Chapter 14

Policy Synthesis for Key Stakeholders

Coordinating Lead Author: Ferenc L. Toth
Lead Authors: Eva Hizsnyik, Jacob Park, Kathryn Saterson, Andrew Stott
Contributing Authors: Douglas Beard, Danielle Deane, Claudia Ringler, Detlef van Vuuren
Review Editors: Wang Rusong, Antonio La Viña, Mohan Munasinghe, Otton Solis

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FIGURES

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Main Messages

The MA scenarios demonstrate the fundamental interdependence between climate change, energy, biodiversity, wetlands, desertification, food, health, trade, and the economy—and thus the need for relevant international agreements to work together to sustain life on Earth. This interdependence between environmental and development goals stresses the importance of partnerships and the potential for synergies among multilateral environmental agreements. As the basis for international cooperation, all global environmental agreements will operate under profoundly different circumstances in the four scenarios, and their current instruments (such as exchange of scientific information and knowledge, technology transfer, benefit sharing, and financial support) might need to be revised and complemented by new ones suited to changing sociopolitical conditions.

The interdependence between socioeconomic development and ecosystems services also requires national governments and intergovernmental organizations to provide the enabling conditions and to regulate the actions of the private sector, communities, and nongovernmental organizations. The responsibility of national governments to establish good governance at the national and subnational levels is complemented by their obligation to shape the international context and enabling conditions by negotiating, endorsing, and implementing international environmental agreements. Current and improving international instruments have better prospects to promote sustainable use of ecosystem services in the Global Orchestration and TechnoGarden futures, while national and local eco-management initiatives play a central role in the Adapting Mosaic scenario.

The MA scenarios show that the present focus of activity within the Convention on Biological Diversity on meeting the World Summit on Sustainable Development's target of significantly reducing rates of biodiversity loss will be difficult to achieve. The pressures on biodiversity will continue to grow during the twenty-first century, particularly through population and economic growth and the additional effects of climate change and pollution. All development pathways described by the MA scenarios have potentially significant negative impacts on biodiversity and its related ecosystem goods and services. The work programs of the CBD already include many of the actions needed to reduce these impacts, and these actions are implemented with varying degrees of success within the differing scenarios. For example, targets and associated actions within the CBD's Global Strategy for Plant Conservation emphasize the issues of habitat loss, conservation of protected areas, and sustainable management, but they may need to be expanded by actions to address the increasing threats of climate change and air pollution. The scenarios also anticipate the exacerbating regional disparity of impacts due to growing populations and economies of Asia, Latin America, and sub-Saharan Africa.

The nature and magnitude of future stress on wetlands and the prospects under the Ramsar Convention for helping to protect them are diverse across the scenarios: some stresses are stronger in the globalization scenarios, others are larger in the regional fragmentation scenarios. Existing international protection mechanisms have better prospects for success in the globally connected worlds and might need to be reformed in response to weakened global institutions of the locally oriented development paths. Greater pressure for agricultural land and massive increases in water withdrawals pose larger threats of wetland drainage and conversion in the regionally fragmented scenarios (Adapting Mosaic and Order from Strength) than the significant but smaller land and water stresses in the high-growth globalized worlds. In addition to more efficient technologies (TechnoGarden) or institutions (Global Orchestration), the latter scenarios imply stronger motivation to undertake and more effective instruments to implement wetland conservation under a global environmental agreement. An important feature of the Adapting Mosaic scenario is nonetheless that it pictures environmentally oriented societies that find practices and resources for cleaning return flows and for restoration of wetlands even in the absence of economic value, although the success of land and ecosystems co-management varies across regions.

The magnitude of future pressures causing desertification and the opportunities for the Desertification Convention to help mitigate the process vary across the scenarios: pressure is largest in Order from Strength, more modest in Adapting Mosaic and TechnoGarden, and lowest in Global Orchestration. Prospects for financial and technology transfers to help combat desertification are better in the globalization scenarios and more difficult in the fragmentation scenarios. All combinations of slow-to-fast population growth and improving economic conditions over the next decades will exert additional pressure on land resources and pose additional risk of desertification in dryland regions. Opportunities for the Desertification Convention will differ according to the diverse sociopolitical, economic, and technological conditions described in the specific scenarios. In a globalizing world, prospects for international environmental cooperation and resource transfers to support their implementation are likely to be better due to the institutional reforms (Global Orchestration) or because of the fast rate of technological development (TechnoGarden). It also requires political willingness in the affected countries to rank land degradation high on their political agenda and to commit national resources to fighting it. In a fragmented world, the role of a global agreement is more limited either because of the diminished interest in resource transfers (Adapting Mosaic) or because of the total lack of interest in what is going on beyond national or regional boundaries (Order from Strength). Yet in Adapting Mosaic, proactive local strategies might mitigate land degradation and reduce the need for global instruments.

Prospects for reaching the Millennium Development Goals by 2015 vary across the scenarios, geographical regions, and the goals themselves: halving poverty by 2015 is more likely to be achieved in a globalizing world in Latin America, South Asia, and India, while hunger will remain in most regions in all scenarios. Income growth is fastest in Global Orchestration and slowest in Order from Strength, on average. Halving the share of population (by 2015 relative to 1990) living on less than $1 a day has already been achieved in the East-Asia/Pacific region and in China. This target is likely to be achieved in Latin America, South Asia, and India under Global Orchestration but not under Order from Strength. Reaching this target in the Middle East and North Africa and in sub-Saharan Africa is unlikely under all four scenarios. The scenarios almost uniformly indicate that it will be difficult to halve undernourishment by 2015 in most regions except China under Global Orchestration and TechnoGarden and in Latin America under TechnoGarden despite sufficient, stable, or slightly increasing average availability of per capita dietary energy (except in sub-Saharan Africa). This implies that hunger remains an economic (income) and social (equity and distribution) issue rather than solely a natural resource/ecosystem problem.

Global environmental sustainability goals, which are part of the MDGs, largely fail, while local environmental quality is projected to improve in some scenarios. These general patterns, however, disguise considerable heterogeneity across regions and over the scenarios' time horizons. Total area covered by forests declines slightly globally, but a strong contrast exists between increasing forest areas in the OECD and the former Soviet Union and declining forest areas in all developing regions, especially sub-Saharan Africa and Middle-East/North Africa. Greenhouse gas emissions are projected to increase under all four scenarios in the OECD, to decline somewhat (except under Order from Strength) in the former Soviet Union, and to increase drastically in all developing regions. The prospects for improving local environmental quality are better. There is a good chance to reach the MDG of halving the

proportion of people without sustainable access to safe drinking water in most regions except sub-Saharan Africa (despite fast progress) and Latin America (due to slow progress).

The MA scenario implications for ecosystem services and human well-being are of primary interest to local communities, NGOs, and other participants in civil society, as they often depend more directly on ecosystem services for daily well-being than other institutional actors (such as corporations) do. While human well-being and GDP per person improves on average in all the scenarios except Order from Strength, this masks increased inequity. The resulting ecosystem degradation causes a decline in per capita aggregated ecosystem services in all scenarios. Opportunities and priorities for community and NGO response differ across the scenarios. The "worst case" scenario for communities and NGOs is Order from Strength, in which community health and well-being are threatened by loss of biological diversity and associated ecosystem services, decreases in the availability and quality of fresh water, climate change, and decreases in air quality. The reactive, regionalized Order from Strength focus would offer little opportunity for success in community and NGO attempts at co-management of resources or at partnerships with other actors at multiple scales due to limited financial support for NGO activity and the challenge of finding ways for global policies to also be reactive to local problems.

While the Global Orchestration scenario might offer significant financial support for social and environmental NGOs, it also describes high risk of adverse impacts from climate change and little opportunity for NGOs and communities to foresee and prevent the thresholds at which further ecosystem degradation and reductions in human well-being might occur. The greater political commitment to address environmental issues in the TechnoGarden and Adapting Mosaic scenarios contributes to less severe implications for biodiversity loss, loss of ecosystems services, and impacts on human well-being. These two scenarios offer the greatest opportunity for communities to obtain land and resource tenure, maintain and use traditional knowledge, and partner with NGOs and other actors to respond successfully to emerging threats. The more institutional and behavioral strategy of Adapting Mosaic might encourage monitoring of indicators of ecosystem change at all levels in order to enhance the ability of communities to anticipate and adapt to change that threatens community livelihoods and health.

Local communities and NGOs can work together with government and the private sector to advocate policies and to execute on-the-ground practices that protect, mitigate, and restore some of the ecosystem services that are threatened by the development paths and assumptions in the four scenarios. NGOs and communities often know what needs to be done; they just need partnerships and financial resources to make it happen. In all scenarios, NGOs and communities can be more strategic in their efforts to integrate environmental imperatives with political realities. The synthesis of changes in ecosystem provisioning and regulating services indicates that in 2050 the trade-offs between ecosystem services will be more intense than at present, there will be greater inequities between rich and poor nations and regions, and there will be greater adverse impacts from unanticipated disasters. This implies that environmental justice and ethics should be of even greater concern to communities and NGOs than they are today.

A critical component of better understanding and managing the interrelationship between human well-being and ecosystem services is the identification of crucial links between ecosystems and the private sector. Climate change, water, and biodiversity loss are likely to pose the greatest policy concerns to the private sector in 2000–50. Climate change is likely to have a significant level of private-sector involvement in the near term (~2010), since it is an issue with sufficient media attention and institutional capacity. The emphasis on globalization and international technology cooperation in Global Orchestration and TechnoGarden highlights the important role that private-sector actors, particularly multinational corporations, will have to play in addressing global environmental policy concerns. At the same time, increased involvement of multinational corporations may lead to greater "privatization" of global environmental governance, diminished government/civil society oversight, and greater criticisms of western eco-business strategies from poor countries. The Order from Strength scenario is likely to lead to the greatest conflict between wealthier countries and the poorer nations as well as within rich countries (most notably, between the United States and Europe). Regionally structured business–civil society partnerships are likely to be an important feature in the Adapting Mosaic scenario. Yet a more geographically sensitive approach may also result in greater fragmentation and the duplication of policy approaches.

None of the scenarios can be singled out as the most desirable future. Each scenario has several positive and negative characteristics because each entails different combinations of relatively smaller or larger ecosystems stresses and more or less stakeholder capacity to cope with the emerging risks. Because of the need to make socioeconomic choices among mutually exclusive options and because of the biophysical trade-offs among ecosystems functions and services, it is not possible to handpick a combination of drivers and ecosystem management strategies to achieve what might appear to be the best selection of features across scenarios. Thus, not even the most brilliant and committed policy-makers operating in a highly cooperative international community could achieve such dreamworld futures. The cornerstone of masterly policy-making is finding the best compromises among conflicting objectives, making appropriate interventions to achieve them, and doing regular reassessments of policies against anticipated and unanticipated outcomes.

14.1 Introduction

The MA scenarios—four plausible pathways into the future—were conceived and developed to provide insights for a broad range of private stakeholders and public policy-makers into the risks and opportunities that might emerge for ecosystems and their provisions of various functions and services under four distinctively different but plausible futures. Preceding chapters in this volume present the social, economic, and political characteristics of the four development paths, their consequences for the demand for ecosystems services, the principal ways societies manage their relations with nature to fulfill those demands, the fundamental implications for ecosystems, and the consequences of how ecosystems respond to the combinations of driving forces. Chapters 9, 10, and 11 provide cross-scenario comparisons of provisioning/regulating functions, biodiversity, and human well-being.

This final chapter summarizes the implications of the scenarios for diverse groups of stakeholders, ranging from local communities to those managing international environmental agreements. Moreover, it seeks to assess the most promising response options that might be available to different actors under the four scenarios to manage emerging ecosystem conditions—both threats and opportunities—according to the stakeholders' objectives (government, communities, the private sector) or mandates (international agreements).

A general trend of accelerating globalization can be observed in recent decades: most national governments delegate smaller or larger parts of their sovereignty to supranational or multinational institutions (to the European Union, for example, or international economic, environmental, and other agreements), an increasing number of private enterprises operate across national boundaries, communities organize themselves into international networks (such as Klimabündnis), environmental movements establish global organizations (WWF, for instance, and Greenpeace), and even antiglobalization movements are globalizing themselves: witness the recent mega-gatherings at the World Social Forum in Porto Alegre, Brazil, and in Mumbai, India. Nonetheless, national governments are likely to maintain their central role in coordinating and regulating most aspects of socioeconomic development, including societies' relationships with ecosystems. The nature and the exact form of the regulation and the distribution of responsibilities among central governments, communities, and the private sector may vary depending on the broad sociopolitical features of the scenario, but the key role of national governments is likely to continue.

The first part of this chapter deals with the three main international conventions concerned with broad environmental issues or specific ecosystems: the biodiversity convention, the wetlands accord, and the desertification agreement. (Although the MA scenarios contain some information on climate change and its impacts, this chapter does not assess the implications for the climate change convention; this could be done in the IPCC's Fourth Assessment Report.) These and other international agreements regulating the many facets of international relations among nation-states are negotiated and signed by national governments. Governments also provide the institutional framework for domestic implementation. Moreover, the central role of the government in the domestic sphere involves delineating and negotiating the distribution of power and responsibilities between communities as well as demarcating guidelines for the private sector and NGOs. Key aspects of the relationships among all the stakeholders shaping the fate of ecosystems and human well-being are highlighted in the final section of the chapter.

Each stakeholder section starts with a brief overview of the main mandates related to or key interests of the group in ecosystems and their services. This is followed by brief assessments of the main threats and opportunities concerning those interests and mandates under the four MA scenarios. Finally, a set of response options are considered and analyzed that are available to the stakeholder group in order to identify those that might be potentially effective and successful under the social and political circumstances of a scenario. At the end of each section, a summary table presents qualitative assessments of the threats and opportunities and of the prospects for response options and interventions to manage them. The only exception is the section of national governments, as their main function, in addition to keeping policies and regulations sufficiently flexible to accommodate changes in external conditions, is to shape future trends and driving forces rather than just adapt to them.

The remainder of this section recaps the four MA scenarios, which are based on contrasting assumptions about the driving forces that are currently changing the world—demographic developments, the rate and structure of economic growth, sociopolitical developments like changing governance systems, cultural factors, and possible developments in science and technology. None of these factors work in isolation, and thus the scenarios contain a number of explicit and implicit assumptions about how the different driving forces interact and what their weight is and will be in the years to come. All these factors determine how natural systems are used to provide the services required for human survival and thus change direct factors of ecosystem changes, such as land use or pollution regimes.

Each of the trajectories that the scenarios portray begins with a number of choices made today or in the very near future. Many of these decisions are quite substantial and require wider changes in policies worldwide. Quite a few of these decisions are based on possibilities we currently see emerging and that are being discussed in various policy fora around the world. All these general policy directions nevertheless require concrete measures to make political choices a reality. The direction these choices go in the real world will determine how we and our children will live in the future, and the real future is likely to represent a mix of various strategies and options described in the scenarios.

The trajectory of the Global Orchestration scenario is based on the strong commitment of governments and other policy-makers to tackle the problems currently plaguing societies. Eradicating hunger and poverty worldwide and fostering the creation of more equitable, democratic societies that give citizens equal opportunities is seen by policy-makers in this scenarios as the foremost task in the years come. Therefore the main focus is developing human and social capital and restructuring economic and social systems. Measures to reach these goals include the creation of equitable access of all players to global markets by eliminating distorting subsidies and trade barriers (the Doha Round of WTO negotiations was to be a first step in this direction), overhauling social systems, investing in education, and ensuring the creation and maintenance of global public goods by rethinking and redefining the role of public and private-sector investments in science and technology. Environmental problems are not forgotten, but they only enter the policy-making arena if they are large-scale or affect a bigger number of people. Otherwise they are dealt with in a reactive manner, fixing what is possible to remedy in the short run but not putting particular attention to the development of long-term solutions that prevent mismanagement of ecosystems.

The Order from Strength scenario trajectory starts off with growing mistrust in global institutions, like the United Nations, and in their ability to find solutions to today's problems. Strong countries feel increasingly that they need to take matters into their own hands to ensure that their integrity and security is not threatened by outside forces they cannot control. These nations focus mainly on internal issues and are only concerned with developments outside their own borders if they directly affect their own country.

