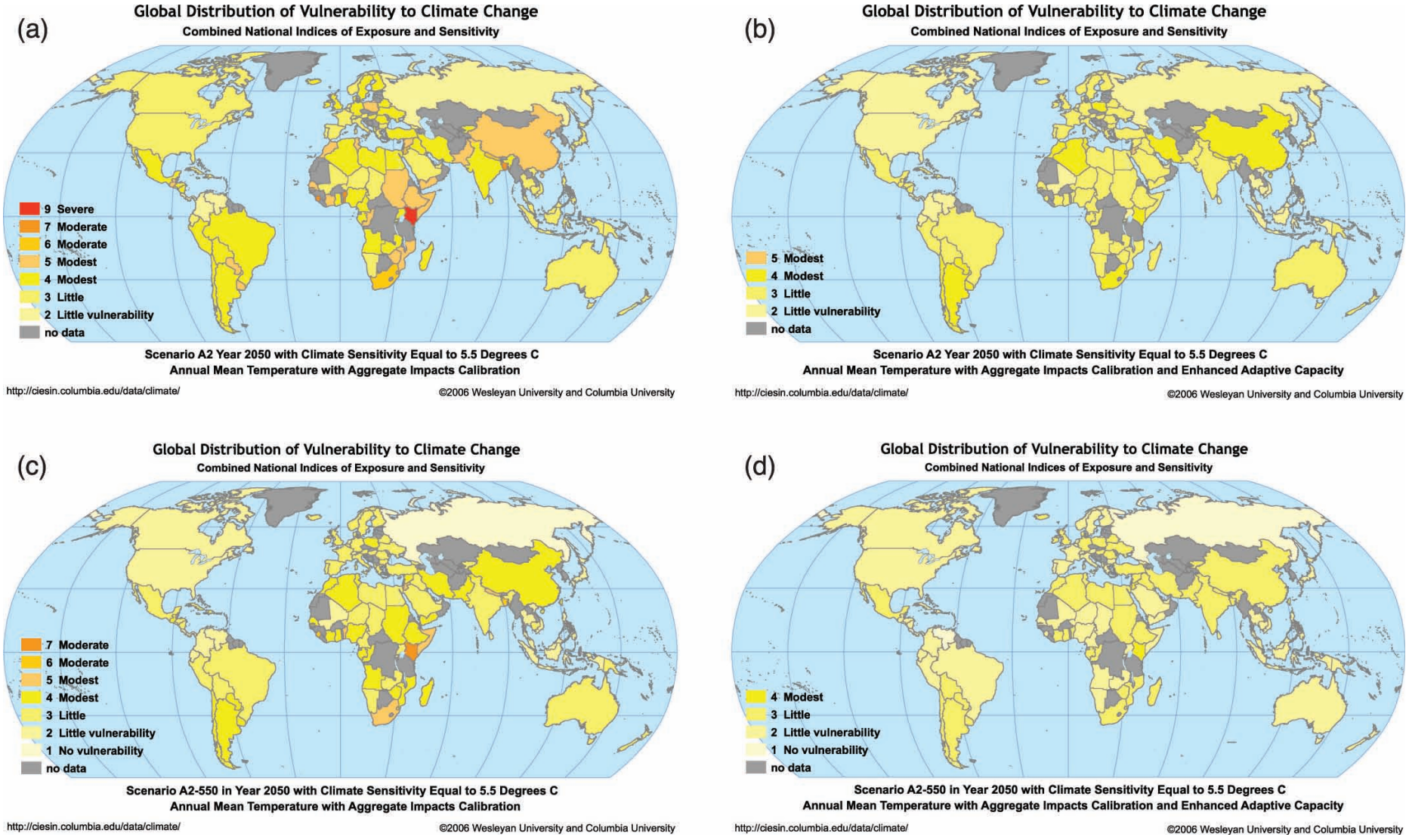
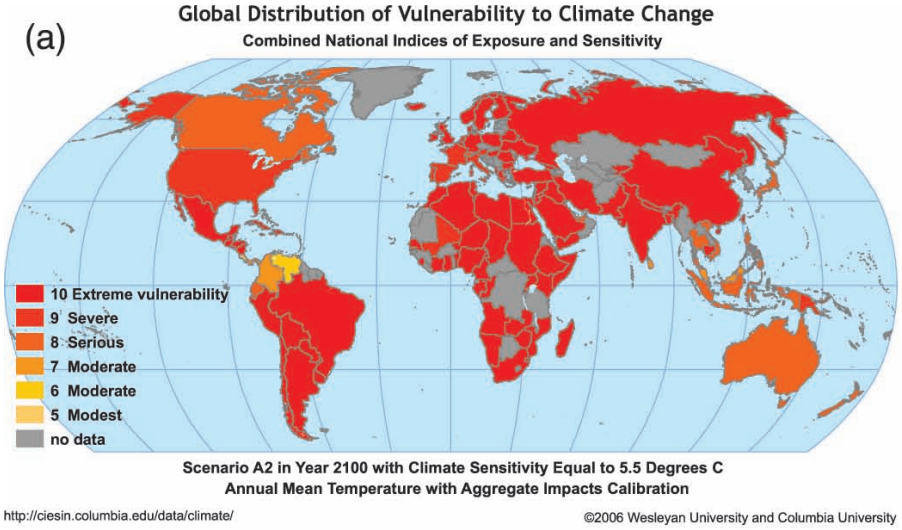
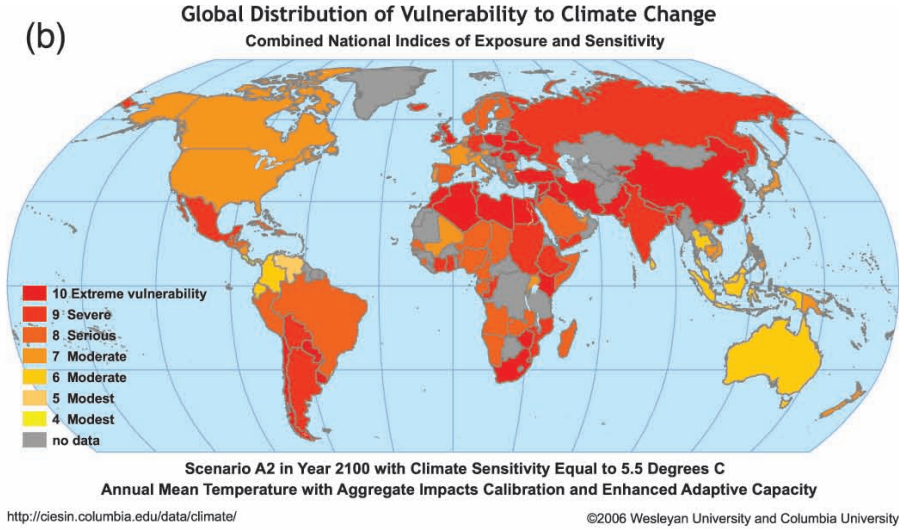
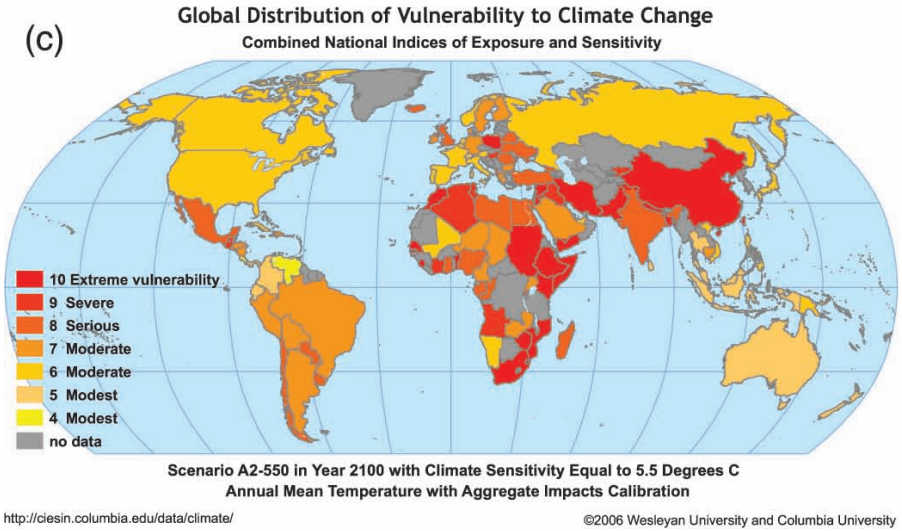


Figure 20.5. *Geographical distribution of vulnerability in 2050 with and without mitigation along an SRES A2 emissions scenario with a climate sensitivity of 5.5°C. (a) portrays vulnerability with a static representation of current adaptive capacity. (b) shows vulnerability with enhanced adaptive capacity worldwide. (c) displays the geographical implications of mitigation designed to cap effective atmospheric concentrations of greenhouse gases at 550 ppm. (d) offers a portrait of the combined complementary effects of mitigation to the same 550 ppm concentration limit and enhanced adaptive capacity. Source: Yohe et al., 2006b.*







