mitigation. Whereas there were concerted efforts to assess links of both adaptation and mitigation to sustainable development (see Chapter 20, Section 20.7.3), there was little room to consider the direct relationships between these two domains. The integration of results and the development of policy-oriented synthesis were therefore difficult (Toth, 2003).

The attempt to establish the foundations of the TAR Synthesis Report (IPCC, 2001a) in the final chapters of WGII and WGIII did not shed light on inter-relationships between adaptation and mitigation. The WGII TAR in Chapter 19 presented "reasons for concern about projected climate change impacts" in a summary figure that outlines the risks associated with different magnitudes of warming, expressed in terms of the increase in global mean temperature. Largely based on IAMs, the WGIII TAR in Chapter 10 summarised the costs of stabilising CO_2 concentrations at different levels. These two summaries are difficult to compare because questions as to what radiative-forcing and climate-sensitivity parameters should be used to bridge the concentration-temperature gap remain unanswered. Moreover, many statements in the two Working Group Reports were themselves distilled from a large number of reviewed studies. Yet the generic assumptions underlying the methods, the specific assumptions of the applications, the selected baseline values for the scenarios, incompatible discount rates, economic growth assumptions and many other postulations implicit in the parameterisation of adaptation and mitigation assessments were largely ignored or remained hidden in the Synthesis Report.

Nonetheless, the TAR presented new concepts for addressing inter-relationships between adaptation and mitigation. Local adaptive and mitigative capacities vary significantly across regions and over time. Superficially they appear to be strongly correlated because they share the same list of determinants. However, aggregate representation across nations or social groups of both adaptation and mitigation is misleading because the capacity to reduce emissions of greenhouse gases and the ability to adapt to it can deviate significantly. As the TAR pointed out: "one country can easily display high adaptive capacity and low mitigative capacity simultaneously (or *vice versa*)" (IPCC, 2001b; see also Yohe, 2001). In a wealthy nation, damages of climate change may fall on a small but influential social group and the costs of adaptation can be distributed across the entire population through the tax system. Yet, in the same country, another small group might be hurt by mitigation policies without the possibility to spread this burden. In addition to the conceptual deliberations, the TAR discussed inter-relationships between adaptation and mitigation at two levels: at the aggregated, global and national levels, and in the context of economic sectors and specific projects.

The WGII report pointed out that "adaptation is a necessary strategy at all scales to complement climate change mitigation efforts" (IPCC, 2001c), but also elaborates the complex relationships between the two domains at various levels. Some relationships are synergistic, while others are characterised by trade-offs. The report noted the arguments in the literature about the trade-off between adaptation and mitigation because resources committed to one are not available for the other, and also noted that this is "debatable in practice because the people who bear emissions reduction costs or benefits often are different from those who pay for and benefit from adaptation measures" (IPCC, 2001c). From the dynamic perspective, "climatic changes today still are relatively small, thus there is little need for adaptation, although there is considerable need for mitigation to avoid more severe future damages. By this logic, it is more prudent to invest the bulk of the resources for climate policy in mitigation, rather than adaptation" (IPCC, 2001c). Yet, as the WGIII TAR noted, one has to bear in mind the intergenerational trade-offs. The impacts of today's climate change investments on future generations' opportunities should also be considered. Investments might enhance the capacity of future generations to adapt to climate change, but at the same time may displace investments that could create other opportunities for future generations (IPCC, 2001b).

Chapter 10 of the WGIII TAR outlined the iterative process in which nations balance their own mitigation burden against their own adaptation and damage costs. "The need for, extent and costs of adaptation measures in any region will be determined by the magnitude and nature of the regional climate change driven by shifts in global climate. How global climate change unfolds will be determined by the total amount of greenhouse-gas emissions that, in turn, reflects nations' willingness to undertake mitigation measures. Balancing mitigation and adaptation efforts largely depends on how mitigation costs are related to net damages (primary or gross damage minus damage averted through adaptation plus costs of adaptation). Both mitigation costs and net damages, in turn, depend on some crucial baseline assumptions: economic development and baseline emissions largely determine emissions reduction costs, while development and institutions influence vulnerability and adaptive capacity" (IPCC, 2001b).

Discussions of inter-relationships between adaptation and mitigation are sparser at the sector/project level. Some chapters in the WGII TAR noted the link to mitigation when discussing climate-change impacts and adaptation in selected sectors, primarily those related to land use, agriculture and forestry. Chapter 5 noted that "afforestation in agroforestry projects designed to mitigate climate change may provide important initial steps towards adaptation" (Gitay et al., 2001). Chapter 8 emphasised sustainable forestry, agriculture and wetlands practices that yield benefits in watershed management and flood/mudflow control but involve trade-offs such as wetlands restoration helping to protect against flooding and coastal erosion, but in some cases increasing methane release (Vellinga et al., 2001).