This attitude also leads to a retreat from a number of global agreements such as WTO or the Kyoto Protocol if they are seen as being out of harmony with country interests. These developments eventually result in a growing fragmentation between stronger and weaker countries. But this attitude also affects developments within nations. More powerful or wealthier groups try to make sure that things work for them, neglecting some of the costs this might have for others. This attitude then results in a growing fragmentation within society. Although the environment is not forgotten, growing environmental problems are only dealt with whenever they directly affect people or if the benefits from environmentally friendly management are perceived to substantially outweigh costs. Particularly in currently developing countries, scarce financial and deteriorating natural capital forces decision-makers to make tough choices between long-term solutions and short-term fixes to arising problems.

The Adapting Mosaic scenario starts in a similar way as Order from Strength, in that it sets off with the growing conviction of decision-makers around the globe that the solutions to many problems need concrete remedies at the local and national level. A second notion though makes this scenario very different: The focus on local solutions is not driven by overall security concerns but by the growing understanding of human-ecosystem connections and the importance of maintaining the functioning of the whole suite of local ecosystem services that underpin local economic systems. Increasingly the diversity of local systems is seen as an important asset that needs to be fostered, as it provides a variety of new solutions to old problems. Human and ecological systems are seen as evolving together. This nevertheless also requires changes in resource management and governance systems, leading to the devolution of power to local resource users, which is not always and in all nations a smooth process. This development, though, is thought to eventually result in the emergence of new governance systems and organizations not just at the global level, but also at the regional and global scale.

The TechnoGarden scenario trajectory also starts off with a change in the definition of the importance of ecosystem services and their relationship to economic systems. As in Adapting Mosaic, maintaining all categories of ecosystem services and taking a proactive approach to their management is increasingly felt to be necessary in order to guarantee the smooth functioning of human systems. In this scenario, however, technology is seen as the key to managing ecosystems; ''natural capitalism,'' which focuses on obtaining profits by working with nature, is perceived to be advantageous for both individuals and society. Policymakers all over the world push for and invest in the development of environmentally friendly, ''green'' technologies that allow for a better management of the ecosystems for human purposes. Examples are new technologies for ''cleaner'' transportation systems or new urban planning and building schemes. One example of a measure that can set off this trajectory is the move of the European Union from production-based agricultural subsidies to payments for environmental services of farmers.

Each scenario trajectory together with decisions taken along the way will result in quite different outcomes by 2050, and each outcome will encompass different trade-offs. None of the future worlds described have only positive or negative outcomes. In Global Orchestration, the main trade-offs consist in managing ecosystems for their provisioning services at the expense of regulating, supporting, and cultural services. In addition, long-term maintenance of all services is traded off for current benefits to human societies. This trade-off is even stronger in the Order from Strength scenario. In Adapting Mosaic, trade-offs between ecosystem service categories and between services and human well-being components exist, but due to the varying nature of pursued management strategies around the globe (the ''mosaic'' of different experiments, approaches, and strategies), no overall trade-off paradigm exists. Rather a diversity of trade-off decisions emerges. The TechnoGarden world explores the double- edged sword of technology, which can have large beneficial effects but is also prone to failures. In addition, cultural ecosystem services are undervalued, and they are traded off for improvements in other services.

Improvements for human well-being can be found in all four scenarios but with very different rates of improvement and very different groups of society or countries winning or losing. And the environmental costs for human gains also differ widely between the scenarios. In three of them, human well-being overall improves but the costs and the risks of each development path on the environmental side vary. None of the scenarios portrays a complete breakdown of all ecosystem services, but many decisive steps and decisions have to be taken to change trajectories and avert some of the currently existing risks of ecosystem degradation and depletion. In reality, the future will be a mix of all the different approaches, strategies, and decisions that the scenarios portray, but many tough choices will have to be made along the way.

14.2 Implications for the Convention on Biological Diversity

The objectives of the Convention on Biological Diversity are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Biological diversity means the variability among living organisms from all sources including, among other components, terrestrial, marine, and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems. Sustainable use means the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

The objectives are translated into policies and concrete action through the agreement of international guidelines and the implementation of work programs of the Conven-

tion and of National Biodiversity Strategies and Action Plans. The Convention is developing seven thematic work programs—on forest diversity, dry and subhumid lands, biodiversity of inland waters, marine and coastal biodiversity, agricultural biodiversity, mountain biodiversity, and island biodiversity. Cross-cutting issues include, among others, biosafety; access to genetic resources; traditional knowledge, innovations, and practices; indicators; taxonomy; public education and awareness; incentives; and invasive alien species. Some cross-cutting initiatives directly support work under the thematic programs, such as the work on indicators. Others are developing discrete products that may be separate from the thematic programs. The convention has adopted the ''ecosystem approach'' as a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way.

The sixth meeting of the Conference of the Parties in April 2002 adopted the Strategic Plan for the Convention, which commits Parties to ''achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional, and national level as a contribution to poverty alleviation and to the benefit of all life on earth'' (Decision VI/26). The Strategic Plan also commits Parties to a more effective and coherent implementation of the three objectives of the Convention.

At the World Summit on Sustainable Development in Johannesburg in August/September 2002, governments adopted a Plan of Implementation that reconfirmed the role of the CBD as the key instrument for the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from its use. With respect to the 2010 target, the WSSD Plan of Implementation recognizes that ''the achievement by 2010 of a significant reduction in the current rate of loss of biological diversity will require the provision of new and additional financial and technical resources'' (paragraph 44).

While world political leaders have agreed that ''biodiversity loss'' constitutes a serious challenge at the global, regional, and national level, there is as yet no widely accepted definition of what biodiversity loss means or how it can be monitored or assessed. The following definition of biodiversity loss was proposed at the 2010–The Global Biodiversity Challenge Conference in London in 2003 (UNEP/CBD/SBSTTA/9/INF/9), and adopted by the seventh meeting of the CBD Conference of the Parties in Kuala Lumpur in 2004 (Decision VII/30): ''the long term or permanent qualitative or quantitative reduction in components of biodiversity and their potential to provide goods and services, to be measured at global, regional and national levels.''

COP7 also decided to establish a small number of global goals and sub-targets to clarify the 2010 global biodiversity target, covering six focal areas of the convention. Further work is required to integrate the goals and targets into the work programs of the convention. In order to assess progress at the global level toward the 2010 target, COP7 agreed that a balanced set of indicators should be identified or developed (Decision VII/30), as described later.

The outcomes of the MA scenarios are highly relevant to the immediate work of developing global goals, subtargets, and indicators for assessment of progress toward the 2010 target. The Subsidiary Body on Scientific Technical and Technological Advice has recommended that the targets should be challenging but realistic, recognizing the constraints of Parties, especially developing countries. The MA scenarios can help in the process of setting realistic and attainable outcome-oriented targets within the work programs of the convention, as these are reviewed over the next few years. COP7 invited other related assessment processes such as the MA to contribute reports and information that assist in monitoring progress toward the 2010 target.

At its sixth meeting, the Conference of the Parties adopted the Global Strategy for Plant Conservation as a pilot approach for the use of outcome targets for the convention and to consider the application of the approach to other areas (Decision VI/9). The GSPC includes 16 specific and measurable targets for 2010. It therefore offers a case study to evaluate the MA scenarios against specific CBD targets and to provide feedback to the convention on the general use of outcome targets.

No consideration has yet been given by international policy-makers to establishing targets over longer time scales (up to 2050). However, the CBD objectives imply that biological diversity, at ecosystem, species, and genetic levels, should be conserved indefinitely in order to maintain its potential to meet the needs and aspirations of present and future generations. For this longer time scale, the MA scenarios help inform future policy direction within the CBD by identifying the future risks to biological diversity and how these risks vary with different response options.

14.2.1 Threats to Biodiversity in the MA Scenarios

The main global-level threats to biodiversity identified within the work programs of the CBD are habitat transformation (such as conversion to agriculture, urbanization and infrastructure development, fragmentation, and mining and engineering works); overexploitation (such as overgrazing, overharvesting, overfishing, loss of plant and animal genetic resources, and water abstraction); inappropriate management (such as undergrazing, changes in fire regimes, and soil erosion); invasive alien species; pollution (such as sulfur and nitrogen emissions); and climate change (such as long-term changes in temperature and rainfall, extreme events, and sea level change).

The quantitative outputs of the MA scenarios are mapped onto the main threats to biodiversity in Table 14.1. The association between MA output variables and threats is not precise, and there are significant aspects of the threats that are not represented within the MA outputs. Gaps in coverage relate particularly to fisheries, inappropriate management, and invasive alien species. However, the association between MA scenario output variables and biodiversity threats is sufficient to identify the general, long-term risks to meeting the objectives of the CBD. (Chapter 10 provides quantitative information of expected impacts on global bio-

Table 14.1. MA Quantitative Scenario Outputs Related to Main Threats to Biodiversity

Threats to Biodiversity	Quantitative Scenario Outputs[a]
Habitat transformation	change in agriculture area conversion of forests fragmentation and biodiversity loss population growth (urbanization) fossil fuel extraction
Overexploitation and inappropriate management	agricultural intensification water abstraction
Invasive species	
Pollution	emissions of SO_2 and NO_X excess of critical loads return flows to rivers
Climate change	temperature rainfall biome shift

[a] This is not a comprehensive list of possible threats but a list of threats that have been quantified in the MA scenarios.

diversity, in particular loss of habitats, loss of plant species, and shifts in terrestrial biomes due to climate change.)

14.2.1.1 Habitat Transformation

In the Global Orchestration and Adapting Mosaic scenarios, global rates of forest loss due to agricultural expansion are similar to present rates, while in TechnoGarden they are slightly lower. Rates increase by 50% in Order from Strength up to 2020. In all scenarios there is a large increase of the rate of forest loss in sub-Saharan Africa and a lesser increase in OECD countries.

Biodiversity losses occur directly through loss of habitat and indirectly through fragmentation. The results show a decline of 12–16% in vascular plant species diversity as a consequence of global habitat loss between 1970 and 2050, assuming that species diversity eventually reaches an equilibrium with the area of habitat available. The highest losses occur in Order from Strength and the lowest in the TechnoGarden and Adapting Mosaic. Rates of loss in plant diversity increase between the two time periods 1980–2000 and 2000–20 in Order from Strength and Global Orchestration by 40% and 10%, respectively, but decline by 15–20% in the other two scenarios. There are major differences in plant diversity between the different biomes, and tropical forest, tropical woodland, savanna, and warm mixed forest account for 80% of all plant species lost. The severity of impact of habitat transformation on biodiversity depends largely on details of habitat conversion. If biodiversity hot spots and functioning ecological networks are maintained within protected areas or by other conservation mechanisms, then risks of massive biodiversity loss may be reduced. Nonlinear and lagged responses may occur as habitats become progressively isolated and reduced in size.

14.2.1.2 Overexploitation

Agricultural intensification occurs under all scenarios, but especially in Global Orchestration and TechnoGarden, where intensification enables increased food production with less land-take for agriculture. Intensification, including introduction of new crop/livestock varieties, management, fertilizer, and pesticide regimes, is likely to be detrimental to wildlife species and genetic varieties of crops and livestock that are associated with traditional/low intensity agricultural habitats. Risks to biodiversity may be reduced in TechnoGarden by adoption of appropriate management regimes or traditional practices (such as preservation of uncultivated areas and linear habitats) in agricultural ecosystems of high importance for biodiversity. Under the Adapting Mosaic scenario, genetic diversity used by people is increased by spatial heterogeneity of ecosystem management.

Water abstraction and water stress are critical threats to wetland ecosystems. Water abstractions increase to meet population growth and irrigation demands in all scenarios by between 20% and 80% globally, with two- to threefold increases in sub-Saharan Africa and Latin America. Increased abstractions exceed expected increases in precipitation (due to climate change) and create water stress under Global Orchestration and especially under Adapting Mosaic and Order from Strength. Geographical variations in future precipitation are highly uncertain. Wetland habitats in sub-Saharan Africa and Latin America, in catchments where increased demand coincides with lower precipitation, are most vulnerable to reduced water levels. However, under TechnoGarden, reduced abstractions may enable restoration of wetlands in the former Soviet Union.

GDP per person increases in all scenarios, especially in Global Orchestration and TechnoGarden, and especially in Asia and the OECD. Growing income levels, coupled with increased populations, are likely to intensify pressure from tourism, leading to habitat loss and overexploitation. However, there will also be more opportunity for tourism to provide self-funding opportunities for biodiversity conservation. Both positive and negative impacts of tourism are likely to be highly localized. Global tourism is most likely to increase under Global Orchestration and TechnoGarden.

14.2.1.3 Pollution

Sulfur dioxide emissions can cause acidification impacts, especially in freshwater ecosystems, where high levels of deposition occur on acidic soils with low buffering capacity (as in Scandinavia and North America). Global sulfur dioxide emissions fall in all scenarios, but especially in TechnoGarden and Global Orchestration. Regionally, however, increases occur from existing low levels in sub-Saharan Africa in all scenarios. Following large reductions in emissions in OECD, Asia becomes the dominant source of sulfur dioxide under all scenarios. The scenarios indicate a reduced acidification risk in OECD and the former Soviet Union. There is a high risk of acidification becoming a localized problem within vulnerable ecosystems in Asia under Adapting Mosaic and Order from Strength scenarios.

Nitrogen oxide emissions can cause eutrophication (artificially raised nutrient levels), especially where high levels of deposition occur in low nutrient status terrestrial ecosystems (such as in lowland heaths in northern Europe). Global nitrogen oxide emissions increase under all scenarios by 20–

50%, with the highest increase occurring in Global Orchestration. (Ammonia emissions have not been modeled.) Emissions are likely to be reduced in OECD but increase two- to fourfold in Asia and the former Soviet Union. There is a high risk of eutrophication becoming a significant problem within vulnerable ecosystems in Asia under all scenarios.

The combined impacts of acidification and eutrophication result in an overall estimated decline in plant species diversity of 2–5% across all terrestrial habitats by 2050. Temperate and warm mixed woodlands are most severely affected, with plant species diversity decline of 5–10% across the scenarios. Losses are highest in Global Orchestration and lowest in TechnoGarden.

Return flows, as an indication of freshwater and estuarine pollution, increase under all scenarios by 40–200%. Return flows are generally stable or reducing in OECD and the former Soviet Union, but there are large increases in sub-Saharan Africa and Latin America. There are therefore high risks of increased pollution of freshwater and recipient coastal habitats in those regions.

14.2.1.4 Climate Change

The impacts of climate change will be most severe where the rates of change in climatic variables exceed the rate of species dispersal and adaptation within biomes. In the four scenarios, about 5–20% of ecosystems will be seriously affected by climate change, the worst being Global Orchestration. In that case, in 20% of protected areas the originally protected ecosystem will have either been replaced or seriously damaged as a consequence of climate change alone. The most heavily affected biomes are boreal and cool conifer forests, tundra, shrubland, and savanna. In addition to shifts in zonal climates, coastal habitats are also affected by an increasing rate of sea level rise, reaching around 25 centimeters above 2000 levels by 2050 under all scenarios. Coral reefs, mangrove forests, and salt marshes are particularly vulnerable, but estimates of potential global losses are not available.

14.2.1.5 Combined Threats

The above threats to biodiversity do not act in isolation. Under most scenarios, and in most regions, there is a high risk that rapid climate change will occur concurrently with continuing loss and fragmentation of natural habitats and with increasing overexploitation of natural resources and pollution.

The combined impacts on biodiversity of land use change, climate change, emissions of greenhouse gases, and regional air pollutants have been modeled using the IMAGE integrated assessment framework. The outputs show that the area of agricultural land increases at the expense of natural habitats in all scenarios. The increase in area of agricultural land is as much as 24% in Order from Strength by 2050 but only 7–9% in the other scenarios. Tropical savanna is the most severely affected biome, with losses of between 27% in Adapting Mosaic and 55% in Order from Strength. Forested land as a whole shows a slight increase in all scenarios except Order from Strength. But within the forest biomes, gains in regrowth, boreal, and temperate mixed forests are offset by losses in the more species-rich tropical, temperate deciduous, and warm mixed forests under most scenarios. Order from Strength is the most extreme, with losses of 22% of tropical forest, 24% of temperate deciduous, and 35% of warm mixed forest by 2050. In contrast, under TechnoGarden there are gains in most forest biomes except tropical forests, which decrease by 11% by 2050.