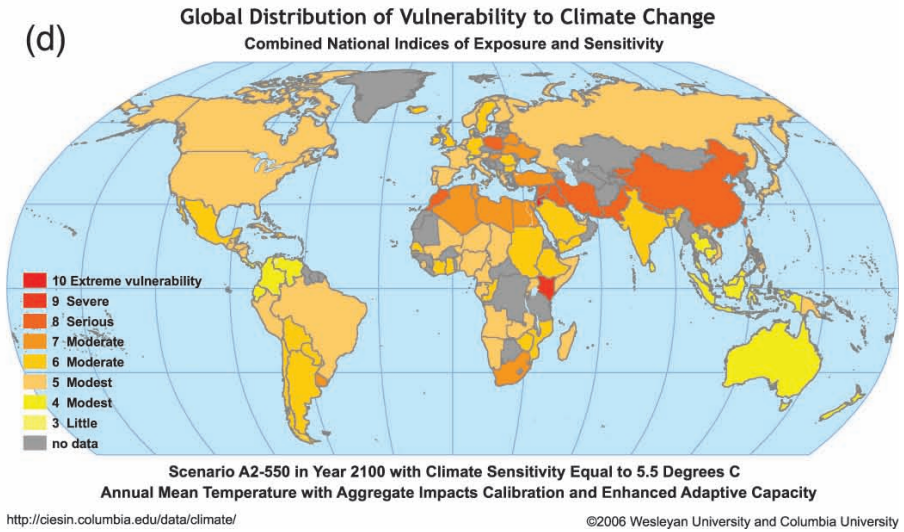


Figure 20.6. *Geographical distribution of vulnerability in 2100 with and without mitigation along an SRES A2 emissions scenario with a climate sensitivity of 5.5°C. (a) portrays vulnerability with a static representation of current adaptive capacity. (b) shows vulnerability with enhanced adaptive capacity worldwide. (c) displays the geographical implications of mitigation designed to cap effective atmospheric concentrations of greenhouse gases at 550 ppm. (d) offers a portrait of the combined complementary effects of mitigation to the same 550 ppm concentration limit and enhanced adaptive capacity. Source: Yohe et al., 2006b.*

respectively. Significant improvement is seen in 2050, but adaptation alone still cannot reduce extreme vulnerability worldwide in 2100. The lower panels present the effect of limiting atmospheric concentrations of greenhouse gases to 550 ppm along least-cost emissions trajectories; global mean temperature is 1.3°C and 3.1°C higher than 1990 levels by 2050 and 2100 in this case. In the lower left panels, adaptive capacity is again held constant at current levels. Mitigation reduces vulnerability across much of the world in 2050, but extreme vulnerability persists in developing countries and threatens developed countries in 2100. Mitigation alone cannot overcome climate risk. Finally, the lower right panels show the combined effects of investments in enhanced adaptive capacity and mitigation. Climate risks are substantially reduced in 2050, but significant vulnerabilities reappear by 2100. Developing countries are still most vulnerable. Developed countries are also vulnerable, but they see noticeable benefits from the complementary effects of the policy portfolio. These results suggest that global mitigation efforts up to 2050 would benefit developing countries more than developed countries when combined with enhanced adaptation. By 2100, however, climate change would produce significant vulnerabilities ubiquitously even if a relatively restrictive concentration cap were implemented in combination with a programme designed to enhance adaptive capacity significantly.

20.8 Opportunities, co-benefits and challenges for adaptation

This section extends some of the ideas outlined in Najam et al. (2003); they focus on mainstreaming climate-change adaptation into planning and development decisions with particular emphasis on participatory processes.

20.8.1 Challenges and opportunities for mainstreaming adaptation into national, regional and local development processes

An international opportunity for mainstreaming adaptation into national, regional and local development processes has recently emerged with the community approach to disaster management adopted by the World Conference on Disaster Reduction held in Kobe, Hyogo, Japan in January 2005 (Hyogo Declaration, 2005). This approach is described in, for example, UNCRD (2003). The results of an action research and pilot activity undertaken during 2002 to 2004 (APJED, 2004) have been reported, albeit on a limited scale in Bangladesh, India and Nepal, with support from World Meteorological Organization (WMO) and Global Water Partnership (GWP). The pilot activity focused on community approaches to flood management, and found that a community flood management committee formed in a local area, working in co-operation with the relevant local government and supported by national government policy, can significantly reduce adverse consequences of floods. There are, however, many challenges. Progress in carrying out analyses and identifying what needs to be and can be done can be documented, but action on the ground to mainstream adaptation to climate change remains limited, particularly in the least developed countries. National policy making in this context remains a major challenge that can only be met with increased international funding for adaptation and disaster management (Ahmad and Ahmed, 2002; Jegillos, 2003; Huq et al., 2006).

Socio-economic and even environmental policy agendas of developing countries do not yet prominently embrace climate change (Beg et al., 2002) even though most developing countries participate in various international protocols and conventions relating to climate change and sustainable development and most have adopted national environmental conservation and natural disaster management policies. Watson International Scholars of the Environment (2006) has offered some suggestions for improved mainstreaming within multilateral environmental agreements; they include fostering links with poverty reduction and increasing support designed to engage professionals, researchers and governments at local levels in developing countries more directly.

Even as economic growth is pursued, progress towards health, education, training and access to safe water and sanitation, and other indicators of social and environmental progress including adaptive capacity remains a significant challenge. It can be addressed through appropriate policies and commitment to ending poverty (WSSD, 2002; Sachs, 2005). Strengthened linkages between government and people, and the consequent capacity building at local levels, are key factors for robust progress towards sustainability at the grassroots (Jegillos, 2003). Social and environmental (climate change) issues are, however, often left resource-constrained and without effective institutional support when economic growth takes precedence (UNSEA, 2005).

20.8.2 Participatory processes in research and practice

Participatory processes can help to create dialogues that link and mutually instruct researchers, practitioners, communities and governments. There are, however, challenges in applying these processes as a methodology for using dialogue and narrative (i.e., communication of quantitative and qualitative information) to influence social learning and decision-making, including governance.

Knowledge about climate-change adaptation and sustainable development can be translated into public policy through processes that generate usable knowledge. The idea of usable knowledge in climate assessments stems from the experiences of national and international bodies (academies, boards, committees, panels, etc.) that offer credible and legitimate information to policymakers through transparent multi-disciplinary processes (Lemos and Morehouse, 2005). It requires the inclusion of local knowledge, including indigenous knowledge (see Box 20.1), to complement more formal technical understanding generated through scientific research and the consideration of the role that institutions and governance play in the translation of scientific information into effective action.

Box 20.1. Role of local and indigenous knowledge in adaptation and sustainability research

Research on indigenous environmental knowledge has been undertaken in many countries, often in the context of understanding local oral histories and cultural attachment to place. A survey of research during the 1980s and early 1990s was produced by Johnson (1992). Reid et al. (2006) outline the many technical and social issues related to the intersection of different knowledge systems, and the challenge of linking the scales and contexts associated with these forms of knowledge. With the increased interest in climate change and global environmental change, recent studies have emerged that explore how indigenous knowledge can become part of a shared learning effort to address climate-change impacts and adaptation, and its links with sustainability. Some examples are indicated here.

Sutherland et al. (2005) describe a community-based vulnerability assessment in Samoa, addressing both future changes in climate-related exposure and future challenges for improving adaptive capacity. Twinomugisha (2005) describes the dangers of not considering local knowledge in dialogues on food security in Uganda.

A scenario-building exercise in Costa Rica has been undertaken as part of the Millennium Ecosystem Assessment (MA, 2005). This was a collaborative study in which indigenous communities and scientists developed common visions of future development. Two pilot five-year storylines were constructed, incorporating aspects of coping with external drivers of development (Bennett and Zurek, 2006). Although this was not directly addressing climate change, it demonstrates the potential for joint scenario-building incorporating different forms of knowledge.

In Arctic Canada, traditional knowledge was used as part of an assessment which recognised the implications of climate change for the ecological integrity of a large freshwater delta (NRBS, 1996). In another case, an environmental assessment of a proposed mine was produced through a partnership with governments and indigenous peoples. Knowledge to facilitate sustainable development was identified as an explicit goal of the assessment, and climate-change impacts were listed as one of the long-term concerns for the region (WKSS, 2001).

Vlassova (2006) describes results of interviews of indigenous peoples of the Russian North on climate and environmental trends within the Russian boreal forest. Additional examples from the Arctic are described in ACIA (2005), Reidlinger and Berkes (2001), Krupnik and Jolly (2002), Furgal et al. (2006) and Chapter 15.

Social learning of complex issues like climate change emerges through consensus that includes both scientific discourse and policy debate. In the case of climate change, participatory processes encourage local practitioners from climate-sensitive endeavours (water management, land-use planning, etc.) to become engaged so that past experiences can be included in the study of (and the planning for) future climate change and development pressures. Processes designed to integrate various dimensions of knowledge about how regional resource systems operate are essential; so is understanding of how resource systems are affected by biophysical and socio-economic forces including a wide range of possible future changes in climate. This requirement has led to increased interest in a number of participatory processes like participatory integrated assessment (PIA) and participatory mapping (using, for example, specially designed geographic information systems – GIS).

PIA is an umbrella term describing approaches in which non-researchers play an active role in integrated assessment (Rotmans and van Asselt, 2002). Participatory processes can be used to facilitate the integration of biophysical and socio-economic aspects of climate-change adaptation and development by creating opportunities for shared experiences in learning, problem definition and design of potential solutions (Hisschemöller et al., 2001). Van Asselt and Rijkens-Klomp (2002) identify several approaches, including methods for mapping diversity of opinion (e.g., focus groups, participatory modelling) and reaching consensus (e.g., citizens' juries, participatory planning). Kangur (2004) reported on a recent exercise on water policy that employed citizens' juries. PIA has also been used to facilitate the development of integrated models (e.g., Turnpenny et al., 2004) and to use models to facilitate policy dialogue (e.g., van de Kerkhof, 2004).

Participatory mapping is a process by which local information, including indigenous knowledge, is incorporated into information management systems (Corbett et al., 2006). Ranging from paper to GIS, it is becoming more popular, and it has contributed to the increased application of Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) as techniques to support rural development (Chambers, 2006). Maps have displayed natural resources, social patterns and mobility, and they have been used to identify landscape changes, tenure, boundaries and places of cultural significance (Rambaldi et al., 2006). With the advent of modern GIS technologies,

concerns have been raised regarding disempowerment of communities from lack of training. Questions related to who owns the maps and to who controls their use have also been raised (Corbett et al., 2006; Rambaldi et al., 2006).