The WGII TAR in Chapter 12 observed the complexities in land management in Australia and New Zealand "where control of land degradation through farm and plantation forestry is being considered as a major option, partly for its benefits in controlling salinisation and waterlogging, and possibly as a new economic option with the advent of incentives for carbon storage as a greenhouse mitigation measure" (IPCC, 2001c). Chapter 15 mentioned soil conservation practices (e.g., no tillage, increased forage production, higher cropping frequency) implemented as mitigation strategies in North America (Cohen et al., 2001). It observed that the Kyoto Protocol mentions human-induced land-use changes and forestry activities (afforestation, reforestation, deforestation) as sinks of greenhouse gases for which sequestration credits can be claimed, and that agricultural sinks may be considered in the future. The market emerging in North America to enhance carbon sequestration leads to land-management decisions with diverse effects. The negative consequences of reduced tillage implemented to enhance soil carbon sequestration include the increased use of pesticides for disease, insect and weed management; capturing carbon in labile forms that are vulnerable to rapid oxidation if the system is changed; and reduced yields and cropping management options and increased risk for farmers. The beneficial consequences of reduced tillage (especially no-till) are reduced input costs (e.g., fuel) for farmers, increased soil moisture and hence reductions in crop-water stress in dry areas, reduction in soil erosion and improved soil quality (IPCC, 2001c).

In chapters dealing with other sectors affected by climate-change impacts and mitigation, less attention was paid to their inter-relationships. The WGII TAR in Chapter 8 mentioned energy end-use efficiency in buildings having both adaptation and mitigation benefits, as improved insulation and equipment efficiency can reduce the vulnerability of structures to extreme temperature episodes and emissions. An example of the more remote inter-relationships between adaptation and mitigation across space and time was provided by Chapter 17. Small island states are recognised to be vulnerable to climate change and tourism is a major source of income for many of them. While, over the long term, milder winters in their current markets could reduce the appeal of these islands as tourist destinations, they could be even more severely harmed by increased airline fares "if greenhouse gas mitigation measures (e.g., levies and emissions charges) were to result in higher costs to airlines servicing routes between the main markets and small island states" (IPCC, 2001c).

Finally, the WGII TAR in Chapter 8 drew attention to a link between adaptation and mitigation in the Kyoto Protocol that establishes a surcharge ('set-aside') on mitigation activities implemented as Clean Development Mechanism (CDM) projects. "One key issue is the size of the 'set-aside' from CDM projects that is dedicated to funding adaptation. If this set-aside is too large, it will make otherwise viable mitigation projects uneconomic and serve as a disincentive to undertake projects. This would be counterproductive to the creation of a viable source of funding for adaptation" (IPCC, 2001c).

18.3 Decision processes, stakeholder objectives and scale

A portfolio of actions is available for reducing the risks of climate change, within which each option requires evaluation of its individual and collective merits. Decision-makers at all levels need to decide on appropriate near-term actions in the face of the many long-term uncertainties and competing pressures, goals and market signals. Section 18.1 identified four types of inter-relationships between adaptation and mitigation. Investments in mitigation may have consequences for adaptation; and investments in adaptation may have consequences for the emission of greenhouse gases. At the highest level of aggregation, adaptation and mitigation are both policy substitutes and policy complements, and may compete for finite resources. However, this need not be the case: both adaptation and mitigation may be considered in a policy process without invoking trade-offs, often in the context of broader considerations of sustainable development. This section introduces the nature of the decision problem followed by a review of stakeholder objectives, risk and scales.

18.3.1 The nature of the decision problem

It is difficult, and perhaps counterproductive, to explore the pay-offs from various types of investments without a conceptual framework for thinking about their interactions. Decision analysis provides one such framework (Raiffa, 1968; Keeney and Raiffa, 1976) that allows for the systematic evaluation of near-term options in light of the careful consideration of the potential consequences (see Lempert et al., 2004; IPCC, 2007; Keller et al., 2007; Nicholls et al., 2007; Chapter 20). The next several decades will require a series of decisions on how best to reduce the risks from climate change. There will be, no doubt, opportunities for learning and mid-course corrections. The immediate challenge facing policy-makers is to find out which actions are currently appropriate and likely to be robust in the face of the many long-term uncertainties.

The climate-policy decision tree can be represented as points at which decisions are made, and the reduction of uncertainty in the outcomes (if any) in a wide range of possible decisions and outcomes. The first decision node represents some of today's investment options. How much should we invest in mitigation, how much in adaptation? How much should be invested in research? Once we act, we have an opportunity to learn and make mid-course corrections. The outcomes include types of learning that will occur between now and the next set of decisions. The outcomes are uncertain; the uncertainty may not be resolved but there will be new information which may influence future actions. Hence the expression: "act, then learn, and then act again" (Manne and Richels, 1992).

The 'act, then learn, then act again' framework is used here solely to lay out the elements of the decision problem and not as an alternative to the many analytical approaches discussed in this Report. Indeed, it can be used to parse various approaches for descriptive purposes, such as deterministic versus probabilistic approaches and cost-effectiveness analysis versus cost-benefit analysis. Decision analysis has been more widely