Of the three main threats to terrestrial biodiversity, habitat loss emerges as the most significant pressure on biodiversity under all scenarios up to 2050. Habitat loss leads to 11–16% decline in biodiversity across all habitats. According to these models, climate change and air pollution are associated with lesser declines of 2–5%. However, there is strong differentiation between impacts on different biomes. The greatest pressure in tundra and desert biomes is climate change, whereas in warm mixed and tropical forests, habitat loss and air pollution are most significant. Savanna and temperate forest have high levels of pressure from all three factors. Boreal forest has low pressure from all three factors. There is less distinction between the four scenarios. Overall, Order from Strength creates the highest rates of habitat loss and Global Orchestration has the highest risk of climate change and air pollution impacts. In most biomes TechnoGarden has the lowest pressures for all three impacts. The highest threats to biodiversity in most scenarios are in sub-Saharan Africa and Latin America. In these regions pressures on biodiversity by 2050 are increased by factors of two to four above present levels. These regions also contain many of the world's existing hot spots of biodiversity. The lowest threats in most scenarios are found in the OECD and the former Soviet Union. TechnoGarden emerges consistently as the scenario with lowest pressure on biodiversity.

Losses in biodiversity—that is, loss of habitats, decline in species abundance, and loss of genetic diversity—have implications for ecosystem goods and services and human well-being. The qualitative assessment of the future vulnerability of ecosystem services shows strong differentiation between the scenarios. The highest vulnerability occurs in the Order from Strength scenario, with decreases in provisioning services (such as genetic resources and biochemical discoveries) and decreases in regulating services (such as water regulation and biological control). In Global Orchestration, ecosystem services are maintained in the North but show some losses in the South. In Adapting Mosaic and TechnoGarden, ecosystem services generally increase or are unchanged. Adapting Mosaic in particular shows increases in ecosystem services associated with biodiversity (such as genetic resources, ornamental resources, and biological control).

14.2.2 Prospects for the CBD

14.2.2.1 2010 Target

COP7 adopted a limited number of global indicators for assessing progress toward the 2010 target (Decision VII/30). These trial indicators are not yet specified in detail and they have not been evaluated directly by the MA scenarios.

However, there is some evidence from the quantitative scenario results to suggest the possible short-term trends in the aspects of biodiversity covered by these indicators. (See Table 14.2.) The evidence is inconclusive, but it suggests that the target is very challenging though achievable—at least, in some regions.

The pressures identified by the MA up to 2010 are mostly similar in character, scale, and intensity to those that the international community has experienced over the past 20 years and that are already the subject of the CBD work programs. However, emerging pressures from climate change and air pollution may not be adequately addressed. For example, targets and associated actions within the CBD Global Strategy for Plant Conservation (see Table 14.3) emphasize issues of habitat loss, conservation of protected areas, and sustainable management and pay less attention to the less tangible but increasing threats of climate change and air pollution. As all these pressures on biodiversity increase under the MA scenarios up to 2010, the policy responses need to extend and become more effective at global, regional, national, and local levels. This shows the need for full implementation and provision of adequate resources for existing CBD work programs. There is also evidence that the growing populations and economies of Asia, Latin America, and sub-Saharan Africa will exacerbate regional disparity of impacts. There is a real prospect that rates of biodiversity loss will slow or halt in rich nations while accelerating elsewhere.

14.2.2.2 Response Strategies beyond 2010

The CBD encompasses a comprehensive range of detailed response strategies within its work programs. Although space does not permit a full analysis of how these responses may develop within each program under the different scenarios, the Expanded Work Programme on Forest Biological Diversity (Decision VI/22) is used as an example. This was chosen because it contains a comprehensive set of policy responses that address the main threats to biodiversity assessed within the MA.

Table 14.4 summarizes the responses currently planned within the expanded work program and shows how these may develop under each scenario, based on a qualitative interpretation of the scenario storylines up to 2030. The results show that the wide range of current policy responses in the forest work program is generally robust to the different possible futures. The CBD appears to have anticipated the major dimensions of change captured in the MA scenarios. For example, when we looked at the threat of habitat loss we saw that response strategies regarding establishment of networks of protected areas would develop a different emphasis in each of the scenarios. In Global Orchestration, we anticipate that global networks of protected forest areas will be established with an emphasis on promoting the economic and social benefits of global tourism. In Order from Strength, we anticipate that regional or national networks of protected forest areas and private reserves will be the main policy tool for maintaining forest goods and services in wealthy countries, with ineffective networks and accelerated loss of forests elsewhere.

The goals and sub-targets agreed to by COP7 in Kuala Lumpur provide a framework for assessing longer-term implications of the MA scenarios for the CBD. Although these goals and sub-targets are primarily intended to clarify the 2010 biodiversity target, facilitate assessment of progress, and promote coherence among the programs of work, they are sufficiently general to be used as a guide to the longer-term objectives of the convention.

Table 14.5 compares the outcomes of the four MA scenarios for the period 2030–50 with respect to these CBD goals. TechnoGarden and Adapting Mosaic provide the most positive outcomes for the CBD. TechnoGarden combines multilateral regulation and management of global commons with an integrated, ''ecosystem approach'' to conservation of biodiversity within sustainable production systems. Adapting Mosaic also provides positive outcomes, but these are more regionally differentiated, as the best practices and resources for conservation of biodiversity are not universally applied. Traditional knowledge and rights of indigenous communities receive greater recognition, but global commons are not managed collectively. The Global Orchestration and, especially, Order from Strength scenarios have poor outcomes for the CBD goals. In Global Orchestration there is some success in conserving biodiversity in protected areas, at least within wealthy countries, and in benefit sharing and transfer of resources, but the CBD is marginalized in the drive for economic growth. In Order from Strength, the outcomes are overwhelmingly negative as the lack of global cooperation is compounded by increasing regional inequality and a failure to share benefits or transfer resources.

Table 14.6 provides a concise summary of key stresses for the CBD and the prospects for success of relevant response options under the four scenarios. The most favorable future scenario for conservation of biodiversity may combine elements of the TechnoGarden and Adapting Mosaic scenarios by developing strong international institutions for the sharing of information, guidance, and resources but still enabling regional and national diversity and recognizing the value of local knowledge and solutions. The work programs of the CBD and the national strategies and action plans already provide an appropriate response framework. In particular, the CBD provides a basis for international cooperation, exchange of scientific information and knowledge, access and benefit sharing, and transfer of financial resources and technology. The CBD has already developed guidance on sustainable use and the ''ecosystem approach'' and is working to establish synergies with the other Rio conventions and related multilateral environmental agreements.

The CBD recognizes the sovereign right of states to exploit their own resources pursuant to their own environmental policies and the responsibility to ensure that activities in their jurisdiction do not cause damage to the environment of other states. The CBD therefore relies primarily on the voluntary participation and cooperation of Parties in the implementation of its work programs. Efforts to introduce a stronger regulatory component, such as a protocol on protected areas, have been resisted, and instead the emphasis is

Table 14.2. Evidence from MA Scenarios for Provisional CBD Indicators for Assessing Progress toward the 2010 Biodiversity Target (CBD Decision VII/30)

Provisional Indicators	Evidence from Scenarios up to 2010
Components of biodiversity	
Trends in extent of selected biomes, ecosystems, and habitats	rate of natural forest loss continues at current rates, or accelerates; warm mixed forest and savanna most at risk from habitat loss; some restoration of forest and wetlands in OECD and former Soviet Union
Trends in abundance and distribution of selected species	increased pressures from habitat loss, overexploitation, and pollution; sub-Saharan Africa, Latin America, and Asia most at risk; temperate and warm mixed woodland most at risk from air pollution
Change in status of threatened species	threatened species not modeled directly but rate of extinction of vascular plant species due to habitat loss accelerates in OS and GO scenarios and slows in TG and AM scenarios; likely to be exacerbated by climate change; tropical forest, tropical woodland, savanna, and warm mixed forest account for 80% of all plant species lost
Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance	increased pressure from agricultural intensification; genetic resources decrease in OS
Coverage of protected areas	coverage of protected areas not modeled; protected areas at risk from longer-term climate change impacts, air pollution, and overexploitation
Sustainable use	
Area of forest, agricultural, and aquacultural ecosystems under sustainable management	not modeled; expected to vary in accordance with scenario storylines; increases in TG and AM scenarios
Proportion of products derived from sustainable sources	
Threats to biodiversity	
Nitrogen deposition	increases under all scenarios by 20–50% by 2050
Numbers and cost of alien invasions	not modeled; expected to increase as a result of climate change and increased global trade and mobility
Ecosystem integrity and ecosystem goods and services	
Marine trophic index	marine biodiversity modeling results uncertain
Fragmentation	not modeled
Human-induced ecosystem failure	not modeled; expected to vary in accordance with scenario storylines; most significant failures in OS and GO scenarios
Health and well-being of people living in biodiversity-based resource-dependent communities	not modeled; expected to vary in accordance with scenario storylines; most significant failures in OS and GO scenarios
Water quality	decreases under all scenarios by 40–200% by 2050
Biodiversity used in food and medicine	not modeled; expected to vary in accordance with scenario storylines; most significant uses in TG and AM scenarios
Traditional knowledge, innovations, and practices	
Linguistic diversity and numbers of speakers of indigenous languages	not modeled; expected to vary in accordance with scenario storylines; greatest diversity maintained in AM scenario
Access and benefit-sharing	
To be defined	not modeled; access likely to be greatest with GO and TG, least with AM; total benefits likely to be greatest with TG
Resource transfers	
Overseas development assistance	not modeled; expected to vary in accordance with scenario storylines; greatest resource and technology transfers in TG and GO scenarios
Technology transfer	

Key: GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden

Table 14.3. Analysis of Future Trends Identified in MA Scenarios and Planned Actions up to 2010 within the CBD

Threats to Biodiversity	Current GSPC 2010 Targets	Planned Actions within CBD	Response to Future Trends Identified in MA
Habitat loss *Increasing pressure for agricultural and development land*	At least 10% of the world's ecological regions effectively conserved. Protection of 50% of the most important areas of plant diversity.	About 10% of the land surface is currently protected but some ecosystem types are poorly represented. Actions are needed to improve the representation of different ecosystems within protected areas and increase their effectiveness.	Strengthen protection, management, sustainable use, and funding of protected areas. Improve markets for ecosystem services and for common property and community-based management. Maintain and restore connectivity within fragmented ecosystems. Enhance yields from productive ecosystems to reduce pressure for agricultural expansion. Adopt flexible and forward-looking approach to PA networks that recognizes that the distributions of habitats and species will change as a consequence of climate change.
Overexploitation and inappropriate management *Increasing agricultural intensification, use of new technologies, and overharvesting of natural products*	At least 30% of productive lands managed consistent with the conservation of plant diversity. No species of wild flora endangered by international trade. 30% of plant-based products derived from sustainable sources. 70% of genetic diversity of crops conserved.	Conserve biodiversity within production systems (e.g., agriculture or forestry). Use management practices that avoid adverse impacts. Use integrated, sustainable management practices. Apply ecosystem approach to land use decisions and management. Extend certified products. Extend gene banks and acquisition of indigenous and local knowledge.	Promote sustainable use of productive lands. Promote more-effective education, incentives, regulation, and enforcement. Maintain traditional knowledge about plant varieties. Improve markets for ecosystem services and for common property and community-based management.
Invasive species *Increased risk of invasion due to climate change and world trade*	Management plans in place for at least 100 major alien invasive species.	Establish risk assessment procedures and management strategies at national levels.	Implement control strategies.
Pollution *Increased impacts of acidification and eutrophication, especially in temperate and warm mixed woodland*	No targets.	None within GSPC, but actions included in forest work program.	Establish monitoring protocols for impact assessment. Extend multilateral agreements on control of emissions. Improve efficiency of nitrogen use.
Climate change *Evidence of biodiversity impacts and first losses attributed to climate change*	No targets.	None.	Establish monitoring protocols and assessment tools. Review implications for in situ conservation objectives and policy instruments.

on promotion of voluntary guidelines. Overall, progress is largely determined by the commitment, effective voluntary participation, and cooperation of Parties, other nations, and relevant stakeholders from local to international levels, as well as the provision of adequate human and financial resources necessary for the conservation of biodiversity.

The present focus of activity within the CBD is toward meeting the WSSD target of significantly reducing the rate of biodiversity loss by 2010, recognizing the fundamental contribution that biodiversity makes to ecosystem goods and services and poverty reduction. The MA scenarios show that this target will be difficult to achieve by 2010 and that the pressures on biodiversity will continue to grow during the first half of the twenty-first century, particularly through population and economic growth and the additional effects of climate change and pollution. The immediate challenge for the CBD is to translate the growing evidence of rapid biodiversity loss and ecosystem failure, both observed and projected, and their implications for human well-being into willingness by governments to fully implement their commitments under the CBD. An important step toward addressing this challenge was made at COP7 by agreeing on a framework and a process to set outcome-oriented targets for the work programs of the convention and to assess progress using a limited number of global indicators. Clarity about the issues and the gravity of the situation is an essential stimulus to government action.

The MA scenarios make an important contribution to the evidence base and will be a useful tool in the ongoing process of formulating attainable targets for the convention. Inevitably there is not an exact match between the MA outputs and the goals, targets, and associated indicators that have subsequently been agreed on as priorities within the CBD. In the future, a better match should be achievable.

Table 14.4. Analysis of Future Trends Identified in MA Scenarios up to 2030 and Possible Responses within the CBD

Major Threats to Biodiversity and MA Trends	Planned Responses within CBD Programme on Forest Biological Diversity	Possible Responses in MA Scenarios up to 2030			
		Global Orchestration	***Order from Strength***	***Adapting Mosaic***	***TechnoGarden***
Habitat loss *Increasing pressure of conversion for agriculture, urbanization, and infrastructure*	Ensure adequate and effective protected area forest networks. Assess adequacy of existing PAs and establish effective networks. Prevent and mitigate losses due to fragmentation and conversion. Encourage creation of private reserves. Establish ecological corridors. Promote cost-benefit analysis of development projects, taking into account impacts on biodiversity.	Global networks of protected areas established. However, remaining areas of forest depleted and ineffective ecological corridors. Development projects do not take full a account of forest biodiversity in cost-benefit analysis; greater emphasis on economic and social benefits. Emphasis on economic and social values of forest biodiversity. Protected areas managed to provide economic and social benefits through tourism.	Strongly regulated networks of protected areas and private reserves established in some regions or countries. Elsewhere, areas of forest severely depleted and fragmented. Approach lacks global representation and flexibility in face of climate change. Emphasis on national and regional PA networks and private reserves as policy tool.	Effective networks of protected areas and ecological corridors in some regions or countries. Elsewhere, areas of forest depleted and fragmented. Development projects take account of forest ecosystem services and importance for well-being of indigenous and local communities. Emphasis on establishment of protected areas to maintain ecosystem goods and services and support indigenous and local communities within the ecosystem approach.	Effective and representative global networks of protected areas established. Remaining areas of forest reduced, but ecological corridors retained and established. Development projects take account of ecosystem services. Emphasis on protected areas, integrated with ecological networks to maintain ecosystem goods and services. Guidelines/ protocol adopted on protected areas.
Overexploitation and inappropriate management *Increasing demand for timber and overharvesting of natural products; increased fire risk due to human pressures and climate change*	Promote sustainable use of forest resources. Support activities of indigenous and local communities involving the use of traditional knowledge. Develop programs for sustainable use of timber and other forest products. Prevent losses caused by unsustainable harvesting. Prevent and mitigate adverse effects of forest fires. Develop guidance and adapt ecosystem approach to forests both inside and outside protected areas. Promote restoration of forest biodiversity to restore ecosystem services.	Consumer preferences drive sustainable use of timber and other forest products. Regulated global trade and certification schemes. Forest fire management driven by commercial timber considerations. Emphasis on promoting economic and social values of sustainable forest production. Ecosystem approach adapted to optimize economic and social benefits from sustainable use.	Sustainable use of forest resources promoted in wealthier countries, with establishment of effective regional certification schemes. Forests regarded as important recreational resource. Elsewhere, unsustainable harvesting and fire risk increases. Emphasis on national and regional protected area networks and private reserves as policy tool.	Ecosystem approach developed and adopted in some places both within and outside protected areas. Activities of indigenous and local communities supported. Unsustainable harvesting reduced in some regions and countries. Emphasis on developing the ecosystem approach and promoting local solutions to management problems.	Watershed management issues and carbon trading drive sustainable use of timber, substitution for forest products, and restoration and management of forests for biofuels. Development and sharing expertise in forest management. Emphasis on maintenance and restoration of ecosystem services.
Invasive species *Increased risk of invasion due to climate change and world trade*	Prevent the introduction of invasive alien species and mitigate negative impacts.	Emphasis on developing appropriate control methods where economic interests are at risk.	Emphasis on developing appropriate control methods for protected areas.	Emphasis on risk assessment and developing control methods.	Emphasis on risk assessment, monitoring, and prevention, including regulation of genetically modified organisms. Development of technology for excluding or eradicating invasive species.