The long-term sustainability of dialogue processes is critical to the success of participatory approaches. For PIA, PRA, participatory GIS and similar processes to be successful as shared learning experiences, they have to be inclusive and transparent. Haas (2004) describes examples of experiences in social learning on sustainable development and climate change, noting the importance of sustaining the learning process over the long term, and maintaining distance between science and policy while still promoting focused science-policy interactions. Applications of focus group and other techniques for stakeholder engagement are described for several studies in Europe (Welp et al., 2006) and Africa (Conde and Lonsdale, 2004). However, there has been particular concern regarding its application within development processes and hazard management in poor countries. Cooke and Kothari (2001) and Garande and Dagg (2005) document some problems, including hindering empowerment of local scale interests, reinforcing existing power structures and constraining how local knowledge is expressed. Barriers include uneven gains from cross-scale interactions (Adger et al., 2005; Young, 2006) and increased responsibility without increased capacity (Allen, 2006). There can be difficulties in reaching consensus on identifying and engaging participants (Bulkeley and Mol, 2003; Parkins and Mitchell, 2005), and in interpreting the results of dialogue within variations in cultural and epistemological contexts (e.g., Huntington et al., 2006). There are also challenges in measuring the quality of dialogue (debate, argument), particularly the transparency of process, promotion of learning and indicators of influence (van de Kerkhof, 2004; Rowe and Frewer, 2000).

Participatory governance is part of a growing global movement to decentralise many aspects of natural resources management. Hickey and Mohan (2004) offer several examples of the convergence of participatory development and participatory governance with empowerment for marginalised communities. Other examples include agrarian reform in the Philippines, the Popular Participation Law in Bolivia (Schneider, 1999; Iwanciw, 2004) and the appointment of an 'exploratory committee' for addressing water resources concerns in Nagoya, Japan (Kabat et al., 2002). In each case, the point is to improve access to resources and enhance social capital (Larson and Ribot, 2004a and 2004b). Unfortunately, broadening decision-making can work to exacerbate vulnerabilities. For example, there have been cases emerging from Latin America describing difficulties in building national adaptive capacity as national and local institutions change their roles in governance. Although the language of sustainability and shared governance is widely accepted, obtaining benefits from globalisation in enhanced adaptive capacity is difficult (Eakin and Lemos, 2006).

Dialogue processes in assessment and appraisal are becoming important tools in the support of participatory processes. Although they may be seen as relatively similar activities, PIA and PRA have different mandates. The latter is directly within a policy process (selecting among development options), while the former is a research method that assesses complex problems (e.g., environmental impact of development, climate-change impacts/adaptation), producing results that can have policy implications. This chapter's discussion on PIA is offered as a complement to integrated modelling results reported in Sections 20.6 and 20.7 to suggest that PIA may assist in providing regional-scale technical support to match the scale of information needs of decentralised governance.

An agricultural example of a PIA of climate-change adaptation can be found in the eastern United Kingdom (Lorenzoni et al., 2001). Adaptation options are identified (e.g., shifting cultivation times, modifying soil management to improve water retention and avoid compaction), but questions about how a climate component can be built into the way non-climate issues are currently addressed emerge. Long-term strategies may have to include greater fluctuations in crop yields across a region; as a result, farm operations may have to diversity if they are to maintain incomes and employment. The compartmentalisation of regional decision-making is seen as a barrier to encouraging more sustainable land management over the periods in which climate change evolves. In an example from Canada, Cohen and Neale (2006) and Cohen et al. (2004) illustrate the linkages between water management and scenarios of population growth and climate change in the Okanagan region (see also Chapter 3, Box 3.1). Planners in one district have responded by incorporating adaptation to climate change into long-term water plans (Summit Environmental Consultants Ltd., 2004) even though governance-related obstacles to proactive implementation of innovative measures to manage water demand have appeared in the past (Shepherd et al., 2006).

A comprehensive understanding of the implications of extreme climate change requires an in-depth exploration of the perceptions and reactions of the affected stakeholder groups and the lay public. Toth and Hizsnyik (2005) describe how participatory techniques might be applied to inform decisions in the context of possible abrupt climate change. Their project has studied one such case, the collapse of the West Antarctic Ice Sheet and a subsequent 5 to 6 m sea-level rise. Possible methods for assessing the societal consequences of impacts and adaptations include simulation-gaming techniques, a policy exercise approach, as well as directed focus-group conversations. Each approach can be designed to explore adaptation as a local response to a global phenomenon. As a result, each sees adaptation being informed by a fusion of top-down descriptions of impacts from global climate change and bottom-up deliberations rooted in local, national and regional experiences (see Chapter 2, Section 2.2.1).

20.8.3 Bringing climate-change adaptation and development communities together to promote sustainable development

The Millennium Development Goals (MDGs) are the latest international articulation of approaching poverty eradication and related goals in the developing world (see Section 20.7.1). Economic growth is necessary for poverty reduction and promoting other millennium goals; but, unless the growth achieved is equitably distributed, the result is a lopsided development where inequality increases. Many countries face

intensifying poverty and inequality predicaments in the wake of undertaking free market policies (UNDP, 2003; UNSEA, 2005). As noted above, however, climate change is represented in the Millennium goals solely by indicators of changes in energy use per unit of GDP and/or by total or per capita emissions of CO_2. Tracking indicators of protected areas for biological diversity, changes in forests and access to water all appear in the goals, but they are not linked to climate-change impacts or adaptation; nor are they identified as part of a country's capacity to adapt to climate change.

Other issues of particular concern include ensuring energy services, promoting agriculture and industrialisation, promoting trade and upgrading technologies. Sustainable natural-resource management is a key to sustained economic growth and poverty reduction. It calls for clean energy sources; and the nature and pattern of agriculture, industry and trade should not unduly impinge on ecological health and resilience. Otherwise, the very basis of economic growth will be shattered through environmental degradation, more so as a consequence of climate change (Sachs, 2005). Put another way by Swaminathan (2005), developing and employing 'eco-technologies' (based on an integration of traditional and frontier technologies including bio-technologies, renewable energy and modern management techniques) is a critical ingredient rooted in the principles of economics, gender, social equity and employment generation with due emphasis given to climate change.

For environmentally-sustainable economic growth and social progress, therefore, development policy issues must inform the work of the climate-change community such that the two communities bring their perspectives to bear on the formulation and implementation of integrated approaches and processes that recognise how persistent poverty and environmental needs exacerbate the adverse consequences of climate change. In this process, science has a critical role to play in assessing the prevailing realities and likely future scenarios, and identifying policies and cost-effective methods to address various aspects of development and climate change; and it is important that all relevant stakeholders are involved in science-based dialogues (Welp et al., 2006). In order to go down this integrated and participatory road, a strong political will and public commitment to promoting sustainable development is needed, focusing simultaneously on economic growth, social progress, environmental conservation and adaptation to climate change (World Bank, 1998; AfDB et al., 2003). It is also important that private and public sectors work together within a framework of identified roles of each, with economic, social and climate-change perspectives built into the process. Further, co-ordination among national development and climate-change communities, as well as co-ordination among appropriate national and international institutions, is imperative.

This raises an important question regarding the process for bringing climate change and sustainable development together. Growing interest in these linkages is evident in a series of recent publications, including Toth (1999), Yamin (2004), Collier and Löfstedt (1997), Jepma and Munasinghe (1998), Munasinghe and Swart (2000, 2005), Abaza and Baranzini (2002), Markandya and Halsnaes (2002), Cohen et al. (1998), Kok et al. (2002), Swart et al. (2003). A number of themes that are particularly relevant to adaptation run through this literature. They include the need for equity between developed and developing countries in the delineation of rights and responsibilities within any climate-change response framework. Shue (1999), Thomas and Twyman (2004) and Paavola and Adger (2006) point, as well, to the need for equity across vulnerable groups that are disproportionately exposed to climate-change impacts. Hasselman (1999), Gardiner (2004) and Kemfert and Tol (2002) identify some examples from economics which raise concerns for intergenerational ethics; i.e., the degree to which the interests of future generations are given relatively lower weighting in favour of short-term concerns. Intergenerational justice implications, for individuals and collectives (e.g., indigenous cultures) are described in Page (1999). Masika (2002) specifically outlines gender aspects of differential vulnerabilities. Swart et al. (2003) identify the need to describe potential changes in vulnerability and adaptive capacity within the SRES storylines.

Although linkages between climate-change adaptation and sustainable development should appear to be self evident, it has been difficult to act on them in practice. Beg et al. (2002) identify potential synergies between climate change and other policies that could facilitate adaptation, such as those that address desertification and biodiversity. Ethical guidance from various spiritual and religious sources is reviewed in Coward (2004). However, an 'adaptation deficit' exists. Burton and May (2004) identify this as the gap between current and optimal levels of adaptation to climate-related events (including extremes); it is expected that climate change and poor development decisions will lead to an increased adaptation deficit in the future. While mitigation within the UNFCCC includes clearly defined objectives, measures, costs and instruments, this is not the case for adaptation. Agrawala (2005) indicates that much less attention has been paid to how development could be made more resilient to climate-change impacts, and identifies a number of barriers to mainstreaming climate-change adaptation within development activity (see, as well Chapter 17, Section 17.3).

The existence of these barriers does not mean that the development community does not recognise the linkage between development and climate-change adaptation. Climate change is identified as a serious risk to poverty reduction in developing countries, particularly because these countries have a limited capacity to cope with current climate variability and extremes not to mention future climate change (Schipper and Pelling, 2006). Adaptation measures will need to be integrated into strategies of poverty reduction to ensure sustainable development, and this will require improved governance, mainstreaming of climate-change measures, and the integration of climate-change impacts information into national economic projections (AfDB et al., 2003; Davidson et al., 2003). Brooks et al. (2005) offer an extensive list of potential proxy indicators for national-level vulnerability to climate change, including health, governance and technology indicators. Agrawala (2005) describes case studies of natural resources management in Nepal, Bangladesh, Egypt, Fiji, Uruguay and Tanzania, and recommends several priority actions for overcoming barriers to mainstreaming, including project screening for climate-related

risk, inclusion of climate impacts in environmental impact assessments , and shifting emphasis from creating new plans to better implementation of existing measures. Approaches for integration of adaptation with development are outlined for East Africa (Orindi and Murray, 2005). The Commission for Africa (2005) explicitly links the need to address climate-change risks with achievement of poverty reduction and sustainable growth.