(continues)

Table 14.4. Continued

Major Threats to Biodiversity and MA Trends	Planned Responses within CBD Programme on Forest Biological Diversity	Possible Responses in MA Scenarios up to 2030			
		Global Orchestration	***Order from Strength***	***Adapting Mosaic***	***TechnoGarden***
Pollution *Increased impacts of acidification and eutrophication, especially in temperate and warm mixed woodland*	Increase understanding of impact. Support monitoring programs. Promote reduction of pollution levels (sulfur dioxide and nitrogen oxides) and mitigate impacts.	Multilateral regional agreements on control of emissions relaxed. Emphasis on monitoring, assessment, and mitigation of impact of pollution on commercial forest products.	Failure of multilateral regional agreements on control of emissions. Monitoring protocols for impact assessment established in some regions and countries. Research undertaken to develop mitigation techniques for protected areas in wealthier regions and countries. Emphasis on monitoring, assessment. and mitigation of impact on protected areas.	Failure of multilateral regional agreements on control of emissions. Mitigation methods developed within ecosystem approach at a local level. Emphasis on monitoring, assessment, and mitigation of impact of pollution within ecosystem approach.	Multilateral regional agreements on control of emissions extended. Monitoring protocols for impact assessment established. Research undertaken to develop mitigation techniques. Emphasis on monitoring, assessment and mitigation of impact on ecosystem services and developing synergies with regional agreements on control of emissions.
Climate change *Evidence of biodiversity impacts and first losses attributed to climate change*	Promote monitoring and research on impacts of climate change. Promote maintenance and restoration of forest biodiversity to enhance capacity to resist or adapt to climate change. Promote forest biodiversity conservation and restoration in climate change mitigation and adaptation strategies.	Forest restoration an important component of adaptation strategies, including development assistance. Emphasis on promoting appropriate forest restoration and management strategies to maintain forest productivity.	Forest restoration an important component of adaptation strategies in wealthier regions and countries. Emphasis on monitoring impacts on protected areas and developing management guidelines for forest restoration and management in protected areas.	Forest restoration an important component of mitigation and adaptation strategies within ecosystem approach. Emphasis on providing guidelines for mitigation and adaptation to maintain ecosystem services and support indigenous and local communities.	Forest restoration an important component of mitigation and adaptation strategies, including development assistance. Management seeks to enhance capacity of forest ecosystems to adapt to change, including attempts to improve ecological connectivity. Emphasis on monitoring and research to anticipate climate change effects and develop guidelines for forest management and restoration strategies. Developing synergies with mitigation and adaptation strategies in the climate change convention.

14.3 Implications for the Ramsar Convention

Currently, wetlands cover about 6% of Earth's land surface. Besides their direct contribution to local economies through water supply, fisheries, forestry, agriculture, and tourism, they provide various ecosystems services, most notably biodiversity conservation. The Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) is one of the oldest global environmental agreements and to date the only one dealing with a particular ecosystem. It defines wetlands in an all-encompassing manner: ''Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters'' (Article 1.1 of the Convention).

The primary objective of the convention is to provide a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Convention defines wise use of wetlands as ''their sustainable utilization for the benefit of human kind in a way compatible with the maintenance of the natural properties of the ecosystem.'' Sustainable utilization, in turn, is explained as ''human use of a wetland so that it may yield the greatest continuous benefit to present generations

Table 14.5. Qualitative Comparison between Scenarios with Respect to Global Goals and Targets of the CBD up to 2050. Note that CBD targets are specified in relation to the WSSD 2010 global target.

	MA Scenarios			
CBD Goals and Targets	**GO**	**OS**	**AM**	**TG**
Protect the components of biodiversity				
Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats, and biomes				
Target 1.1: At least 10% of each of the world's ecological regions effectively conserved	+/−	+/−	+	+
Target 1.2: Areas of particular importance to biodiversity protected	+/−	−−	+/−	+
Goal 2. Promote the conservation of species diversity				
Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups	−−	−−	−	−
Target 2.2: Status of threatened species improved	−	−−	+/−	+/−
Goal 3. Promote conservation of genetic diversity				
Target 3.1: Genetic diversity of crops, livestock, and harvested species conserved and associated indigenous knowledge maintained	−−	−	+	−
Promote sustainable use				
Goal 4. Promote sustainable use and consumption				
Target 4.1: Biodiversity-based products derived from sources that are sustainably managed	+/−	−−	+/−	+
Target 4.2: Unsustainable consumption of biological resources reduced	−−	−−	+/−	+
Target 4.3: No species of wild flora or fauna endangered by international trade[a]	+/−	−−	−	+/−
Address threats to biodiversity				
Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use reduced				
Target 5.1: Rate of loss and degradation of natural habitats decreased	−	−−	+/−	+
Goal 6. Control threats from invasive alien species				
Target 6.1: Pathways for major potential alien invasive species controlled	−	+/−	−	+
Target 6.2: Management plans in place for major alien invasive species that threaten ecosystems, habitats, or species	+	−	+	+
Goal 7. Address challenges to biodiversity from climate change and pollution				
Target 7.1: Maintain and enhance resilience of the components of biodiversity to adapt to climate change	−−	−−	+/−	+
Target 7.2: Reduce pollution and its impacts on biodiversity	−−	−−	+/−	+/−
Maintain goods and services from biodiversity				
Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods				
Target 8.1: Capacity of ecosystems to deliver goods and services maintained	−−	−−	+/−	+
Target 8.2: Biological resources that support sustainable livelihoods, local food security, and health care, especially of poor people, maintained	−−	−−	+/−	−
Protect traditional knowledge, innovations, and practices				
Goal 9. Maintain sociocultural diversity of indigenous and local communities				
Target 9.1: Protect traditional knowledge, innovations, and practices	−−	−−	+	−
Target 9.2: Protect the rights of indigenous and local communities over their traditional knowledge	+/−	−−	+	+/−
Fair and equitable sharing of benefits				
Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources				
Target 10.1: All transfers of genetic resources are in line with CBD and other applicable agreements	+	−	+/−	+
Target 10.2: Benefits arising from the commercial exploitation of genetic resources shared with countries providing such resources	+	−	+/−	+
Ensure provision of adequate resources				
Goal 11. Parties have improved financial, human, scientific, technical, and technological capacity to implement CBD				
Target 11.1: New and additional financial resources are transferred to developing countries to allow for effective implementation of CBD	+	−−	−	+
Target 11.2: Technology is transferred to developing countries to allow for effective implementation of CBD	+	−−	+	+

[a] The CBD target refers to trade in endangered species.

Key: + trend toward target; − trend away from target; −− marked trend away from target; +/− strong regional differentiation of trends

GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden

Table 14.6. Summary of Key Stresses and the Prospects for Success of Relevant CBD Response Options in MA Scenarios. All values are estimates of relative comparison among scenarios and stresses. Many responses apply to more than one stressor.

Stresses and Responses	GO	OS	AM	TG
Ecosystem stress—habitat loss	●●●●	●●●●●	●●	●●
Establish effective global network of protected areas	✻✻✻	✻	✻✻	✻✻✻✻
Maintain and restore connectivity	✻	✻	✻✻	✻✻✻
Reduce pressure for agricultural expansion	✻	✻	✻✻	✻✻✻
Ecosystem stress—overexploitation	●●●	●●●●	●●	●●
Promote sustainable use of productive lands	✻✻	✻	✻✻✻	✻✻✻✻
Promote more-effective education, incentives, regulation	✻✻	✻✻	✻✻✻	✻✻✻✻
Maintain traditional knowledge	✻	✻	✻✻✻✻	✻✻
Ecosystem stress—invasive species	●●	●●	●	●
Implement control strategies	✻	✻	✻✻✻	✻✻✻
Ecosystem stress—pollution	●●●	●●	●●	●
Reduce emissions of NO_x	✻	✻	✻✻	✻✻✻
Establish monitoring protocols	✻✻	✻	✻✻✻	✻✻✻✻
Ecosystem stress—climate change	●●●●	●●●	●●●	●●
Promote synergy between carbon storage and habitat conservation	✻✻	✻	✻✻	✻✻✻

Key: GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden
Stresses: 5 ● = severe stress, 0 ● = no worse than 2004
Responses: 5 ✻ = success likely, 0 ✻ = unfeasible/ineffective

while maintaining its potential to meet the needs and aspirations of future generations.''

This section summarizes the most characteristic implications for wetlands of the four MA scenarios and provides a comparative assessment of the relative importance of direct and indirect drivers of wetland change. This is followed by an appraisal of the promising response options and the prospects for action for the convention and its parties under the four scenarios.

14.3.1 Threats to Wetlands in the MA Scenarios

None of the models used in the MA scenario exercise deals directly with wetlands. What makes this assessment even more difficult is that modeling results provide very few clues from which information could be derived concerning the fate of wetlands under the four scenarios. The combined outcomes of climate and land use change calculations in the IMAGE model can be used to get a rough estimate of the main natural driver, climate. The WaterGAP model performs detailed calculations of water availability, water demand, and water stress indicators. Modeling results presented in Chapter 9 suggest that, on balance, besides a gradually increasing climate change impact, socioeconomic driving forces are likely to remain the main source of threats to wetlands over the next half-century.

Table 14.7 summarizes the findings of the modeling activities concerning water-related issues on the basis of results in Chapter 9. As the modelers correctly point out, these results need to be handled with extreme care. The magnitude of uncertainties involved is clearly demonstrated by the case of modeling water availability. Estimates about the present values of water availability vary up to a factor of two in some regions. There is a much bigger diversion among present water availability values across models than there is for diversions among projected values for 2050 or 2100 across the scenarios on the basis of the same models. In terms of water availability, models indicate that regions are affected differently, but regional precipitation modeling is still among the most uncertain parts of general circulation models. Nonetheless, the modeling results appear to be plausible and they are certainly useful for comparing the projected values across scenarios.

It is interesting to observe that similar water-related indicators may emerge from rather different socioeconomic scenarios. The two globalization scenarios involve rather similar water availability, water withdrawal values, scarcity/stress features, and even return flows, although TechnoGarden has only 10% more people who are on average about 30% less well off compared with the Global Orchestration scenario. The key difference is in water quality, which is much worse in Global Orchestration and not declining in TechnoGarden relative to the present. The explanation is the strong environmental orientation and the fast rate of technological development in TechnoGarden. Similar relationships can be observed between the two isolation scenarios. In the bleak world of high population and very low economic growth of Order from Strength, the drastically increasing pollution of the doubling return flows is posing a major threat to wetlands, especially in developing regions. In contrast, under similar demographic and economic conditions in Adapting Mosaic, the quality of the almost doubling return flows can even improve in many

Table 14.7. Water-related Indicators in MA Scenarios in 2050 Relative to 2000. Note that, for example, 2.4* indicates a factor increase of 2.4 by 2050 relative to 2000.

Model Results	Global Orchestration	Order from Strength	Adapting Mosaic	Techno-Garden
Water availability	largest change: 5%	4–5%	4–5%	smallest change: 4%
Water withdrawals	+40% 2.5* SSA 1.7* LA 1.5* Asia MENA decrease OECD, FSU slight increase	+80% 4* SSA 3.5* LA +40% MENA +90% Asia +32% OECD no change FSU	+50% 4* SSA 3* LA +25% MENA +60 Asia +5% OECD −9% FSU	+20% 2.4* SSA −11% OECD −24% FSU
Area affected by water scarcity or stress (18% in 2000)	slight expansion	23%	22%	slowly increasing
Water return flow	+40% 3.6* SSA 2.0* LA +22% MENA +48% Asia OECD, FSU decrease	+100% 5.6* SSA 4* LA +100% MENA +100% Asia +40% OECD +10% FSU	+60% 5.5* SSA 3.6* LA +55% MENA +75% Asia +3% OECD FSU decrease	+20% 3.6* SSA 2* LA +16% MENA +20% Asia −18% OECD −42% FSU
Water quality	worse	much worse	same/improve	same +/−

Key: SSA = Sub-Saharan Africa; LA = Latin America; MENA = Middle-East and North Africa; FSU = Former Soviet Union

regions thanks to the environmental orientation and the reliance on local knowledge and eco-management experimentation.

Table 14.8 presents the qualitative assessment of the impacts of different indirect and direct drivers of wetland change based on the MA scenarios. A caveat should be mentioned, however: the relationships among the indirect and direct drivers and their impacts on wetlands are much more complex than can be presented in a simple table. It is obvious that a larger and more affluent population would demand much more food and, all other factors being equal, this would imply pressure for more agricultural land and would threaten wetlands to be drained and converted into cropland. Yet if the food demand is satisfied from modestly increasing areas by adopting fast-improving technologies and relying on more-efficient production (TechnoGarden) or on the basis of more-efficient allocation of production fostered by fairer trade and the elimination of subsidies (Global Orchestration), then the pressure for more agricultural land and wetland drainage is significantly less than if the basic needs of larger, less affluent populations need to be satisfied entirely on the basis of local knowledge (Adapting Mosaic) and local resources (Order from Strength).

The globalization of agricultural and fishery markets can take effect in two directions. If the process involves an ever-tougher competition of perverse subsidies, the threats to wetlands can be significant. If, however, the globalizing markets are not distorted by preferential interventions, the risks for wetlands are likely to be much smaller and opportunities for conservation may even arise. Depending on the cultural and sociopolitical circumstances, the empowerment of communities to manage their own resources or the privatization of open-access resources (always exposed to the risk of overexploitation), both accompanied by appropriate conservation incentives and regulation and by internalizing all external costs, are good opportunities for wetland conservation. The prospects for social transformations with favorable impacts for wetlands from the global level are best under Global Orchestration, while positive regional influences will be stronger under Adapting Mosaic. The chances of favorable social effects for wetlands are more limited in the other two scenarios.

The effects of the small magnitude of climate change expected up to 2050 are likely to be minor compared with

Table 14.8. Relative Importance of Direct and Indirect Drivers of Wetland Change in MA Scenarios

Indirect Drivers	Direct Drivers	Global Orchestration	Order from Strength	Adapting Mosaic	TechnoGarden
Population growth	Drainage/conversion	−	− − −	− −	−
Economic growth		− −	−	−	−
Globalization of agriculture, fishery markets	Introduction of alien species	− −/+	−	−	−/+
Increasing demand for water	Water diversion,	−	− − −	− −	−
	Water pollution	− −	− − −	−/+	−/+
Privatization and empowerment		+	−/+	+	+ + +
Financial transfers		+	. . .	+	+ +
Climate change	Mean temperature/precipitation,	−	−	−	−
	Extreme events	−	−	−	−
	Sea temperature, sea level rise	−	−	−	−

Key: − − − high, − − medium, − low level of risk of degradation
+ + + high, + + medium, + low level of opportunity for conservation

the changes that might be triggered by the social, economic, and technological drivers in most places. The slowly emerging patterns of climate change may play a more significant role for wetlands at some locations close to boundaries of climatic zones. This is expected to change in the long term by 2100 and beyond if uncontrolled emissions of greenhouse gases continue. The gradually changing temperature and precipitation patterns are likely to be less of a problem than changes in the frequency and magnitude of extreme events triggered by climate change. Unfortunately, there is hardly any reliable information available on the latter. Nonetheless, the next few decades present challenges but also the opportunity for wetland managers to devise ways to help wetlands adapt to possibly more significant climate change in the second half of this century.

14.3.2 Prospects for the Ramsar Convention

The Ramsar Strategic Plan 2003–2008 was adopted by the Eighth Meeting of the Conference of the Contracting Parties in 2002. The plan lists specific WSSD objectives to which Ramsar could contribute, but it does not delineate near-term targets. In fact, it does not distinguish near-term goals and long-term objectives at all. Rather, general objectives of the Strategic Plan are specified as progress toward the ultimate objective of the convention over the long term. The five general objectives are stimulating the wise use of all wetlands by developing, adopting, and using the appropriate instruments and measures; stimulating and supporting the implementation of the Strategic Framework by monitoring and managing their listed sites; promoting international cooperation, particularly by mobilizing additional financial and technical assistance for wetland conservation and wise use; ensuring the necessary implementation capacity, resources, and mechanisms for the convention; and proceeding toward the accession of all countries to the convention.

The actual response options and implementation mechanisms available to the Ramsar Convention appear to be rather weak at first sight. Yet they have proved remarkably effective in most cases in the past, and their effectiveness could certainly be improved by making more resources available to foster some of the implementation mechanisms. Table 14.9 presents an assessment of the prospects for the various response options to provide effective support to wetland conservation under the four scenarios.

There is a clear and obvious pattern emerging from Table 14.9. A global environmental agreement based on the voluntary commitments of its parties has much better prospects to be an effective mechanism of wetland protection under the globalization scenarios than in the fragmented worlds. The motivation for and the perceived benefits from including ecological treasures on the List of Wetlands of International Importance are much larger in a future in which countries have a rich web of economic, cultural, and environmental linkages. The relative importance of policy guidelines versus technical guidelines differs slightly as a function of how technologically oriented societies are (TechnoGarden) versus the extent to which they pursue policy coordination (Global Orchestration). This is also the case for the prospects for financial mechanisms as opposed to technical assistance as implementation mechanisms. In a dynamic, innovation-oriented future, technical assistance projects under the Ramsar Convention appear to be more dominant, whereas a free-market- and trade-oriented world biased toward reactive environmental management is more likely to use financial mechanisms to compensate occasional losers of environmental change and to support rehabilitative measures.

Table 14.9. Prospects for the Ramsar Convention's Policy Instruments in MA Scenarios

Response Options and Implementation Mechanisms	Global Orchestration	Order from Strength	Adapting Mosaic	Techno-Garden
Listing	***	*	**	***
Policy guidelines	***	*	*	**
Technical guidelines	**	*	*	***
Financial mechanisms	***	*	*	**
Technical assistance	**	*	**	***
Regional initiatives for implementation (core fund)	***	*	**	***
Communication/ education/public awareness	**	*	**	***

Key: *** good; ** modest; * poor

Given the vulnerability of many small wetland areas to irreversible changes triggered by relatively modest perturbations, proactive protection is ecologically more sensible. Funding to support regional initiatives for implementation through the Ramsar Convention is obviously more likely in the futures in which countries are interconnected than among largely segregated, introverted countries. Communication, education, and public awareness are more likely to be able to contribute to wetland conservation in the environmentally oriented scenarios (TechnoGarden and Adapting Mosaic), although Global Orchestration also offers good chances. In the globalization scenarios, the high level of affluence and the increasing leisure time of people are likely to give an unprecedented rise to ecotourism, and this in itself could provide a very strong economic motivation to pursue the wise use of wetlands. Eco-tourism is also an important connection back to the idea of listing as an implementation mechanism, because the List of Wetlands of International Importance could be an obvious source for guidebooks and tourism operators in selecting destinations.

Table 14.10 summarizes the key stresses of concern for the Ramsar Convention and the prospects for success of relevant response options under the four MA scenarios. While the pressure on wetlands is relatively modest in the Adapting Mosaic scenario, the role of the Ramsar Conven-

Table 14.10. Summary of Key Stresses and the Prospects for Success of Relevant Ramsar Convention Response Options in MA Scenarios. All values are estimates of relative comparison among scenarios. Many responses apply to more than one stressor.

Stresses and Responses	Global Orchestration	Order from Strength	Adapting Mosaic	TechnoGarden
Ecosystem stress—drainage and conversion	●●●	●●●●	●●●	●●
Listing	✻✻✻✻	✻	✻✻✻	✻✻✻✻
Technical guidelines	✻✻✻	✻✻	✻✻	✻✻✻✻
Financial mechanisms	✻✻✻✻	✻	✻	✻✻✻
Ecosystem stress—water diversion and pollution	●●●	●●●●●	●●●	●●
Policy guidelines	✻✻✻✻		✻✻✻	✻✻✻
Technical assistance from higher-income to developing countries	✻✻✻	✻	✻✻	✻✻✻✻
Regional initiatives for implementation	✻✻✻✻	✻	✻✻✻✻	✻✻✻✻

Key: Stresses, 5 ● = severe stress, 0 ● = no worse than 2004
Responses, 5 ✻ = success likely, 0 ✻ = unfeasible/ineffective

tion to help protect or counterbalance the risks is much more limited than in the globalization scenarios.

The obvious worst case is the Order from Strength world, in which the severe threats to wetlands from multiple sources (high population growth, slow technological development, and negligence of the environment) are combined with a severely weakened Ramsar Convention due to the breakdown of global institutions at large. Another important difference between Adapting Mosaic and Order from Strength is that in the proactive, environmentally oriented Adapting Mosaic world, the focus of the Ramsar Convention might shift from the global to the regional level. Regions with similar wetland problems could get into tighter regional cooperation networks, while the global agreement might serve as an umbrella of lesser importance. Since many regions are likely to be economically homogeneous, the emphasis in the operation of the regional Ramsar mosaics might shift from financial transfers to knowledge sharing and know-how transfer.

14.4 Implications for the Desertification Convention

Desertification is defined as the degradation of land in arid, semiarid, and dry subhumid areas. It has been identified as a major socioeconomic and environmental problem for many countries around the world. Direct drivers of desertification include overcultivation, overgrazing, deforestation, and inappropriate irrigation management. These drivers can be traced back to a range of economic and social pressures, lack of knowledge, war, and natural climate fluctuations such as drought. (See also MA *Current State and Trends,* Chapter 22.)

The objective of the United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, as specified by Article 2, is ''to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership agreements, in the framework of an integrated approach which is consistent with Agenda 21, with a view to contributing to the achievement of sustainable development in affected areas.'' The implementation of this objective involves long-term integrated strategies to improve the productivity of land and to rehabilitate, conserve, and sustainably manage land and water resources.

14.4.1 Risk of Desertification in the MA Scenarios

Desertification results from natural causes (such as a change in precipitation) or human causes (such as land clearance and inappropriate land uses) or a combination of these. In general, desertification results in lower biodiversity levels, shifts in species composition and natural areas, and lower productivity in cultivated areas. The decrease in vegetation cover and the subsequent loss of soil material and soil organic matter reduces soil fertility. Low soil fertility, in turn, reduces vegetative cover, leading to a vicious circle. The CCD uses the ratio of mean annual precipitation to mean annual potential evapotranspiration to identify drylands. They include arid, semiarid, and dry subhumid areas (in other than polar and subpolar regions) in which this ratio ranges from 0.05 to 0.65.

The MA adopted this definition to identify the total amount of dryland areas and their changes over time under the four MA scenarios using the IMAGE 2.2 model. Obviously, as these are modeling results, the 2000 results from IMAGE are somewhat different from those based on current actual climate estimates, but in general they approximate the reality reasonably well. Table 14.11 indicates that globally, changes in arid areas (as a result of climate change) are relatively small. This follows from the fact that climate change is expected to result in increasing precipitation but also increasing evaporation (as a result of temperature increase). The changes differ clearly among the different regions. It should be noted, however, that the regional results should be regarded as uncertain: both temperature and precipitation patterns differ strongly among the different climate models. In Latin America and the former Soviet Union, a considerable decrease in arid areas is observed. In contrast, in the OECD, Asia, and sub-Saharan Africa, a

Table 14.11. Changes in Dryland Areas in MA Scenarios. Note that year 2000 values correspond to 100%. (IMAGE 2.2 Model runs)

	Dryland Area		Change in 2050			
Region	Area	Share of Total Area	Global Orchestration	Order from Strength	TechnoGarden	Adapting Mosaic
	(thousand sq. km.)	*(percent)*		*(percent)*		
OECD	10,670	47	106	101	107	106
Latin America	5,004	25	97	97	96	97
Sub-Saharan Africa	13,024	55	102	101	101	102
Middle East and North Africa	11,351	97	101	101	101	101
Asia	8,440	41	103	102	101	103
Former Soviet Union	4,406	20	98	99	99	98
World	**52,896**	**44**	**102**	**101**	**102**	**102**

clear increase of arid areas is noticeable. Finally, in the Middle East and North Africa, the arid areas are more or less constant.

For desertification, however, the increase in arid areas is less important than the pressure on these areas. Therefore, Figure 14.1 indicates the size of arid areas that are used for agricultural purposes—that is, for cropland and intensive pastures but also (and mostly) for extensive grazing. It is worth noting that there is a large interannual variation in the use of drylands, and their use for agricultural and nonagricultural purposes is also changing over time. The resolution of the global models used in the MA scenario development is too coarse to depict such variations at the local scale. Moreover, the analysis of the desertification risk is based on the predicted increase of arid areas devoted to agriculture, including the area for free-ranging livestock. In reality, the desertification risks are more complex and numerous, but they are difficult to depict in a global model. Nonetheless, the broad patterns emerging from these models provide useful insights into the emerging risks and opportunities for dryland management under the four scenarios.

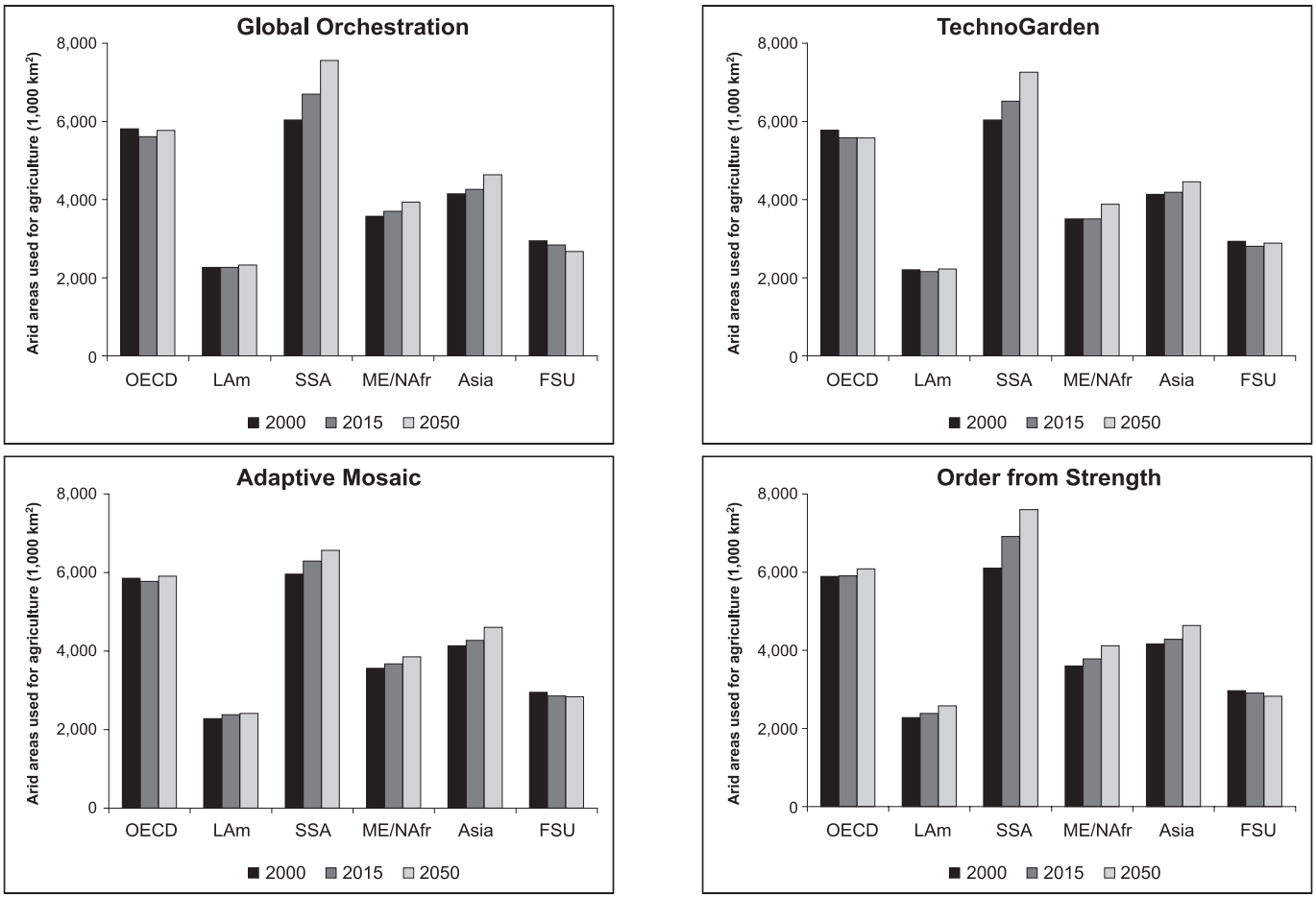

Figure 14.1. Arid Areas under Agriculture in MA Scenarios (IMAGE 2.2 Model)

Concerning the pressures on arid areas, some clear differences among the scenarios are noticeable. In three scenarios—TechnoGarden, Global Orchestration, and Order from Strength—there is a considerable expansion of agricultural land in Africa, driven by population growth and relatively rapid increases in food demand (TechnoGarden and Global Orchestration only). As shown in Figure 14.1, a considerable part of the expansion is likely to occur in arid areas—a trend that has been observed already over the last few decades. While the increase in food demand in Adapting Mosaic is comparable to Order from Strength but increases in agricultural efficiencies are assumed to be higher, this scenario turns out to be the most optimistic (although also here some expansion occurs). Other regions that are expected to see further expansion of agriculture into arid areas are Middle East and North Africa and Asia. For these regions, the differences across the scenarios are relatively small.

In Order from Strength there is a clear increase of the desertification risk in Latin America, while in the other scenarios the risks remain more or less constant. In OECD, under Order from Strength there is a small increase in the desertification risks; for Adapting Mosaic and Global Orchestration it is constant; and for TechnoGarden there is a small decrease. The latter is mainly caused by relatively low meat-intensive diets combined with rapid technological development. Finally, for the region of the former Soviet Union, most scenarios project a decrease in desertification risks, caused mainly by a decrease of the arid areas themselves as a result of climate change.

Table 14.12 summarizes the most plausible direct and indirect causes behind the desertification risk under the four scenarios. The reactive management scenarios involve the largest amount of cumulative risk of desertification. Under Order from Strength, the characteristics of socioeconomic development (high population growth, slow rates of technological development, and neglect of the environment) lead to severe stresses to land resources in dryland regions. Due to policy reforms (privatization and consolidation of property rights), relatively less pressure results under Global Orchestration, but market failures and policy failures can equally pose certain risks of desertification.

Table 14.12. Relative Importance of Direct and Indirect Drivers of Desertification in MA Scenarios

		Scenarios			
Indirect Drivers	**Direct Drivers**	**GO**	**OS**	**AM**	**TG**
Economic and social pressure	overcultivation	*	***	*	*
	overgrazing	**	***	*	*
	deforestation	*	***	*	*
Lack of knowledge	poor irrigation	**	***	*	**
War		**	**	**	*
Drought		*	*	*	*

Key: GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden

*** = major factor ** = medium factor * = minor factor

In the TechnoGarden world, technological development can make a dramatic contribution to reducing pressure in dryland areas. Improvements in crop varieties and agronomic techniques, including irrigation technologies, can contribute to the reduction of desertification and also to the reclamation of some already-degraded areas. The other environmentally proactive scenario, Adapting Mosaic, turns out to be relatively beneficial concerning desertification, but for different reasons. Here the basic mode of operation is to develop local combinations of technologies and organizations (formal institutions) that lead toward sustainable agriculture in dryland areas. Given the diversity of socioeconomic conditions across the regions in this scenario, it is difficult to detect comprehensive patterns. Nonetheless, abolishing open access in one way or another (through community management, local or regional government control, privatization, or combinations thereof) is the first crucial step to control overexploitation and reduce pressure on drylands in a proactive ecosystem management scenario.

14.4.2 Prospects for the Desertification Convention

What are the prospects and opportunities for action under the CCD in the contexts of the four scenarios? The primary form of implementation of the desertification convention is National Action Programs complemented by sub-regional and regional action programs where appropriate. The five regional implementation annexes of the convention specify the criteria for these programs.

Activities in the NAPs can be divided into general and specific categories. The general actions include addressing the underlying causes of desertification; promoting awareness about the risks, causes, and processes; and providing the enabling environment (institutional and legal framework) for managing the risk of desertification. A series of specific actions are included in the NAPs: establishing early warning systems, strengthening drought preparedness, establishing food security, establishing alternative livelihoods, and developing sustainable irrigation schemes.

The second main implementation vehicle of CCD is scientific and technical cooperation. This involves information collection, analysis, and exchange; technological research and development; and technology transfer. The third main category of implementation incorporates capacity building, education, and efforts to raise public awareness. The measures to support NAPs are based on various forms of financial cooperation. Such cooperation includes mobilizing financial resources directly; encouraging the mobilization of private finances; and promoting access to technology, knowledge, and know-how.