In recent years, new mechanisms have been established to support adaptation, including the Lesser Developed Countries (LDC) Fund, Special Climate Change Fund and the Adaptation Fund (Huq, 2002; Brander, 2003; Desanker, 2004; Huq, 2006; Huq et al., 2006). They have provided visibility and opportunity to mainstream adaptation into local/regional development activities. However, there are technical challenges associated with defining adaptation benefits for particular actions within UNFCCC mechanisms such as the Global Environmental Facility (GEF). For example, Burton (2004) and Huq and Reid (2004) note that the calculation of costs of adapting to future climate change (as opposed to current climate variability), as well as the local nature of resulting benefits, are both problematic *vis-à-vis* GEF requirements for defining global environmental benefits. On the other hand, there are opportunities. Dang et al. (2003) illustrate how including "adaptation benefits of mitigation" in Vietnam offers a way of linking both criteria in the analysis of potential projects for inclusion in the Clean Development Mechanism. Bouwer and Aerts (2006) and Schipper and Pelling (2006) identify opportunities for integrating climate-change adaptation and disaster risk management through insurance mechanisms, official development assistance and ongoing risk management programmes. Niang-Diop and Bosch (2004) outline methods for linking adaptation strategies with sustainable development at national and local scales, as part of National Adaptation Programmes of Action (NAPAs). As of the autumn of 2006, the LDC Fund was operational in its support of NAPAs in LDCs and both the Conference of Parties (COP) and GEF were in the process of defining how the implementation of adaptation activities highlighted in NAPAs could be funded (Huq et al., 2006).

20.9 Uncertainties, unknowns and priorities for research

Uncertainties, unknowns and priorities for research illuminate the confidence statements that modify scientific conclusions delivered to members of the policy community. For the research community, however, they can be translated into tasks designed to improve understanding and elaborate sources confidence. This section is therefore organised as a series of tasks.

Expand understanding of the synergies in and/or obstacles to simultaneous progress in promoting enhanced adaptive capacity and sustainable development. The current state of knowledge in casting adaptive capacity and vulnerability into the future is primitive. More thorough understandings of the process by which adaptive capacity and vulnerability evolve over time along specific development pathways are required. Commonalities exist across the determinants of adaptive capacity, mitigative capacity and the factors that support sustainable development, but current understanding of how they can be recognised and exploited is minimal.

Integrate more closely current work in the development and climate-change communities. Synergies exist between practitioners and researchers in the sustainable development and climate-change communities, but there is a need to develop means by which these communities can integrate their efforts more productively. The relative efficacies of dialogue processes and new tools required to promote this integration, and the various participatory and/or model-based approaches required to support their efforts must be refined or developed from scratch. Opportunities for shared learning should be identified, explored and exploited.

Search for common ground between spatially explicit analyses of vulnerability and aggregate integrated assessment models. Geographical and temporal scales of development and climate initiatives vary widely. The interaction and intersection between spatially explicit and aggregate integrated assessment models has yet to be explored rigorously. For example, representations of adaptive capacities and resulting vulnerabilities in aggregate integrated assessment models are still rudimentary. As progress is encouraged in improving their abilities to depict reality, research initiatives must also recognise and work to overcome difficulties in matching the scales at which models are constructed and exercised with the scales at which decisions are made. New tools are required to handle these differences, particularly between the local and national, short-to-medium-term scales of adaptation and development programmes and projects and the global, medium-to-long-term scale of mitigation.

Recognise that uncertainties will continue to be pervasive and persistent, and develop or refine new decision-support mechanisms that can identify robust coping strategies even in the face of this uncertainty. Significant uncertainties in estimating the social cost of greenhouse gases exist, and many of their sources have been identified; indeed many of their sources reside in the research needs listed above. Reducing these uncertainties would certainly be productive, but it cannot be guaranteed that future research will make much progress in this regard. It follows that concurrent improvement in our ability to use existing decision-support tools and to design new approaches to cope with uncertainties and associated risks that will be required over the foreseeable future is even more essential. In short, identify appropriate decision-support tools and clarify the criteria that they can inform in an uncertain world.

Characterise the full range of possible climate futures and the paths that might bring them forward. The research communities in both climate and development must, along with practitioners and decision-makers, be informed not only about the central tendencies of climate change and its ramifications, but also about the outlier possibilities about which the natural-science community is less sanguine. It is simply impossible to comprehend the risks associated with high-consequence outcomes with low probabilities if neither their character nor their likelihood has been described.

This chapter has offered a glimpse into where to turn for guidance in confronting and managing the risks associated with climate change and climate variability. Indeed, the climate problem is a classic risk management problem of the sort with which decision-makers are already familiar. It is critical to see risk as the product of likelihood and consequence, to recognise that the likelihood of a climate impact is dependent on natural and human systems, and to understand that the consequence of that impact can be measured in terms of a multitude of numeraires (currency, millions at risk, species extinction, abrupt physical changes and so on). These expressions of risk are determined fundamentally by location in time and space.

This chapter also points to synergies that exist at the nexus of sustainable development and adaptive capacity, primarily by noting for the first time that many of the goals of sustainable development match the determinants of adaptive capacity (and, for that matter, mitigative capacity). Planners in the decision-intensive ministries around the world are therefore already familiar with the generic mechanisms by which including climate change into their risk assessments of development programmes can complicate their decisions. Adding climate to the list of multiple stresses which can impede progress in meeting their goals in their specific context is thus not a new problem. Climate change, even when its impacts are amplified by the effects of other stresses, is just one more thing: one more problem to confront, but also one more reason to act in ways that promote progress along multiple fronts. Exploitation of the synergies is not automatic, so care must be taken to avoid development activities that can exacerbate climate change or impacts just as care must be taken to take explicit account of climate risks.

The United Nations Framework Convention on Climate Change commits governments to avoiding "dangerous anthropogenic interference with the climate system", but governments will be informed in their deliberations of what is or is not 'dangerous' only by an approach that explicitly reflects the rich diversity of climate risk across the globe and into the coming decades instead of burying this diversity into incomplete aggregate indices of damages. Risk management techniques have been designed for such tasks; but it is important to note that risk-based approaches require exploration of the implications of not only the central tendencies of climate change that are the focus of consensus-driven assessments of the literature, but also the uncomfortable (or more benign) futures that reside in the 'tails' of current understanding. Viewing the climate issue from a risk perspective can offer climate policy deliberations and negotiations new insight into the synergies by which governments can promote sustainable development, reduce the risk of climate-related damages and take advantage of climate-related opportunities.

References

Abaza, H. and A. Baranzini, Eds., 2002: *Implementing Sustainable Development: Integrated Assessment and Participatory Decision-making Processes*. United Nations Environment Programme, Edward Elgar Publishing, Cheltenham, 320 pp.

ACIA (Arctic Climate Impact Assessment), 2005: *Arctic Climate Impact Assessment*. Cambridge University Press, Cambridge, 1042 pp.

Adger, N. and K. Vincent, 2004: Uncertainty in adaptive capacity. *IPCC Workshop on Describing Uncertainties in Climate Change to Support Analysis of Risk and Options*, M. Manning, M. Petit, D. Easterling, J. Murphy, A. Patwardhan, H-H Rogner, R. Swart and G. Yohe, Eds., Intergovernmental Panel on Climate Change, Geneva, 49-51.

Adger, W.N., K. Brown and E.L. Tompkins, 2005: The political economy of cross-scale networks in resource co-management. *Ecology and Society*, **10**, article 9. [Accessed 30.05.07: http://www.ecologyandsociety.org/vol10/iss2/art9/]

Adger, W.N., K. Brown, J. Fairbrass, A. Jordan, J. Paavola, S. Rosendo and G. Seyfang, 2003: Governance for sustainability: towards a 'thick' analysis of environmental decision-making. *Environ. Plann. A*, **35**, 1095-1110.

AfDB (African Development Bank), ADB, DFID, DGIS, EC, BMZ, OECD, UNDP and WB, 2003: *Poverty and Climate Change: Reducing Vulnerability of the Poor*. African Development Bank; Asian Development Bank; UK Department for International Development; Directorate-General for Development, European Commission; Federal Ministry for Economic Cooperation and Development, Germany; Ministry of Foreign Affairs – Development Cooperation, the Netherlands; Organization for Economic Cooperation and Development; United Nations Development Programme; United Nations Environment Programme and the World Bank, Eds., DFID, UK, 43 pp.

AfDB (African Development Bank), African Development Fund, African Union, International Strategy for Disaster Reduction, and New Partnership for Africa's Development, 2004: *Guidelines for Mainstreaming Disaster Risk Assessment in Development*, United Nations, 68 pp.

Agrawala, S., 2004: Adaptation, development assistance and planning: challenges and opportunities. *IDS Bulletin*, **35**, 50-54.

Agrawala, S., Ed., 2005: *Bridge over Troubled Waters: Linking Climate Change and Development*. Organization for Economic Co-Operation and Development, OECD Publishing, Paris, 153 pp.

Ahmad, Q.K. and A.U. Ahmed, Eds., 2002: Bangladesh: citizen's perspective on sustainable development, Bangladesh Unnayan Parishad (BUP), Dhaka, 181 pp.

Allen, K.M., 2006. Community-based disaster preparedness and climate adaptation: local capacity-building in the Philippines. *Disasters*, **30**, 81-101.

APJED (Asia Pacific Journal on Environment and Development), 2004: Community approaches to flood management in South Asia. *Asia Pacific Journal on Environment and Development*, special double issue, **11**, Nos. 1 and 2.