Table 14.13 provides an overview of the prospects of the various response options and implementation mechanisms of CCD under the four MA scenarios. The first strikingly bad news is that in the world of Order from Strength, in which the risk of desertification is the highest and the actual magnitude of desertification is likely to be the highest by far, there will be very little chance for the CCD to help countries halt or even slow desertification. The two main reasons for this are obvious. In a fragmented world with

Table 14.13. CCD Response Options and Implementation Relationships in MA Scenarios

Response Options	Global Orchestration	Order from Strength	Adapting Mosaic	TechnoGarden	Notes
NAP general					
Address underlying causes	***	*	**	**	
Promote awareness	***	*	***	**	
Provide enabling environment (legislation, institutions/legal)	***	*	**	**	
NAP specific					
Establish early warning system	*	*	***	***	drought
Strengthen drought preparedness	**	*	***	***	overcultivation
Establish food security	**	**	***	***	overgrazing,
Establish alternative livelihood	*	*	***	**	deforestation
Develop sustainable irrigation	**	*	***	***	poor irrigation
Scientific and technical cooperation					
Information collection, analysis, exchange	**	*	**	***	
Research and development Transfer of technology	**	*	***	***	
Research and development	**	*	***	***	
Transfer of technology	**	*	**	***	
Capacity building					
Education	**	*	***	***	
Public awareness	**	*	***	***	
Measures to support NAPs					
Mobilize financial resources	***	*	*	***	
Encourage private financing	***	*	*	***	
Promote access to technology, knowledge, know-how	***	*	**	***	

***Key: *** = good prospects ** = medium prospects * = poor prospects

inward-looking regions, the scope for global environmental agreements is rather poor in the first place. The outlook is bad even for ''global commons'' types of agreements, and there remains little motivation to arrange massive resource transfers from rich nations to poorer dryland regions in order to mitigate desertification. The second reason is the underlying management philosophy of this scenario. In an environmentally reactive ecosystem management mode, dryland degradation is likely to go further before its impacts (massive famines, environmental and hunger refugees) trigger a significant response.

As a global environmental agreement with resource transfer from North to South, the CCD has the best prospects in the scenarios assuming continuing globalization. The overall socioeconomic and political conditions under Global Orchestration provide better conditions to implement the general components of NAPs, like addressing the underlying causes and providing the necessary enabling environment to combat desertification. In a TechnoGarden world, CCD mechanisms involving direct and specific interventions by developing and transferring the appropriate technologies are more likely.

The most promising sources of funding are likely to differ as well. With the confidence in markets and secured property rights, it is likely to be much easier to mobilize private capital under Global Orchestration. TechnoGarden is more likely to mobilize public funds and publicly financed technological development and transfer. In Adapting Mosaic, the overall social and political conditions and the focus on environmentally sound management options are favorable for the CCD implementation mechanisms as well, but the disconnect among the regions of the world would probably allow only limited resource transfers. As the main focus in this scenario shifts away from global agreements to developing local solutions and experimenting and learning how to mange local systems better, it is likely that resources will have to be mobilized and used primarily within a region, which might not be easy to do in the currently poor regions of the world. Sharing and transfer of knowledge across regions, however, is not likely to be affected.

It is important to point out that NAP implementation requires not only resource transfers from donors but also political willingness and awareness by affected countries—for example, by ranking land degradation high in their political agenda and consequently also committing national resources to fight it. An equally important and closely related issue is that the mode of operation of CCD needs to change after the Sixth Conference of the Parties from issues of process to real implementation on the ground. Establishing the appropriate links between the CCD main instruments (National, Sub-regional, and Regional Action Programs) and development strategies of the affected countries (National Strategy for Sustainable Development, Poverty Reduction Strategy Programs, and so on) would be a first step to ensure that NAPs are not just purely theoretical exercises disconnected from reality but tools deeply anchored in the national context. Both issues appear to be

major hurdles in many countries today, and the prospects for improvement will evolve differently in the four MA scenario worlds.

A summary of key stresses for the concerns of the CCD is presented in Table 14.14, together with the prospects for success of relevant response options under the four scenarios. In Global Orchestration and TechnoGarden, in which global agreements (including transparency and accountability of resource transfers) function well, an increasing flow of funds and technologies to poorer countries that establish the domestic frameworks of NAP implementation will help persuade other countries to get their domestic policies organized in order to secure their shares from those flows. Such a positive trend may also help in establishing appropriate relationships between national development frameworks and CCD implementing tools (the action programs), thus helping to overcome the experienced gap at country level between measures targeting land degradation and those aimed at eradicating poverty or achieving food security and sound water management, as well as between national agriculture sector priorities and the improvement of livelihoods for rural populations.

The incentive for NAP implementation in Adapting Mosaic may come from regional cooperation between local networks and groups of practitioners and ecosystem managers interested in NAP measures who also push to keep them on the agendas of national governments. Finally, neither social motivation (no interest in the environment) nor international economic motivation (resource or technology transfers) exists for caring much about desertification NAPs in the Order from Strength scenario.

In summary, continued population growth through the first half of this century and improving economic conditions are likely to exert a substantial amount of additional pressure on land resources worldwide. These trends enhance the risk of desertification in dryland regions. Since the scenarios involve diverse sociopolitical, economic, and technological features, the opportunities for CCD to fulfill its mission will differ as well. In a globalizing world, prospects for international environmental cooperation and resource transfers to support their implementation are likely to be better either due to the institutional reforms (Global Orchestration) or because of the fast rate of technological development and deployment (TechnoGarden). In a fragmented world, the role of a global agreement is more limited either because of the diminished interest in resource transfers (Adapting Mosaic, although the stress is also lower under this scenario) or because of the total lack of interest in what is going on beyond the national or regional boundaries (Order from Strength).

14.5 Implications for National Governments

National governments play a central role in regulating many activities affecting ecosystems and the use of their services. They represent sovereign nation-states at international negotiations and become parties to international environmental agreements that directly regulate international aspects of ecosystems management. Similarly, they decide whether to join international economic agreements (trade, finance, development) that often trigger indirect implications for the use and protection of ecosystems services. This section considers the domestic concerns of national governments and focuses on how the evolution of ecosystems under the four MA scenarios affects the chances of governments to accomplish their declared objectives of pursuing sustainable development.

The assessment of national-scale issues on the basis of global scenarios is no easy task. Countries differ widely in so many of the key attributes (geography, climate, economic development, social values, institutional arrangements) that make each of them rather unique and require country-specific analysis. This is clearly impossible in a global-scale study because neither the verbal scenarios (storylines) nor the adopted models provide information at the national level. Instead, we contemplate global and large-scale re-

Table 14.14. Summary of Key Stresses to Drylands and the Prospects for Success of Relevant CCD Response Options in MA Scenarios. All values are estimates of relative comparison among scenarios. Many responses apply to more than one stressor.

Stresses and Responses	GO	OS	AM	TG
Ecosystem stress—overcultivation	●●●	●●●●●	●●	●
Address underlying causes	✻✻✻✻	✻	✻✻✻	✻✻✻
Establish alternative livelihood	✻✻	✻✻	✻✻✻✻	✻✻✻
Develop sustainable irrigation	✻✻✻	✻	✻✻✻✻✻	✻✻✻✻✻
Transfer technology	✻✻✻✻	✻	✻✻✻	✻✻✻✻✻
Ecosystem stress—overgrazing	●●●	●●●●●	●●	●●
Address underlying causes	✻✻✻✻	✻	✻✻✻	✻✻✻
Establish alternative livelihood	✻✻✻	✻	✻✻✻	✻✻
Establish early warning and drought preparedness	✻✻✻	✻	✻✻✻✻	✻✻✻✻
Promote awareness	✻✻✻	✻	✻✻✻✻	✻✻✻

Key: GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden

Stresses, 5 ● = severe stress, 0 ● = no worse than 2004 Responses, 5 ✻ = success likely, 0 ✻ = unfeasible/ineffective

gional (continental or subcontinental) patterns of the issues national governments are concerned about. The global scenario results and the assessment in this section might become useful starting points for national studies that seek to explore the country-specific prospects and challenges under the MA scenarios in more detail.

Notwithstanding the numerous specificities in their ecosystem-related interests and objectives, governments have repeatedly pronounced common principles and objectives concerning socioeconomic development and environmental management at various international fora over the past two decades. This section looks at two recent proclamations: the U.N. Millennium Development Goals and associated targets provide the framework for exploring the medium-term implications (to 2015) of the MA scenarios, and the Johannesburg Declaration on Sustainable Development serves as the basis to investigate the long-term (to 2030–50) outcomes. Since these were both approved at large intergovernmental conferences, they are the officially confirmed and documented concerns of national governments. These sections are followed by a more detailed assessment of the food-ecosystems-security relationships.

14.5.1 Medium-term Implications for the MDGs

The Millennium Summit in 2000 confirmed that progress toward sustainable development and poverty eradication has top priority. The Millennium Development Goals, derived from agreements and resolutions of relevant U.N. conferences in the post-Rio years, established rather ambitious goals. The most pressing challenges for humanity are organized into eight main goals and are specified in terms of 15 (+1) quantitative targets. Some goals are only very remotely related to the protection of ecosystems and the use of their services: Goals 2, 3, 4, and 5, for example, focus on crucial social (primary education, gender equality) and human health (child mortality, maternal health) concerns. Other goals have important indirect implications for ecosystems services and development: Goal 1 (halving the proportion of people who suffer from hunger), for instance, and Goal 7 (halving the proportion of people without sustainable access to safe drinking water).

At the macro policy level, Goal 7 calls for integrating the principles of sustainable development into country policies and mentions, among others, the land area covered by forests or under protection to maintain biological diversity, energy intensity, and per capita carbon emissions as indicators of measuring progress. Ample opportunities exist to make progress on this goal, and many economists suggest that eliminating perverse subsidies that distort the energy and agriculture sectors in many countries could make a good start. Ironically, some energy-related measures aimed at poverty alleviation would be likely to affect the sustainability indicators on energy intensity or emissions in the short run because they would increase energy use per unit of GDP (providing electricity to promote education, increased industrialization, and urbanization) and CO_2 emissions per capita (replacing unsustainable biomass, typically fuelwood, by commercial fossil energy in households, for example). However, once these investments in infrastructure and human capital (education, gender equality) start paying back, the energy and carbon intensity indicators should improve as well.

To ensure appropriate interpretation of the results in this section, it is important to note that the MDGs denote most quantitative targets as improvements relative to the 1990 situation. Most models that provide quantitative projections under the four MA scenarios use 2000 as their reference year. It is therefore difficult to assess the projected achievements until 2015 according to the MDG starting point. Another complication is that the MDGs specify most targets for 2015, whereas the models adopted in the MA scenario exercise have 50- or even 100-year time horizons and, in some cases, 5- or 10-year time steps. This means that these models make only two or three steps until 2015, and the scenario dynamics are hardly distinguishable at this time horizon.

The broad evolution patterns of the verbal scenario storylines are even more difficult to peg to specific years like 2015. Moreover, the early phase of any scenario exercise designed to explore long-term futures is dominated by the starting situation. The MA scenarios are no exemptions, and the marked diversions among the four storylines just begin to emerge by 2015.

Next it should be noted that the MDGs encompass key elements of the full span of social, economic, political, institutional, and environmental components of sustainable development. The MA scenarios are concerned with a specific subset: the main components of socioeconomic development that shape human impacts on ecosystems and the use of their services as driving forces of ecosystem changes, along with the repercussions on human well-being of the changes triggered in the quantities and qualities of ecosystems services. Therefore it is not possible even to infer information for some MDGs, and only remotely related information can be presented as proxy or ''circumstantial evidence'' for others.

The first MDG is to eradicate extreme poverty and hunger. The MA models do not break down populations into subcategories according to income levels. Hence it is impossible to obtain direct information about the proportion of population below $1 per day, the poverty gap ratio, or the share of poorest quintile in national consumption. The economic growth assumptions in the scenarios nevertheless can provide an indication. Per capita GDP growth is highest in Global Orchestration, followed by TechnoGarden and Adapting Mosaic, with Order from Strength lagging behind. Global Orchestration furthermore results in the greatest improvements for the poorest people, as the main focus of decision-makers in this scenario is placed on improving human systems. Despite slower increases in incomes in TechnoGarden and Adapting Mosaic, other aspects of human well-being improve in both scenarios and the number of hungry people also declines. In Order from Strength, the distribution of the modestly increasing material wealth deteriorates and all human well-being aspects decline compared with today.

Despite numerous international initiatives and national programs, hunger and malnutrition have been persistent problems in several world regions in the past few decades. All four MA scenarios project declining proportions of underweight children in the 0–5 age group, but these improvements are far from the ambitious target of halving the share of people suffering from hunger even if we consider the improvements between 1990 and 1997 (the year of the model's reference point). Moreover, the improvements are slowest in the regions with the biggest problems: South Asia and sub-Saharan Africa. Due to the lack of disaggregated population in the models, we cannot say much about the proportion of population below minimum level of dietary energy consumption. The per capita figures of available dietary energy improve in all developing regions (except West Asia and North Africa), more or less together with improving per capita incomes. This confirms that currently and in the near future hunger is more a social and economic problem than an environmental one. Thus the distribution of the available calories will remain a fundamental issue in determining the actual prevalence of hunger in 2015.

MDG 3 is on promoting gender equality and empowering women. The MA scenarios provide only one rather remote indicator on this topic. The percentage of females undertaking secondary schooling differed widely across developing regions in 1997. Improvements are projected in all regions under all scenarios, but the vast differences in female secondary education remain: one in five females getting secondary education in sub-Saharan Africa stand out against the 70% in China. (Nonetheless, gender disparity remains hidden in the absence of comparable indicators for males.)

The sixth MDG calls for combating HIV/AIDS, malaria, and other disease. Neither human health nor its linkages to ecosystems services are modeled in the MA scenarios. The storylines provide some indications, but they are more relevant for getting some ideas about the longer-term trends than as indicators of actual achievements up to 2015. The general patterns of change in human health mirror those of per capita incomes: substantial health improvements and considerable reductions in the burden of epidemic diseases (HIV/AIDS, malaria, tuberculosis), particularly in the South under Global Orchestration, and moderate progress in these areas, albeit elimination of diseases due to water and indoor air pollution in Techno-Garden. It is difficult to estimate how many of these improvements will take place by 2015. The scenarios speak of a number of obstacles to health improvements in the Adapting Mosaic future, as there is less technology transfer and cooperation across regions. This slower improvement of health gives little hope for any progress toward the MDG targets of halting the spread of HIV/AIDS and the incidence of malaria by 2015. The calamitous future of Order from Strength implies disastrous health trends for many low-income regions: the collapse of international malaria programs, the continued spread of HIV/AIDS, and the failure to manage tuberculosis might put the world on a trajectory that leads it away from and not toward this MDG target. The severity of this risk is illustrated by the fact that populations in some regions might actually decline as a result.

Target 9 of MDG 7—ensure environmental sustainability—embraces a policy-related principle (incorporate sustainable development into all relevant policies and programs) and an overall biophysical target (reverse the loss of environmental resources). The models adopted in the MA scenario work calculate several indicators relevant for the latter. It is a gloomy observation that, except for Latin America, none of the developing regions come even close to stabilizing their forested areas. In fact, deforestation continues in all scenarios in the Middle East and North Africa, sub-Saharan Africa, and Asia. The bleakest future awaits forests in the first two regions under Global Orchestration and Order from Strength, as about one third of their forests in 1995 are projected to disappear by 2015. The MA scenarios do not contain projections of the changes in land area protected to maintain biological diversity.

The MDG indicator list has GDP per unit of energy use as a proxy indicator of energy efficiency. The MA models project changes in the inverse of this indicator, energy intensity, which measures the amount of primary energy consumed per unit of GDP. This indicator shows impressive improvements in most regions in all scenarios. The two exceptions are the Middle East/North Africa, where energy intensity stagnates, and Latin America, where this indicator is projected to deteriorate through 2015 relative to 1995 in all four scenarios. The really bad news, however, is that the energy efficiency improvements are projected to be overwhelmed by fast-growing energy use and other activities emitting greenhouse gases, mainly CO_2. In the two decades between 1995 and 2015, GHG emissions increase around 50% in Asia under each of the four scenarios, more than triple in sub-Saharan Africa under Global Orchestration, and also double in the other three scenarios.

Access to safe (treated or uncontaminated) water appears to be a success story in the MA scenarios. Solid improvements are projected for all developing regions under all scenarios. Even in sub-Saharan Africa, where more than half the population had to use contaminated water in 1997, the share of population with access to safe water reaches 60% in all four scenarios.

The final MDG, on a global partnership for development, has three main components—official development assistance, market access, and debt sustainability—that are central elements of the ''globalization-fragmentation'' axis that splits global futures into these two main categories. Accordingly, it is not difficult to guess the prospects for the targets and indicators included in this category: in the future worlds in which global cooperation is a key element, it is also likely that development aid and fairer access to global markets will be a priority for decision-makers. The Global Orchestration scenario in particular focuses on these issues. Yet the scenario storylines do not give particular indicators that can be used to gauge progress on these important matters, and they are not included as variables in the MA models either.

As this short assessment demonstrates, the MA scenarios contain a lot of relevant information about the prospects for

reaching the MDGs under four profoundly different scenarios. Yet 2015 is too near and the temporal resolution of the long-term MA scenarios and models is too coarse for spectacular diversions to emerge. ''Fast variables'' that respond to changes in their driving forces without delay—deforestation, energy efficiency improvements, deterioration of morbidity and mortality as a result of collapsing because of a lack of well-targeted,-organized, and -funded programs—can show large differences in their development paths across the scenarios even in one or two decades. In contrast, ''slow variables'' that have their own inertia and react to their determinants with delay—demographic factors, education achievements, infrastructure development like safe water and sanitation—show little variation between the scenarios over the short to medium term. The reason is that it takes years to decades until a change in, for example, demographic or educational policies has a discernible impact on the birth rates, age structure, human capital stock, and so on. Characteristic differences in the future of these variables take at least four to five decades to emerge.

14.5.2 Long-term Implications for the Johannesburg Declaration

The World Summit on Sustainable Development adopted the Johannesburg Declaration on Sustainable Development in 2002. The declaration recognizes that although some progress has been made, major challenges still must be overcome to implement the vision of sustainable development. The section on ''the challenges we face'' specifies poverty eradication, changing consumption and production patterns, and managing the natural resource base for economic and social development as overarching objectives of and essential requirements for sustainable development. The subsequent paragraphs list income gaps between the higher-income and developing worlds, environmental degradation (biodiversity loss, declining fish stocks, desertification, climate change, natural disasters, and pollution), and globalization (bringing both challenges and opportunities for the pursuit of sustainable development), whereupon the entrenchment of these global disparities may result in the poor losing confidence in the democratic systems. Paragraph 18 of the JDSD lists ''essential needs'' and suggests speedily increasing the ''access to such basic requirements as clean water, sanitation, adequate shelter, energy, health care, food security and the protection of biodiversity'' (UN 2002:3).

The MA scenarios resonate well with these concerns even though they do not address all of them explicitly or in full detail. Assuming that the issues listed in the JDSD are officially declared long-term concerns of national governments regarding sustainable development, the performance of the four MA scenarios can be assessed against these overall objectives over the long term. This section synthesizes relevant information by looking at persistent trends in the scenario storylines and presenting two snapshots of the modeling results for 2030 and 2050.

Table 14.15 presents the overall JDSD objectives and scenario results in three main groups: economic, social, and environmental. Many aspects of the scenarios are compared and analyzed in earlier chapters of this volume and in earlier sections of this chapter. Here we present a few emerging insights that are of particular importance for national governments.

Taking the economic objectives first, Table 14.15 does not contain entries about questions like access to financial resources and sharing the benefits of opening markets. However, the GDP growth figures imply the answers. In the Global Orchestration future, the sustained economic growth rate of approximately 8% per year that increases the volume of goods and services by a factor of 20 in 50 years in Asia, and the similarly impressive economic performance in all other currently developing and transitional economies are inconceivable without massive improvements in access to financial resources, both foreign direct investments and official development aid. Another implicit driver behind these remarkable trends in Global Orchestration is the more equitable sharing of the benefits of opening markets that channel a larger proportion of efficiency gains from foreign investments and international trade to developing regions, as the focus of this scenario is to combine more equitable access to markets with strong social policies. This is clearly not the ''Washington Consensus.''

The other three scenarios entail not only slower economic growth rates but also significantly slower convergence (TechnoGarden and Adapting Mosaic) or outright divergence of per capita incomes (Order from Strength) between OECD and the developing regions. In TechnoGarden and Adapting Mosaic, good governance structures, which are based on the elimination of corruption and political stability, are pursued in different ways and evolve slower than in Global Orchestration. Particularly in Adapting Mosaic, decision-makers experiment with a wide range of new, more localized governance structures, and not all experiments work equally well. Some of these might actually foster the proliferation of corruption and mismanagement within the local governance structures if transparency and oversight from either local groups or higher scale structure is missing.

Food security and the elimination of hunger are stated prominently in the JDSD as the most urgent social (but also economic) challenges. In order to explore food security effects, the IMPACT model projects the percentage and number of malnourished preschool children (those under age five) in developing countries. A malnourished child is a child whose weight-for-age is more than two standard deviations below the weight-for-age standard set by the U.S. National Center for Health Statistics/World Health Organization. This standard is adopted by many U.N. agencies in assessing nutritional status in developing countries. The projected numbers of malnourished children are derived from an estimate (for detailed information, see Smith and Haddad 2000) of the functional relationship between the percentage of malnourished children and several factors: average per capita calorie consumption, non-food determinants of child malnutrition such as the quality of maternal and child care (proxied for by percentage of females undertaking secondary schooling as well as by females' status relative to men as captured by the ratio of

Table 14.15. Prospects for Progress toward Long-term Sustainable Development in MA Scenarios, 2030–50

Sustainable Development Objectives for 2030 and 2050 from JDSD	Indicators		Global Orchestration		Order from Strength		Adapting Mosaic		TechnoGarden	
ECONOMIC										
GDP growth (1995 = 100)	million 1995 dollars, in 1995			***2030***	***2050***	***2030***	**2050**	***2030***	***2050***	***2030***	***2050***
	OECD	21,469,311	OECD	259%	382%	203%	237%	203%	265%	232%	316%
	FSU	854,712	FSU	373%	920%	214%	315%	257%	538%	305%	691%
	LAC	1,711,802	LAC	394%	983%	299%	548%	334%	711%	362%	892%
	MENA	875,642	MENA	324%	807%	280%	497%	299%	634%	318%	793%
	Asia	2,945,748	Asia	794%	2118%	435%	720%	566%	1333%	632%	1614%
	SSA	283,642	SSA	319%	936%	290%	656%	305%	792%	321%	1001%
	World	28,140,857	World	330%	636%	236%	321%	254%	429%	287%	520%
Poverty eradication											
Gap between higher-income and developing countries	GDP per person (1995 dollars), in 1995			***2030***	***2050***	***2030***	***2050***	***2030***	***2050***	***2030***	***2050***
	OECD	25,747	OECD	221%	305%	189%	230%	187%	244%	204%	272%
	FSU	2,061	FSU	375%	954%	226%	379%	267%	602%	307%	735%
	LAC	3,591	LAC	276%	633%	180%	278%	202%	365%	235%	513%
	MENA	2,502	MENA	195%	427%	150%	222%	161%	283%	179%	380%
	Asia	968	Asia	596%	1564%	288%	435%	378%	810%	446%	1079%
	SSA	482	SSA	180%	455%	135%	226%	145%	286%	165%	406%
	World	4,931	World	243%	443%	157%	189%	170%	254%	201%	333%
Access to financial resources											
Benefits from opening markets											
Use of modern technology	assumption: overall trend		high			low		medium-low		medium for technology in general; high for environmental technology	
Technology transfer	assumption: international relationships (stimulating technology transfer)		high			low (medium among cultural groups)		low-medium		high	
SOCIAL											
Food security	percent of malnourished children (0–5 years old)										
		1997		***2025***	***2050***	***2020***	***2050***	***2025***	***2050***	***2025***	***2050***
	LatAm	9.1	LatAm	6.0	0.0	7.2	4.3	7.4	4.8	6.4	1.6
	SSA	32.8	SSA	29.0	18.6	30.6	26.3	30.8	23.7	29.3	20.0
	WANA	13.2	WANA	12.1	9.5	12.8	11.5	13.1	12.1	12.5	10.3
	S Asia	50.8	S Asia	44.5	37.3	47.3	45.6	47.2	42.7	45.5	38.7
	SE Asia	34.1	SE Asia	27.7	20.2	31.1	28.6	31.0	27.1	29.4	24.1
	China	17.4	China	11.0	7.2	14.4	14.4	14.4	14.1	12.8	10.9
	Developing	31.4	Developing	27.2	19.8	29.7	26.8	29.7	25.0	27.9	21.5
	number of malnourished children (0–5 years old), in thousands										
		1997		***2025***	***2050***	***2025***	***2050***	***2025***	***2050***	***2025***	***2050***
	LatAm	5,86	LatAm	2,661	0	4,977	3,396	4,937	3,101	3,709	833
	SSA	32,667	SSA	31,066	17,487	50,376	50,500	48,069	38,479		
	WANA	5,978	WANA	4,860	3,120	7,190	6,687	7,121	6,320	6,154	4,784
	S Asia	85,040	S Asia	59,542	34,832	99,693	91,046	94,591	70,913	75,892	53,054
	SE Asia	19,244	SE Asia	11,954	6,489	20,622	19,304	19,562	15,185	16,049	11,391
	China	18,364	China	6,660	2,855	13,307	12,958	12,767	10,842	9,795	7,171
	Developing	166,379	Developing	116,742	64,783	196,166	183,891	187,047	144,842	150,512	105,172

(continues)

Table 14.15. Continued

Sustainable Development Objectives for 2030 and 2050 from JDSD	Indicators		Global Orchestration		Order from Strength		Adapting Mosaic		TechnoGarden	
	kilocalories available per person per day									
			2025	***2050***	***2025***	***2050***	***2025***	***2050***	***2025***	***2050***
		LatAm	3,233	3,698	3,090	3,350	3,063	3,235	3,177	3,484
		SSA	2,539	2,972	2,432	2,617	2,378	2,495	2,500	2,801
		WANA	3,125	3,458	3,035	3,242	2,997	3,141	3,073	3,348
		Asia	3,181	3,702	2,823	2,938	2,829	2,955	3,019	3,291
		Industrial	3,645	3,967	3,522	3,770	3,461	3,612	3,552	3,780
		Developing	3,099	3,562	2,825	2,963	2,814	2,930	2,976	3,240
		World	3,201	3,636	2,939	3,068	2,921	3,025	3,078	3,325
Changing consumption and production patterns	meat consumption, in kilograms per person per year, in 1997		change in 2050 (1997 = 100)							
	OECD	88	OECD	149%		132%		127%		115%
	FSU	42	FSU	207%		131%		126%		114%
	LAM	54	LAM	167%		120%		117%		120%
	MENA	22	MENA	155%		123%		127%		123%
	Asia	23	Asia	291%		135%		130%		152%
	SSA	12	SSA	225%		150%		150%		150%
	World	36	World	194%		114%		114%		117%
Access to adequate shelter										
Access to energy	primary energy use, in gigajoules per person		Change: 1995 = 100							
	1995			***2030***	***2050***	***2030***	***2050***	***2030***	***2050***	***2030***	***2050***
	OECD	204.7	OECD	114%	146%	140%	144%	131%	127%	101%	80%
	FSU	115.7	FSU	158%	213%	130%	159%	130%	165%	94%	89%
	LAC	45.6	LAC	291%	409%	191%	254%	202%	277%	174%	201%
	MENA	55.8	MENA	178%	276%	146%	177%	147%	195%	123%	136%
	Asia	31.9	Asia	243%	405%	150%	187%	164%	228%	134%	164%
	SSA	26.3	SSA	97%	156%	87%	102%	87%	113%	72%	91%
	World	65.3	World	169%	231%	122%	134%	125%	147%	103%	103%
	assumption: energy supply		market liberalization; selects least-cost options; rapid technology change		some preference for clean energy resources		focus on domestic energy resources		preference for renewable energy resources + rapid technology change	
	percent of renewable in world energy		***2030***	***2050***	***2030***	***2050***	***2030***	***2050***	***2030***	***2050***
			4%	11%	4%	11%	4%	11%	4%	11%
Access to health care										
Ensure capacity building										
Human resource development	assumption: investments into human capital		high assumes the highest rates of investment in education and health care		higher-income countries: medium developing countries: low investments in education and health care outside of current high-income regions will be low because of the lack of financial capital		initially follows the pattern of the Order from Strength scenario, because of large investments in education and health care; economic growth rates increase over time and approach those of the TechnoGarden scenario in the last half of the century		medium investments in human resources are likely to be lower than under Global Orchestration, partly as a result of the emphasis of Techno-technology investments	

Education	percentage of females undertaking secondary schooling										
	1997		***2025***	***2050***	***2025***	***2050***	***2025***	***2050***	***2025***	***2050***
	LatAm	56.6	LatAm	62.3	72.0	62.3	68.0	62.3	70.0	62.30	72.00
	SSA	15.8	SSA	21.8	47.3	21.8	32.1	21.8	45.3	21.83	47.25
	WANA	58.5	WANA	72.4	74.5	72.4	73.5	72.4	74.0	72.40	74.50
	S Asia	30.4	S Asia	45.1	60.4	45.1	53.4	45.1	68.0	45.10	68.90
	SE Asia	51.9	SE Asia	65.4	77.0	65.4	70.4	65.4	75.0	65.41	76.64
	China	63.5	China	74.4	75.3	74.4	74.8	74.4	78.1	74.40	75.30
ENVIRONMENTAL											
Protect natural resource base	disruption of landscape		the second-worse case because fossil use increases by about a factor of two over the same period, and environmental management is also largely neglected			the biggest disruption by far because total fossil fuel use increases by more than a factor of 2.5 by 2100 compared with 2000; society gives environmental protection low priority		an in-between case that also gives priority to environmental protection, but fossil fuel use nearly doubles up to 2100		the impact is likely to be the smallest because fossil fuel substantially declines up to 2100, but because environmental management is given high priority	
Biodiversity			high deforestation rates, steadily increasing temperature and climate-related changes in vegetation, intensification of agricultural land, increasing water withdrawals and water stress tend to threaten ecosystems in the South and eventually decrease biodiversity; decreasing biodiversity is compensated for somewhat by increasing investments in biochemical exploration so that the net rate of biochemical discoveries is roughly constant in the South up to 2050							
Fish stocks	sustainability of marine fishery—the scenarios show a medium to large increase in fish production and consumption in all regions of the world										
Desertification	see Section 14.4										
Climate change	GHG emissions, in gigatons of carbon equivalent		1995 = 100								
	1995		***2030***	***2050***	***2030***	***2050***	***2030***	***2050***	***2030***	***2050***
	OECD	3.854	OECD	136%	130%	142%	140%	115%	90%	71%	26%
	FSU	1.219	FSU	103%	104%	129%	151%	99%	101%	41%	11%
	LAC	0.922	LAC	215%	281%	232%	322%	189%	236%	139%	95%
	MENA	0.494	MENA	242%	349%	289%	477%	243%	380%	178%	154%
	Asia	2.729	Asia	203%	273%	270%	392%	206%	256%	134%	103%
	SSA	0.513	SSA	325%	337%	243%	298%	156%	273%	204%	241%
	World	9.731	World	173%	203%	198%	255%	154%	179%	104%	71%
	temperature increase, in degrees Celsius over preindustrial			***2030*** 1.31	***2050*** 1.98	***2030*** 1.25	***2050*** 1.75	***2030*** 1.30	***2050*** 1.86	***2030*** 1.29	***2050*** 1.55
	CO_2-eq. concentration, in ppmv CO_2 equivalent 1995 = <411			***2030*** 561	***2050*** 719	***2030*** 550	***2050*** 666	***2030*** 534	***2050*** 629	***2030*** 503	***2050*** 516

(continues)

Table 14.15. Continued

Sustainable Development Objectives for 2030 and 2050 from JDSD	Indicators		Global Orchestration		Order from Strength		Adapting Mosaic		TechnoGarden	
Air pollution	NO_x emissions, in teragrams of nitrogen per year		1995 = 100							
			2030	***2050***	***2030***	***2050***	***2030***	***2050***	***2030***	***2050***
		OECD	88%	79%	102%	86%	80%	63%	48%	30%
	1995	FSU	110%	109%	104%	104%	92%	88%	62%	47%
	OECD 15.916	LAC	166%	171%	148%	171%	132%	142%	106%	87%
	FSU 3.809	MENA	181%	220%	169%	204%	160%	200%	113%	92%
	LAC 4.693	Asia	236%	293%	188%	230%	174%	186%	96%	73%
	MENA 1.89	SSA	102%	111%	114%	119%	107%	122%	89%	88%
	Asia 9.5	World	140%	153%	132%	141%	116%	117%	75%	58%
	SSA 4.601									
	World 40.409									
Water pollution	return flow 2050 water withdrawal—consumptive use-qualitative estimation		***2020:*** increasing except FSU ***2050:*** increasing except OECD and FSU wastewater flows increase by 40% (and hence increase the risk of overloading the detoxification ability of freshwater systems), but this is the second lowest increase among the scenarios; wealth of the North is used to repair breakdowns in water purification as they occur; in the South, there are net losses in water purification by ecosystems		***2020:*** increasing ***2050:*** increasing water purification declines in both the North and the South; large expansion of agricultural land and population poses the largest risk to the state and extent of wetlands (and hence their capacity to process wastes); likewise, the magnitude of wastewater discharges is the largest among the scenarios		***2020:*** increasing except FSU and MENA ***2050:*** increasing except FSU magnitude of wastewater discharges is second largest among the scenarios; although these factors tend to reduce the ability of freshwater ecosystems to purify water, society gives local water management special priority and therefore ensures that wetlands are protected and wastewater discharges are treated; hence in both North and South an improvement is expected in the water purification capacity of ecosystems.		***2020:*** increasing except FSU ***2050:*** increasing except OECD and FSU little change in water regulation by 2050; in the South, improvements by 2050 because the time lags for ecosystem engineering are shorter, and in some cases the South is able to learn from and avoid errors made earlier in the North	
Marine pollution										
Access to clean water	percentage of population with access to treated surface water or untreated but uncontaminated water from another source		***2025***	***2050***	***2025***	***2050***	***2025***	***2050***	***2025***	***2050***
		LatAm	83.5	86.1	83.5	84.7	83.5	85.0	83.5	86.1
		SSA	69.5	78.1	69.5	72.5	69.5	77.1	69.5	78.1
		WANA	92.0	94.0	92.0	92.5	92.0	93.0	92.0	94.0
		S Asia	83.8	92.8	83.8	86.6	83.8	92.5	83.8	93.0
		SE Asia	82.8	91.7	82.8	86.9	82.8	91.3	82.8	91.7
		China	80.0	84.3	80.0	83.0	80.0	81.9	80.0	84.3
Sanitation										

Key: FSU = former Soviet Union; LAC = Latin America and the Caribbean; MENA = Middle East and North Africa; SSA = sub-Saharan Africa; WANA = West Asia and North Africa

female to male life expectancy at birth), and health and sanitation (proxied for by the percentage of the population with access to treated surface water or untreated but uncontaminated water from another source).