Arnell, N.W., 2004: Climate change and global water resources: SRES emissions and socio-economic scenarios. *Global Environ. Chang.*, **14**, 31-52.

Arnell, N.W., 2006: Climate change and water resources: a global perspective. *Avoiding Dangerous Climate Change. Proceedings of the Exeter Conference,* H.J. Schellnhuber, W. Cramer, N. Nakicenovic, T.M.L. Wigley and G. Yohe, Eds., Cambridge University Press, Cambridge, 167-175.

Arnell, N.W. and E.K. Delaney, 2006: Adapting to climate change: public water supply in England and Wales. *Climatic Change*, **78**, 227-255.

Arnell, N.W., M.G.R. Cannell, M. Hulme, R.S. Kovats, J.F.B. Mitchell, R.J. Nicholls, M.L. Parry, M.T.J. Livermore and Co-authors, 2002: The consequences of CO_2 stabilization for the impacts of climate change. *Climatic Change*, **53**, 413-446.

Arrow, K., P. Dasgupta, L. Goulder, G. Daily, P. Ehrlich, G. Heal, S. Levin, K.-G. Maler, S. Schneider, D. Starrett and B. Walker, 2004: Are we consuming too much? *J. Econ. Perspect.*, **18**, 147-172.

Bansal, P., 2005: Evolving sustainably: a longitudinal study of corporate sustainable development. *Strategic Manage. J.*, **26**, 197-218.

Barrow, E.M. and R.J. Lee, 2000: *Climate change and environmental assessment part 2: climate change guidance for environmental assessments*. The Research and Development Monograph Series 2000, The Canadian Institute for Climate Studies, University of Victoria, Victoria, 85 pp.

Beg, N., J.C. Morlot, O. Davidson, Y. Afrane-Okesse, L. Tyani, F. Denton, Y. Sokona, J.P. Thomas, E.L. La Rovere, J.K. Parikh, K. Parikh and A.A. Rahman., 2002: Linkages between climate change and sustainable development. *Clim. Policy*, **2**, 129-144.

Belliveau, S., B. Smit and B. Bradshaw, 2006: Multiple exposures and dynamic vulnerability: evidence from the grape industry in the Okanagan Valley, Canada. *Global Environ. Chang.*, **16**, 364-378.

Bennett, E. and M. Zurek, 2006: Integrating epistemologies through scenarios. *Bridging Scales and Knowledge Systems*, W.V. Reid, F. Berkes, T. Wilbanks and D. Capistrano, Eds., Island Press, Washington, District of Columbia, 264-280.

Blanco, A.V.R., 2006: Local initiatives and adaptation to climate change. *Disasters*, **30**, 140-147.

Bouwer, L.M. and J.C.J.H. Aerts, 2006: Financing climate change adaptation. *Disasters*, **30**, 49-63.

Brander, L., 2003: The Kyoto mechanisms and the economics of their design. *Climate Change and the Kyoto Protocol: The Role of Institutions and Instruments to Control Global Change*, M. Faure, J. Gupta and A. Nentjes, Eds., Edward Elgar, Cheltenham, 25-44.

Brenkert, A. and E. Malone, 2005: Modeling vulnerability and resilience to climate change: a case study of India and Indian States. *Climatic Change*, **72**, 57-102.

Brooks, N. and W.N. Adger, 2005: Assessing and enhancing adaptive capacity. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, B. Lim and E. Spanger-Siegfried, Eds., Cambridge University Press, Cambridge, 165-182.

Brooks, N., W.N. Adger and P.M. Kelly, 2005: The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environ. Chang.*, **15**, 151-163.

Bulkeley, H. and A.P.J. Mol, 2003: Participation and environmental governance: consensus, ambivalence and debate. *Environmental Values*, **12**, 143-154.

Burton, I., 2004: The adaptation deficit. *Building the Adaptive Capacity*, A. Fenech, D. MacIver, H. Auld, R. Bing Rong and Y. Yin, Eds., Environment Canada, Toronto, 25-33.

Burton, I. and E. May, 2004: The adaptation deficit in water resources management *IDS Bulletin*, **35**, 31-37.

Burton, I. and M. van Aalst, 2004: *Look Before You Leap: A Risk Management Approach for Incorporating Climate Change Adaptation into World Bank Operations*. World Bank, Washington, District of Columbia, 47 pp.

Burton, I., S. Huq, B. Lim, O. Pilifosova and E.L. Schipper, 2002: From impacts assessment to adaptation priorities: the shaping of adaptation policy. *Clim. Policy*, **2**, 145-159.

Caparrós, A. and F. Jacquemont, 2003: Conflict between biodiversity and carbon sequestration programs: economic and legal implications. *Ecol. Econ.*, **46**, 143-157.

Chambers, R., 2006: Participatory mapping and geographic information systems: whose map? Who is empowered and who disempowered? Who gains and who loses? *The Electronic Journal on Information Systems in Developing Countries*, **25**, 1-11. [Accessed 30.05.07: http://www.ejisdc.org]

Clark, M.J., 2002: Dealing with uncertainty: adaptive approaches to sustainable river management. *Aquat. Conserv.*, **12**, 347-363.

Clarkson, R. and K. Deyes, 2002: Estimating the social cost of carbon emissions. Government Economic Service Working Paper 140, HM Treasury and Defra, 59 pp.

Cohen, S. and T. Neale, Eds., 2006: Participatory integrated assessment of water management and climate change in the Okanagan Basin, British Columbia. Environment Canada and University of British Columbia, Vancouver, 221 pp.

Cohen, S., D. Demeritt, J. Robinson and D. Rothman, 1998: Climate change and sustainable development: towards dialogue. *Global Environ. Chang.*, **8**, 341-371.

Cohen, S., D. Neilsen and R. Welbourn, Eds., 2004: Expanding the dialogue on climate change & water management in the Okanagan Basin, British Columbia. Environment Canada, Agriculture & Agri-Food Canada and University of British Columbia, 224 pp.

Collier, U. and R.E. Löfstedt, Eds., 1997: *Cases in Climate Change Policy: Political Reality in the European Union*. Earthscan Publications Ltd., London. 204 pp.

Commission for Africa, 2005: *Our Common Interest*. Report of the Commission for Africa, 461 pp. [Accessed 30.05.07: www.commissionforafrica.org].

Conde, C. and K. Lonsdale, 2004: Engaging stakeholders in the adaptation process. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, B. Lim and E. Spanger-Siegfried, Eds., Cambridge University Press, Cambridge, 47-66.

Cooke, B. and U. Kothari, Eds., 2001: *Participation: The New Tyranny?* Zed Books, London, 207 pp.

Corbett, J., G. Rambaldi, P. Kyem, D. Weiner, R. Olson, J. Muchemi, M. McCall and R. Chambers, 2006: Overview: mapping for change – the emergence of a new practice. *Participatory Learning and Action*, **54**, 13-19.

Coward, H., 2004: What can individuals do? *Hard Choices: Climate Change in Canada*, H. Coward and A.J. Weaver, Eds., Wilfrid Laurier University Press, Waterloo, Canada, 233-252.

Dang, H.H., A. Michaelowa and D.D. Tuan, 2003: Synergy of adaptation and mitigation strategies in the context of sustainable development: the case of Vietnam. *Climate Policy*, **3**, S81-S96.

Davidson, O., K. Halsnaes, S. Huq, M. Kok, B. Metz, Y. Sokona and J. Verhagen, 2003: The development and climate nexus: the case of sub-Saharan Africa. *Climate Policy*, **3**, S97-S113.

Desanker, P.V., 2004: *The NAPA Primer*. United Nations Framework Convention on Climate Change (UNFCCC) Least Developed Countries Expert Group (LEG), Bonn, Germany, 192 pp.

DFID, 2004: Reducing the risk of disasters: helping to achieve sustainable poverty reduction in a vulnerable world. Department for International Development Policy Paper, London, 36 pp.

Downing, T., D. Anthoff, R. Butterfield, M. Ceronsky, M. Grubb, J. Guo, C. Hepburn, C. Hope and Co-authors, 2005: Social cost of carbon: a closer look at uncertainty. Final Report, Defra, 95 pp.

Eakin, H. and M.C. Lemos, 2006: Adaptation and the state: Latin America and the challenge of capacity building under globalization. *Global Environ. Chang.*, **16**, 7-18.

EEA (European Environment Agency), 2006: Vulnerability and adaptation to climate change in Europe. Technical Report No. 7, European Environment Agency, 84 pp.

Elasha, B.O., 2005: Sustainable development. *Tiempo*, **57**, 18-23.

Epstein, M.J. and M.J. Roy, 2003: Making the business case for sustainability: linking social and environmental actions to financial performance. *Journal of Corporate Citizenship*, **9**, 79-96.

Figge, F. and T. Hahn, 2004: Sustainable value added - measuring corporate contributions to sustainability beyond eco-efficiency. *Ecol. Econ.*, **48**, 173-187.

Foley, J.A., R. DeFries, G. Asner, C. Barford, G. Bonan, S. Carpenter, F. Chapin, M. Coe and Co-authors, 2005: Global consequences of land use. *Science*, **309**, 570-574.

Ford, J.D., B. Smit and J. Wandel, 2006: Vulnerability to climate change in the Arctic: a case study from Arctic Bay, Canada. *Global Environ. Chang.*, **16**, 145-160.

Furgal, C.M., C. Fletcher and C. Dickson, 2006: Ways of knowing and understanding: towards the convergence of traditional and scientific understanding of climate change in the Canadian North. Environment Canada, No. KM467-05-6213, 96 pp.

Garande, T. and S. Dagg, 2005: Public participation and effective water governance at the local level: a case study from a small under-developed area in Chile. *Environment, Development and Sustainability*, **7**, 417-431.

Gardiner, S.M., 2004: Ethics and global climate change. *Ethics*, **114**, 555-600.

Goklany, I.M., in press: Integrated strategies to reduce vulnerability and advance adaptation, mitigation and sustainable development. *Mitigation and Adaptation Strategies for Global Change*. doi: 10.1007/s11027-007-9098-1.

Guiso, L., P. Sapienza and L. Zingales, 2004: The role of social capital in financial development. *Am. Econ. Rev.*, **94**, 526-556.

Gupta, J. and R.S.J. Tol, 2003: Why reduce greenhouse gas emissions? Reasons, issue-linkages, and dilemmas. *Issues in International Climate Policy: Theory and Policy*, E.C. van Ireland, J. Gupta and M.T.J. Kok, Eds., Edward Elgar Publishing, Cheltenham, 17-38.

Haas, P.M., 2004: When does power listen to truth? A constructivist approach to the policy process. *J. Eur. Public Policy*, **11**, 569-592.

Haddad, B.M., 2005: Ranking the adaptive capacity of nations to climate change when socio-political goals are explicit. *Global Environ. Chang.*, **15**, 165-176.

Hamlet, A.F., 2003: The role of transboundary agreements in the Columbia River Basin: an integrated assessment in the context of historic development, climate, and evolving water policy. *Climate, Water, and Transboundary Challenges in the Americas*, H. Diaz and B. Morehouse, Eds., Kluwer Press, Dordrecht, 263-289.

Harman, J., Bramley, M. E. and Funnell, M., 2002: Sustainable flood defense in England and Wales. *P. I. Civil Eng.-Civ. En.*, **150**, 3-9.

Hasselman, K., 1999: Intertemporal accounting of climate change - harmonizing economic efficiency and climate stewardship. *Climatic Change*, **41**, 333-350.

Hickey, S. and G. Mohan, Eds., 2004: *Participation, from Tyranny to Transformation? Exploring new Approaches to Participation in Development*. Zed Books, London, 292 pp.

Hilson, G., 2001: Putting theory into practice: how has the gold mining industry interpreted the concept of sustainable development? *Miner. Resour. Eng.*, **10**, 397-413.

Hisschemöller, M., R.S.J. Tol and P. Vellinga., 2001: The relevance of participatory approaches in integrated environmental assessment. *Integrated Assessment*, **2**, 57-72.

Hitz, S. and J. Smith, 2004: Estimating global impacts from climate change. *Global Environ. Chang.*, **14**, 201-218.

Hope, C., 2005: Memorandum by Dr Chris Hope, Judge Institute of Management, University of Cambridge. The Economics of Climate Change, HL 12-II, Oral Evidence: 18 January 2005, House of Lords Select Committee on Economic Affairs, The Stationery Office, London.

Hope, C., 2006a: The marginal impact of CO_2 from PAGE2002: An integrated assessment model incorporating the IPCC's five reasons for concern. *Integrated Assessment*, **6**, 1-16.

Hope, C., 2006b: The marginal impacts of CO_2, CH4 and SF6 emissions. *Climate Pol.*, **6**, 537-544.

Huntington, H.P., S.F. Trainor, D.C. Natcher, O.H. Huntington, L. DeWilde and F.S. Chapin III, 2006: The significance of context in community-based research: understanding discussions about wildfire in Huslia, Alaska. *Ecology and Society*, **11**, article 40. [Accessed 30.05.07: http://www.ecologyandsociety.org/vol11/iss1/art40/].

Huq, S., 2002: The Bonn-Marrakech agreements on funding. *Climate Policy*, **2**, 243-246.

Huq, S., 2006: Adaptation funding. *Tiempo*, **58**, 20-21.

Huq, S. and H. Reid, 2004: Mainstreaming adaptation in development. *IDS Bulletin*, **35**, 15-21.

Huq, S., H. Reid and L.A. Murray, 2006: *Climate Change and Development Links*. Gatekeeper Series 123, International Institute for Environment and Development, London, 24 pp.

Hyogo Declaration, 2005: Hyogo Declaration. World Conference on Disaster Reduction, Kobe, Japan, International Strategy for Disaster Reduction, A/CONF.206/6, 5 pp.

ICSU (International Council for Science), 2002: ICSU Series on Science for Sustainable Development No 9: Science and Technology for Sustainable Development, 30 pp.

IGES (Institute for Global Environmental Strategies), 2005: Sustainable Asia – 2005 and beyond: in the pursuit of innovative policies. IGES White Paper, Institute for Global Environmental Strategies, Kanagawa, Japan, 174 pp.

IPCC, 1992: *Climate Change 1992: The Supplementary Report to the IPCC Scientific Assessment,* J.T. Houghton, B.A. Callander and S.K. Varney, Eds., Cambridge University Press, Cambridge, 200 pp.

IPCC, 1996: *Climate Change 1995: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change*, R.T. Watson, M.C. Zinyowera and R.H. Moss, Eds., Cambridge University Press, Cambridge, 880 pp.

IPCC, 2001a: *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell and C.A. Johnson, Eds., Cambridge University Press, Cambridge, 881 pp.

IPCC, 2001b: *Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken and K.S. White, Eds., Cambridge University Press, Cambridge, 1032 pp.

IPCC, 2007a: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, B. Metz, O. Davidson, P. Bosch, R. Dave and L. Meyer, Eds., Cambridge University Press, Cambridge, UK.

IPCC, 2007b: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, Eds., Cambridge University Press, Cambridge, 996 pp.

ISDR, 2004: *Living With Risk: a Global Review of Disaster Reduction Initiatives*. International Strategy for Disaster Reduction(ISDR), United Nations, Geneva, 588 pp.

Iwanciw, J.G., 2004: Promoting social adaptation to climate change and variability through knowledge, experiential and co-learning networks in Bolivia. Shell Foundation Sustainable Energy Program, 22 pp.

Jasch, C., 2003: The use of environmental management accounting (EMA) for identifying environmental costs. *J. Clean. Prod.*, **11**, 667-676.

Jegillos, S.R., 2003: Methodology. *Sustainability in Grass-Roots Initiatives: Focus on Community Based Disaster Management*, R. Shaw and K. Okazaki, Eds., United Nations Centre for Regional Development (UNCRD), Disaster Management Planning Hyogo Office, 19-28.

Jepma, C.J. and M. Munasinghe, 1998: *Climate Change Policy: Facts, Issues and Analyses,* Cambridge University Press, Cambridge, 331 pp.

Johnson, D. and C. Walck, 2004: Integrating sustainability into corporate management systems. *Journal of Forestry*, **102**, 32-39.

Johnson, M., Ed., 1992: *Lore: Capturing Traditional Environmental Knowledge*. Dene Cultural Institute, Hay River, and International Development Research Centre, Ottawa, 190 pp.

Jung, T.Y., A. Srinivasan, K. Tamura, T. Sudo, R. Watanabe, K. Shimada and H. Kimura, 2005: *Asian Perspectives on Climate Regime Beyond 2012: Concerns, Interests and Priorities*. Institute for Global Environmental Strategies (IGES), Hayama, Japan, 95 pp.

Kabat, P., R.E. Schulze, M.E. Hellmuth and J.A. Veraart, Eds., 2002: Coping with impacts of climate variability and climate change in water management: a scoping paper. DWC-Report no. DWCSSO-01(2002), International Secretariat of the Dialogue on Water and Climate, Wageningen, 114 pp.

Kangur, K., Ed., 2004: *Focus Groups and Citizens Juries - River Dialogue Experiences in Enhancing Public Participation in Water Management*. Peipsi Center for Transboundary Cooperation, Tartu, Estonia, 64 pp.

Kashyap, A., 2004: Water governance: learning by developing adaptive capacity to incorporate climate variability and change. *Water Science and Technology*, **49**, 141-146.

Kates, R.W., 2000: Cautionary tales: adaptation and the global poor. *Climatic Change*, **45**, 5-17.

Kates, R.W., T.M. Parris and A.A. Leiserowitz, 2005: What is sustainable development? Goals, indicators, values, and practice. *Environment: Science and Policy for Sustainable Development*, **47**, 8–21.

Kates, R.W., C.E. Colten, S. Laska and S.P. Leatherman, 2006: Reconstruction of New Orleans following Hurricane Katrina. *P. Natl. Acad. Sci.*, **103**, 14653-14660.

Kates, R.W., W.C. Clark, R. Corell, J.M. Hall, C.C. Jaeger, I. Lowe, J.J. McCarthy, H.J. Schellnhuber, B. Bolin, N.M. Dickenson, S. Faucheux, G.C. Gallopin, A. Grübler, B. Huntley, J. Jäger, N.S. Jodha, R.E. Kasperson, A. Mabogunje, P. Matson, H. Mooney, B. Moore III, T. O'Riordan and U. Svedlin, 2000: Sustainability science. *Science*, **292**, 641-642.

Kemfert, C. and R.S.J. Tol, 2002: Equity, international trade and climate policy. *International Environmental Agreements: Politics, Law and Economics*, **2**, 23-48.

Klein, R.J.T., E.L.F. Schipper and S. Dessai, 2005: Integrating mitigation and adaptation into climate and development policy: three research questions. *Environ. Sci. Policy*, **8**, 579-588.

Kok, M.T.J., W.J. V. Vermeulen, A.P.C. Faaij and D. de Jager, Eds., 2002: *Global Warming and Social Innovation: The Challenge of a Climate-Neutral Society*. Earthscan Publications Ltd., London, 242 pp.

Krupnik, I. and D. Jolly, Eds., 2002: *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change*. Arctic Research Consortium of the United States, Fairbanks, 384 pp.

Kundzewicz, Z.W., 2002: Non-structural flood protection and sustainability. *Water International*, **27**, 3-13.

Larson, A.M. and J.C. Ribot, Eds., 2004a: Democratic decentralization through a natural resource lens – an introduction. *European Journal of Development Research*, **16**, 1-25.

Larson, A.M. and J.C. Ribot, Eds., 2004b: *Democratic Decentralization through a Natural Resource Lens*. Routledge, New York, 272 pp.

Leemans, R. and Eickhout, B., 2004: Another reason for concern: regional and global impacts on ecosystems for different levels of climate change. *Global Environ. Chang.*, **14**, 219-228.

Lemos, M.C. and B.J. Morehouse, 2005: The co-production of science and policy in integrated climate assessments. *Global Environ. Chang.*, **15**, 57-68.

Levy, P.E., M.G.R. Cannell and A.D. Friend, 2004: Modelling the impact of future changes in climate, CO_2 concentration and land use on natural ecosystems and the terrestrial carbon sink. *Global Environ. Chang.*, **14**, 21-30.

Lorenzoni, I., A. Jordan, D.T. Favis-Mortlock, D. Viner and J. Hall, 2001: Developing sustainable practices to adapt to the impacts of climate change: a case study of agricultural systems in eastern England (UK). *Reg. Environ. Change*, **2**, 106-117.

Low, P.S., Ed., 2005: *Climate Change and Africa*. Cambridge University Press, Cambridge, 412 pp.

Lucas, R.E., 1988: On the Mechanics of Economic Development. *J. Monetary Econ.*, **22**, 3-42.

Lüdeke, M.K.B., G. Petschel-Held and H-J. Schellnhuber, 2004: Syndromes of global change: the first panoramic view. *GAIA*., **13**, 42-49.

MA (Millennium Ecosystem Assessment), 2005: *Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington, District of Columbia, 155 pp.

Markandya, A. and K. Halsnaes, 2002: *Climate Change and Sustainable Development: Prospects for Developing Countries*. Earthscan Publications, London, 291 pp.

Masika, R., Ed., 2002: *Gender, Development, and Climate Change*. Oxfam Focus on Gender, Oxfam GB, Oxford, 112 pp.

Mendelsohn, R.O., W.N. Morrison, M.E. Schlesinger and N.G. Andronova, 1998: Country-specific market impacts of climate change. *Climatic Change*, **45**, 553-569.

Mileti, D., 1999: *Disasters by Design: A Reassessment of Natural Hazards in the United States*. National Academy Press, Washington, District of Columbia, 376 pp.

Mirza, M.M.Q., 2003: Climate change and extreme weather events: can developing countries adapt? *Climate Policy*, **3**, 233-248.

Moretti, E., 2004: Workers' education, spillovers, and productivity: evidence from plant-level production functions. *Am. Econ. Rev.*, **94**, 656-690.

Morimoto, R. and C. Hope, 2004: Applying a cost-benefit analysis model to the Three Gorges project in China. *Impact Assessment and Project Appraisal*, **22**, 205-220.

Munasinghe, M. and R. Swart, 2000: Climate change and its linkages with development, equity and sustainability. *Proc. IPCC Expert Meeting*, Colombo, Sri Lanka, Intergovernmental Panel on Climate Change, 319 pp.

Munasinghe, M. and R. Swart, 2005: *Primer on Climate Change and Sustainable Development Facts, Policy Analysis and Applications*. Cambridge University Press, Cambridge, 445 pp.

Munasinghe, M., O. Canziani, O. Davidson, B. Metz, M. Parry and M. Harisson, 2003: Integrating sustainable development and climate change in the IPCC Fourth Assessment Report. Munasinghe Institute for Development, Colombo, 44-52.

Munich Re, 2005: *Topics Geo Annual Review, Natural Catastrophes, 2004*. Munich Re, Munich, 60 pp. [Accessed 11.06.07: http://www.munichre.com]

Najam, A., A.A. Rahman, S. Huq and Y. Sokona., 2003: Integrating sustainable development into the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. *Climate Policy*, **3**, S9-S17.

Nakicenovic, N. and R. Swart, Eds., 2000: *Special Report on Emissions Scenarios. A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, 599 pp.

NRC (National Research Council), 1999: Our common journey. *Our Common Journey: A Transition Toward Sustainability*, Board on Sustainable Development, Eds., National Academy Press, Washington, District of Columbia, 21-58.

Niang-Diop, I. and H. Bosch, 2004: Formulating an adaptation strategy. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, B. Lim and E. Spanger-Siegfried, Eds., Cambridge University Press, Cambridge, 183-204.

Nicholls, R.J., 2004: Coastal flooding and wetland loss in the 21st century: changes under the SRES climate and socio-economic scenarios. *Global Environ. Chang.*, **14**, 69-86.

Nordhaus, W.D. and J.G. Boyer, 2000: *Warming the World: Economic Models of Global Warming*. MIT Press, Cambridge, Massachusetts, 232 pp.

NRBS (Northern River Basins Study Board), 1996: *Northern River Basins Study: Report to the Ministers 1996*. Alberta Environmental Protection, Edmonton, Alberta, 287 pp. [Accessed 11.06.07: http://www3.gov.ab.ca/env/water/nrbs/index.html]

O'Riordan, T., 2004: Environmental science, sustainability and politics. *T. I. Brit. Geogr.*, **29**, 234-247.

O'Brien, G., P. O'Keefe, J. Rose and B. Wisner, 2006: Climate change and disaster management. *Disasters*, **30**, 64-80.

O'Hare, G., 2002: Climate change and the temple of sustainable development. *Geography*, **87**, 234-246.

Olsen, J.R., 2006: Climate change and floodplain management in the United States. *Climatic Change*, **76**, 407-426.

Orindi, V.A. and L.A. Murray, 2005: Adapting to climate change in East Africa: a strategic approach. Gatekeeper Series 117, International Institute for Environment and Development, London, 23 pp.

Ostrom, E., J. Burger, C.B. Field, R.B. Norgaard and D. Policansky, 1999: Revisiting the commons: local lessons, global challenges. *Science*, **284**, 278-282.

Paavola, J. and W.N. Adger, 2006: Fair adaptation to climate change. *Ecol. Econ.*, **56**, 594-609.

Page, E., 1999: Intergenerational justice and climate change. *Polit. Stud. - London*, **47**, 53-66.

Parkins, J.R. and R.E. Mitchell, 2005: Public participation as public debate: a deliberative turn in natural resource management. *Soc. Natur. Resour.*, **18**, 529-540.

Parry, M.L., C. Rosenzweig, A. Iglesias, M. Livermore and G. Fischer, 2004: Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Global Environ. Chang.*, **14**, 53-67.

Payne, J.T., A.W. Wood, A.F. Hamlet, R.N. Palmer and D.P. Lettenmaier, 2004: Mitigating the effects of climate change on the water resources of the Columbia River basin. *Climatic Change*, **62**, 233-256.

Pearce, D., 2003: The social cost of carbon and its policy implications. *Oxford Rev. Econ. Pol.*, **19**, 362-384.

Philippine Country Report, 1999: National Workshop on Indicators of Sustainable Development, UN Sustainable Development, 91 pp.

Plambeck, E.L. and C.W. Hope, 1996: PAGE95. An updated valuation of the impacts of global warming. *Energ. Policy*, **24**, 783-794.

Porritt, J., 2005: *Capitalism as if the World Matters,* Earthscan, London, 304 pp.

Rambaldi, G., P.A.K. Kyem, M. McCall and D. Weiner, 2006: Participatory spatial information management and communication in developing countries. *The Electronic Journal on Information Systems in Developing Countries*, **25**, 1-9. [Accessed 11.06.07: http://www.ejisdc.org]

Ramus, C.A., 2002: Encouraging innovative environmental actions: what companies and managers must do. *J. World Bus.*, **37**, 151-164.

Reid, H. and M. Alam, 2005: Millennium Development Goals. *Tiempo*, **54**, 18-22.

Reid, W.V., F. Berkes, T. Wilbanks and D. Capistrano, Eds., 2006: *Bridging Scales and Knowledge Systems*. Island Press, Washington, District of Columbia, 314 pp.

Reidlinger, D. and F. Berkes, 2001: Contributions of traditional knowledge to understanding climate change in the Canadian Arctic. *Polar Rec.*, **37**, 315-328.

Richardson, D., 2002: Flood risk - the impact of climate change. *P. I. Civil Eng.-Civ. En.*, **150**, 22-24.

Robinson, J.B. and D. Herbert, 2001: Integrating climate change and sustainable development. *International Journal of Global Environmental Issues*, **1**, 130-149.

Robledo, C., M. Fischler and A. Patino, 2004: Increasing the resilience of hillside communities in Bolivia - has vulnerability to climate change been reduced as a result of previous sustainable development cooperation? *Mt. Res. Dev.*, **24**, 14-18.

Rotmans, J. and B. de Vries, Eds., 1997: *Perspectives on Global Change: the Targets Approach*. Cambridge University Press, Cambridge, 479 pp.

Rotmans, J. and M.B.A. van Asselt, 2002: Integrated assessment: current practices and challenges for the future. *Implementing Sustainable development: Integrated Assessment and Participatory Decision-Making Processes*, H. Abaza and A. Baranzini, Eds., United Nations Environment Programme, Edward Elgar, Cheltenham, 78-116.

Rowe, G. and L.J. Frewer, 2000: Public participation methods: a framework for evaluation. *Sci. Technol. Hum. Val.*, **25**, 3-29.

Rozelle, S. and J.F.M. Swinnen, 2004: Success and failure of reform: insights from the transition of agriculture. *J. Econ. Lit.*, **42**, 433-458.

Sachs, J.D., 2005: *The End of Poverty: Economic Possibilities for Our Time*. The Penguin Press, New York, 416 pp.

Sala-i-Martin, X., G. Doppelhofer and R. Miller, 2004: Determinants of long-term growth: a Bayesian averaging of classical estimates (BACE) approach. *Am. Econ. Rev.*, **94**, 813-835.

Schellnhuber, H.J., M.K.B. Lüdeke and G. Petschel-Held, 2002: The syndromes approach to scaling – describing global change on an intermediate functional scale. *Integrated Assessment*, **3**, 201-219.

Schellnhuber, H.J., A. Block, M. Cassel-Gintz, J. Kropp, G. Lammel, W. Lass, R. Lienenkamp, C. Loose, M.K.B. Lüdeke, O. Moldenhaeur, G. Petschel-Held, M. Plöchl and F. Reusswig, 1997: Syndromes of global change. *GAIA*, **6**, 19-34.

Schipper, E.L.F., 2006: Conceptual history of adaptation to climate change under the UNFCCC. *Review of European Community and International Environmental Law*, **15**, 82-92.

Schipper, L. and M. Pelling, 2006: Disaster risk, climate change and international development: scope for, and challenges to, integration. *Disasters*, **30**, 19-38.

Schneider, H., 1999: Participatory governance: the missing link for poverty reduction. OECD Development Centre Policy Brief No. 17, OECD Development Centre, Paris, 30 pp.

Schroeter, D., W. Cramer, R. Leemans, I.C. Prentice, M.B. Araujo, N.W. Arnell, A. Bondeau, H. Bugmann and Co-authors, 2005: Ecosystem service supply and vul-

nerability to global change in Europe. *Science*, **310**, 1333-1337.
Shaw, R., 2006: Community-based climate change adaptation in Vietnam: interlinkage of environment, disaster and human security. *Multiple Dimensions of Global Environmental Changes*, S. Sonak, Ed., The Energy Research Institute (TERI), TERI Press, New Delhi, 521-547.
Shepherd, P., J. Tansey and H. Dowlatabadi, 2006: Context matters: what shapes adaptation to water stress in the Okanagan? *Climatic Change*, **78**, 31-62.
Shue, H., 1999: Global environment and international inequality. *Int. Aff.*, **75**, 531-545.
Smit, B., O. Pilifosova, I. Burton, B. Challenger, S. Huq, R.J.T. Klein and G. Yohe, 2001: Adaptation to climate change in the context of sustainable development and equity. *Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken and K.S. White, Eds., Cambridge University Press, Cambridge, 877-912.
Sperling, F. and F. Szekely, 2005: Disaster risk management in a changing climate. Discussion Paper for the World Conference on Disaster Reduction on behalf of the Vulnerability and Adaptation Resource Group (VARG), reprint with addendum on conference outcomes, Washington, District of Columbia, 42 pp.
Stern, N., 2007: *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge, 692 pp.
Sutherland, K., B. Smit, V. Wulf and T. Nakalevu, 2005: Vulnerability in Samoa. *Tiempo*, **54**, 11-15.
Summit Environmental Consultants Limited, 2004: Trepanier Landscape Unit (Westside) water management plan. Regional District of Central Okanagan and British Columbia, Ministry of Sustainable Resource Management, Kelowna, 300 pp.
Swaminathan, M.S., 2005: Environmental education for a sustainable future. *Glimpses of the Work on Environment and Development in India*, J.S. Singh and V.P. Sharma, Eds., Angkor Publishers, New Delhi, 51-71.
Swart, R., J. Robinson and S. Cohen, 2003: Climate change and sustainable development: expanding the options. *Climate Policy*, **3**, S19-S40.
Thomalla, F., T. Downing, E. Spanger-Siegfried, G.Y. Han and J. Rockstrom, 2006: Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation. *Disasters*, **30**, 39-48.
Thomas, D.S.G. and C. Twyman, 2004: Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global Environ. Chang.*, **15**, 115-124.
Thomas, T., J.R. Schermerhorn and J.W. Deinhart, 2004: Strategic leadership of ethical behavior in business. *Acad. Manage. Exec.*, **18**, 56-66.
Tol, R.S.J., 1999: The marginal costs of greenhouse gas emissions. *The Energy Journal*, **20**, 61-81.
Tol, R.S.J., 2002: New estimates of the damage costs of climate change, Part II: dynamic estimates. *Environ. Resour. Econ.*, **21**, 135-160.
Tol, R.S.J., 2005: The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties. *Energ. Policy*, **33**, 2064-2074.
Tompkins, E. and N. Adger, 2005: Defining response capacity to enhance climate change policy. *Environ. Sci. Policy*, **8**, 562-571.
Toth, F.L., Ed., 1999: *Fair Weather? Equity Concerns in Climate Change*. Earthscan Publications Ltd., London. 212 pp.
Toth, F.L. and E. Hizsnyik, 2005: Managing the inconceivable: participatory assessments of impacts and responses to extreme climate change, 26 pp. [Accessed 11.06.07: http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/atlantis.htm]
Turner, N.C., 2004: Sustainable production of crops and pastures under drought in a Mediterranean environment. *Ann. Appl. Biol.*, **144**, 139-147.
Turnpenny, J., A. Haxeltine and T. O'Riordan, 2004: A scoping study of user needs for integrated assessment of climate change in the UK context: Part 1 of the development of an interactive integrated assessment process. *Integrated Assessment*, **4**, 283-300.
Twinomugisha, B., 2005: Indigenous adaptation. *Tiempo*, **57**, 6-8.
UN (United Nations), 2005: Progress towards the Millennium Development Goals, 1990-2004. [Accessed 11.06.07: http://millenniumindicators.un.org/unsd/mi/mi_coverfinal.htm]
UNCRD (United Nations Centre for Regional Development), 2003: *Sustainability in Grass-Roots Initiatives: Focus on Community Based Disaster Management*. R. Shaw and K. Okazaki, Eds., Disaster Management Planning Hyogo Office and United Nations Centre for Regional Development, 103 pp.
UNDP (United Nations Development Program), 2003: *Human Development Report*. Oxford University Press, New York, 365 pp.
UNDP (United Nations Development Program), 2004: Reducing disaster risk: a challenge for development. UNDP, Geneva, 161 pp.
UNDSD (United Nations Division for Sustainable Development), 2006: Agenda 21. United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 1992. [Accessed 11.06.07: http://www.un.org/esa/sustdev/documents/agenda21/index.htm]
UNSEA (United Nations Social and Economic Affairs), 2005: The inequality predicament: report on the world social situation 2005. United Nations General Assembly, New York, 152 pp.
Van Asselt, M.B.A. and N. Rijkens-Klomp, 2002: A look in the mirror: reflection on participation in integrated assessment from a methodological perspective. *Global Environ. Chang.*, **12**, 167-184.
van de Kerkhof, M., 2004: *Debating Climate Change: A Study of Stakeholder Participation in an Integrated Assessment of Long-Term Climate Policy in the Netherlands*. Lemma, Dordrecht, 317 pp.
Van Lieshout, M., R.S. Kovats, M.T.J. Livermore and P. Martens, 2004: Climate change and malaria: analysis of the SRES climate and socio-economic scenarios. *Global Environ. Chang.*, **14**, 87-99.
Vlassova, T.K., 2006: Arctic residents' observations and human impact assessments in understanding environmental changes in boreal forests: Russian experience and circumpolar perspectives. *Mitigation and Adaptation Strategies for Global Change*, **11**, 897-909.
Warren, R., 2006: Spotlighting impacts functions in integrated assessment models. Working Paper 91, Tyndall Centre for Climate Change Research, Norwich, 216 pp.
Watkiss, P., D. Anthoff, T. Downing, C. Hepburn, C. Hope, A. Hunt and R. Tol, 2005: The social costs of carbon (SCC) review: methodological approaches for using SCC estimates in policy assessment. Final Report, Defra, UK, 124 pp.
Watson International Scholars of the Environment, 2006: Making MEAs work for the poor. *Tiempo*, **58**, 6-11.
WCED (World Commission on Environment and Development), 1987: *Our Common Future*. Oxford University Press, Oxford, 398 pp.
Welp, M., A. de la Vega-Leinert and S. Stoll-Kleeman, 2006: Science-based stakeholder dialogues: theories and tools. *Global Environ. Chang.*, **16**, 170-181.
Winters, L.A., N. McCulloch and A. McKay, A., 2004: Trade liberalization and poverty: the evidence so far. *J. Econ. Lit.*, **42**, 72-115.
WKSS (West Kitikmeot / Slave Study Society), 2001: West Kitikmeot / Slave Study Society Final Report. West Kitikmeot / Slave Study Society, Yellowknife, Canada, 87 pp. [Accessed 11.06.07: http://www.wkss.nt.ca/index.htm]
World Bank, 1998: *Protecting Our Planet: Securing Our Future*. R.T. Watson, Ed., World Bank/UNEP/ NASA, Washington, District of Columbia, 116 pp.
WRI (World Resources Institute), 2000: *World Resources 2000-2001: People and Ecosystems: The Fraying Web of Life*. World Resources Institute, Washington, District of Columbia. 389 pp.
WSSD, 2002: Plan of implementation of the World Summit on Sustainable Development, 62 pp. [Accessed 11.06.07: http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf]
Yamin, F., 2004: Overview. IDS Bulletin, 35, 1-11.
Yohe, G. and R. Tol, 2002: Indicators for social and economic coping capacity: moving toward a working definition of adaptive capacity. Global Environ. Chang., 12, 25-40.
Yohe, G., E. Malone, A. Brenkert, M.E. Schlesinger, H. Meij and X. Xing, 2006a: Global distributions of vulnerability to climate change. Integrated Assessment Journal, 6, 35-44.
Yohe, G., E. Malone, A. Brenkert, M.E. Schlesinger, H. Meij, X. Xing and D. Lee, 2006b: A synthetic assessment of the global distribution of vulnerability to climate change from the IPCC perspective that reflects exposure and adaptive capacity.CIESIN (Center for International Earth Science Information Network), Columbia University, Palisades, New York, 17 pp. [Accessed 11.06.07: http://ciesin.columbia.edu/data/climate/]
Young, O., 2006: Vertical interplay among scale-dependent environmental and resource regimes. *Ecology and Society*, 11, Art. No. 27. [Accessed 11.06.07: http://www.ecologyandsociety.org/vol11/iss1/art27/]