The parameters determining childhood malnutrition in addition to kilocalorie availability (access to water, female/male life expectancy at birth, and share of female secondary schooling) are collected from actual values for the baseline and are then estimated up to 2050 based on the qualitative scenario storylines. It is deeply disheartening to see that, even after half a century of unprecedented economic growth in the Global Orchestration scenario, almost 4 out of 10 children under five years of age remain malnourished in South Asia and about 20% on average in the poorer world, despite Latin America's successful elimination of the problem. Not surprisingly, malnourishment indicators are worse in all regions under all other scenarios. This reconfirms the importance of the economic development dimension of hunger, which needs to be dealt with urgently as opposed to the importance of the ecological/natural resource constraints as the main cause of hunger, even over the long term.

The MA models do not keep track of the intranational distribution of incomes and the access to food by different social groups. Yet scenario results in Table 14.15 suggest that, perhaps with the exception of sub-Saharan Africa in 2030, at least in the Global Orchestration future the minimum level of dietary energy consumption should be available to all on the basis of the average calories available per capita per day. At a global level, this indicator is less than 10% below the wealthy-country average in 2050 (except for sub-Saharan Africa). This, in turn, reconfirms the importance of the social equity and distribution dimensions of hunger and its mitigation.

These findings should not be taken to mean land, water, and other resources in food and agriculture are less important. Their degradation is likely to just exacerbate the problem. However, MA scenario results on these issues are perfectly plausible and congruent with the results of a large body of past empirical work: the principal underlying causes of persistent hunger are economic (poverty, lack of income to buy or grow enough food) and social (inequity, deprivation of the opportunity to earn incomes or obtain land) rather than environmental or natural resource–related. The three factors—land and natural resources, economic, and social—need to be managed in a coordinated way to foster progress toward eliminating hunger.

The key social factor behind the phenomenal income growth in the Global Orchestration scenario and the rather modest achievements under Order from Strength also becomes obvious from Table 14.15. Investments in human capital (education, health care) stagnate or even decline in Order from Strength. This forecloses the adoption of new technologies, retards the skills of the labor force, and undermines labor productivity because of the feeble health status of the workforce. Not even the most radical reshaping of the international order or the soaring abundance of financial resources would be of any help to accelerate sluggish economic development in these circumstances. In contrast, Global Orchestration exhibits the highest rates of investments in education and health care. The improving labor force facilitates the seizing of opportunities opened by expanding access to financial resources and markets.

There are two important messages emerging from the comparison of these two scenarios. First, international economic conditions (trade, markets, financial resources) and the domestic human capital situation are two equally important preconditions for rapid economic development. Second, these two factors are mutually reinforcing and involve positive feedback loops. Segregation from international markets obstructs efficiency gains and hampers income growth. The resulting shortage of funds impedes investments in human capital and further retards productivity improvements; the poverty trap of Order from Strength is closed. The causality is quite the opposite in Global Orchestration: under the premise that equitable market access is guaranteed, improving human capital can not only help generate faster productivity improvements domestically, it is also allows for better integration into the international economy and helps to reap additional benefits from trade. This makes raising funds for investments in human capital easy and self-enforcing. In this way, human capital formation, together with economic growth, can help establish the economic basis for other aspects (social, environmental) of sustainable development.

The balancing of economic and environmental concerns over time is a contentious issue among scientists and a controversial point in policy-making. Selected environmental features of the scenarios pertaining to international dimensions of biodiversity, wetland conservation, and desertification are discussed in preceding sections of this chapter. This section uses a global and a local environmental issue declared to be of high importance to national governments to illustrate how the MA scenarios differ.

The international environmental agenda has been dominated by the risk of anthropogenic climate change over the past two decades. The MA scenarios suggest that this problem will persist through the end of their time horizon (2050). Global GHG emissions (measured in terms of the Kyoto gases in gigatons of carbon equivalent) more than double by 2050 in Global Orchestration and almost double in Adapting Mosaic. While in both of these scenarios emissions decline after 2050, they continue to increase in Order from Strength. TechnoGarden shows the lowest overall increase in emissions and therefore exhibits the lowest overall temperature change or risk of crossing climate thresholds.

The reasons for these interesting patterns are complex. In the globalized worlds, well-functioning international agreements, such as the UNFCCC, are more likely to succeed in maintaining better control of global pollutants, such as GHGs. TechnoGarden, which describes a globalized and environmentally oriented world, shows the effects of international cooperation combined with strong global climate policies to curb a global commons problem. In Global Orchestration, in which the main focus lies on socially equitable economic growth but less on environmentally sound practices, environmental agreements manage to keep at least partial control on global problems, though progress will be

slower. Emission levels are likely to decline after 2050, as more countries will be able to replace polluting industries due to higher revenues. However, the risks associated with the continued increase in GHG emissions over the first half of the twenty-first century in this scenario are substantial.

In the more fragmented worlds, global commons problems are more difficult to deal with, as the breakdown of global environmental regimes undermines action to reduce globally harmful pollutants. The fragmented global economy and the drying up of international financial flows result in markedly slower growth rates and, other things being equal, in lower GHG emissions under Adapting Mosaic. Nevertheless, the replacement of carbon-intensive industries is also likely to be slower. The preoccupation with local ecosystems and pollution issues is likely to lead at first to a disregard for global climate change problems. Later, however, many local improvements and renewed attention to the global commons will contribute to overall easing of the problem. This renewed attention arises as decision-makers realize that they need to deal with the impacts of global problems on local processes.

In the world of Order from Strength, agreements for the protection of global commons are not likely to be very effective. Despite the fact that economic growth will be relatively low, fragmentation and little consideration for environmental policies will exacerbate the climate problem. Measures to ameliorate the problem will likely be introduced too late (whenever severe impacts become visible) to have a real impact due to the inertia of the climate system.

The MA scenarios indicate that progress toward sustainable development is possible under very different circumstances and along different pathways. But they also demonstrate the potential threats to ecosystems and human well-being that might emerge along some paths. The choice of the actual direction and the implementation strategy rests mainly with national governments. The documentation of the relationships among driving forces, ecosystem change, and human well-being in the scenarios is intended to help governments and other actors make those choices.

14.5.3 Economic Growth, Food Security, and Stable Governance Structures in the MA Scenarios

14.5.3.1 Security Concerns of Governments

Security, defined as the continuation of stable governance structures and safety for citizens within state boundaries, is a key concern for many policy-makers in all countries. One of the key factors affecting global security is the distribution of wealth among individuals and the access to necessary ecosystem services. Within each scenario, many of the inequalities of wealth created among different regions result from the lack of movement of technology and free trade between regions. Many policies that could affect trade and movement could be the result of stringent security barriers. A synergistic effect occurs—the lack of free trade and movement of technologies that may result because of internal government security concerns further exasperate income disparities (especially in the Order from Strength scenario), which in turn could drive instability created by security concerns among regions. If we assume that wealth is one factor that affects access to various levels of ecosystem services, then we can assume that access to ecosystem services will vary in relationship to wealth distribution. The more skewed the distribution of wealth is within a country and between countries, the more likely it is that conflicts about the use of various ecosystem services will arise. Conflicts about provisioning services, such as access to food or water, can already be found today in many parts of the world, posing severe security risks to these regions.

The comparison between food consumption patterns in Order from Strength and Global Orchestration illustrates this point. The greatest disparity in total consumption of meat, fish, and grain among regions for all scenarios occurs between these two. Part of this difference is due to the unequal distribution of wealth between various regions and the ability to afford food production internally within each region. (Certainly other factors, such as the accessibility of fresh water, tillable land, and other ecosystem services, also affect food consumption.) Unequal access to ecosystem services, whether from disparities in wealth or other factors, can lead to development of regional ecosystem service hot spots. Within these hot spots there exist rapid changes in ecosystem services and an increasing need to gain access to these services. The hot spots that have developed across all scenarios are in the developing regions of the Central Part of Africa, the Middle East, and South Asia. Coincidentally, many of the security concerns of the higher-income world have recently focused on the same regions that the scenarios identify as facing rapid changes in delivery of ecosystem services.

What are the promising actions that could help alleviate security concerns for governments? Development of policies that favor high economic growth, equality in wealth distribution, and subsequent equal access to ecosystem services will likely lead to more stable governance within all regions and more security for all governments. More equitable distribution of wealth could be developed by policies that promote fair, free trade and encourage the transfer of technologies among all regions of the world. However, attention given to global hot spots will help alleviate economic growth and wealth disparities, which in turn could help create stable global security environments. If global or regional security is a major concern of governments, the attention should be paid to the regions where the potential exists for rapid change in ecosystem services. This is certainly an oversimplification of the issues driving global security, as a number of other factors, including cultural and human well-being, affect global security, but environmental degradation has become a pressing problem in many regions of the world and its impacts on security need to be considered.

14.5.3.2 Food Production and Ecosystem Services

Food production and food security have been long-standing concerns for national governments. Total food production will increase across all four scenarios. The measures used to achieve overall productivity increases and the importance of food imports differ across scenarios and de-

pend on trade policies, investments in agricultural research and technology, technology adoption, and agricultural infrastructure implementation. Thus, governments face different dilemmas with respect to food production under each of the trajectories the MA scenarios describe.

In Order from Strength and Adapting Mosaic, food production increases are relatively slow, which results from a combination of protectionist policies and lack of investments in agricultural research. More food is being produced locally in each nation. Agricultural production extensifies and more land is taken into production. The results are increased food prices and slow improvements in caloric intake. In these scenarios, all nations face similar dilemmas over expansion of agricultural areas and subsequent negative impacts on ecosystem services. However, wealthier countries are largely able to keep up with food demand whereas poorer ones struggle to do the same. In contrast to these scenarios, the high investment in agricultural research and generally free trade strategies for food result in increased global food production, with less emphasis on agricultural expansion for all nations under Global Orchestration and TechnoGarden. In these scenarios, the open global trade policies result in more trade among nations for food and less reliance on internal production. All nations in these cases fare better with caloric intake, which is fairly even among all countries.

The threats and risks faced by governments concerning food production vary by scenario and between rich and poor countries, but in all cases increases in food production result in differences in irrigation and subsequent access to fresh water. Increases in irrigation will occur in particular in the Global Orchestration and TechnoGarden scenarios and could result in a trade-off between access to fresh water and access to food sources. Potentially devastating effects in countries where fresh water is limited will have to be offset by increased access to food from outside sources. Otherwise, water-poor countries are likely to lose most of their water supplies. Another option might be the development of global freshwater policies. Governments in these scenario worlds will be faced with the dilemma of having agricultural technology development that incorporates innovative approaches to save water match population growth and the subsequent increase in food demand.

Governments in Order from Strength and Adapting Mosaic face a different dilemma. The expansion of agricultural areas within each country needed to keep up with food production will result in a decline in other ecosystem services. For example, wetlands that are drained to establish fields will lose their water retention and purification capabilities, which are important regulating services. Access to technology and improved practices to overcome the problems created by increased cropland area will be different among governments. Particularly in the Order from Strength world, it is likely that rich countries will have a disproportionate ability to develop ''technological fixes'' because of the disparities in wealth. Poorer countries will be faced with the inevitable trade-offs between production of food and access to other ecosystem services, with limited resources to develop new solutions. This will further exasperate the differences among countries. In Adapting Mosaic, these tendencies are not likely to be quite as strong, as there will be a number of areas focusing on experimenting with specific solutions to food production problems. But as the exchange of technology and knowledge is more localized toward the beginning of this scenario, innovative solutions will not catch up with food demands in all areas of the globe. Therefore, poorer countries will have to rely on area expansion, at least for a while, to meet the demand.

What might be promising actions for food policy development? As with previous discussions, the type of policies that governments can implement will depend on the trajectory depicted by each scenario. Comparing strategies across scenarios can help governments adjust their policies and develop robust solutions that work under all the described worlds.

In the more globalized worlds of Global Orchestration and TechnoGarden, all countries continue policies that promote investment in agricultural research and the open and fair exchange of goods and technologies. This will help create novel solutions for food production and balance food supply and demand, particularly for areas in which environmental conditions, such as access to fresh water, constrain food production.

In Order from Strength, governments will have to pursue policies that address the trade-off between increased land use for agriculture and loss of other environmental services. Development of policies that promote increased investment in agricultural technology will inevitably be necessary. In wealthy countries, this will eventually mean a reordering of priorities for research and development funding, which could conflict with other demands on research funds. In poorer countries, this dilemma will be even more severe as resources are fewer. Some of them might have to have stringent protection for areas essential to provide a number of non-agriculture-related ecosystem services. However, it may be unrealistic to believe that countries facing persistent hunger will be able to take key natural resources out of production. Developing measures that couple short-term profitability aspects with conservation objectives may be an important step forward in protecting these natural resources.

In the Adapting Mosaic scenario, some decision-makers in poorer countries are likely to take this route by experimenting with local solutions to address the productivity-conservation problem.

14.6 Implications for Communities and NGOs

This section is addressed to the primary users of the Millennium Ecosystem Assessment, including NGOs working on environmental and social development issues and other civil society organizations involved in local development and environmental protection. This includes cooperatives, indigenous peoples' organizations, and indigenous communities. The section synthesizes the policy implications of all the scenarios for civil society, with a primary emphasis on local communities and local to international NGOs. Local communities are considered to include locally focused

groups or movements of civil society and the managers of local common property/pool natural resources.

Nongovernmental organizations are nonprofit organizations independent of government that receive at least a share of their support from private sources. While most NGOs have a local focus, those that deal with regional or international issues can have significant local impacts. NGOs are considered to include academic institutions, foundations, and private voluntary organizations. They are defined here as focusing on protecting public goods rather than the well-being of their particular constituents (that is, not unions or cooperatives). This section will primarily address responses to the scenario implications requiring formal or informal policies and will give less attention to the other types of responses by communities and NGOs, such as altering management practices or use of technology, that are covered in greater detail in the *Policy Responses* volume.

While it is obvious that none of the scenarios have outcomes that only affect local communities or NGOs, some of the possible outcomes could have particular impacts on local community health and well-being and pose unique challenges and opportunities for NGOs. Table 14.16 summarizes some of the major stresses and response options for communities and NGOs under the four global scenarios.

14.6.1 Communities

14.6.1.1 Community Concerns and Specific Scenario Implications

Local communities are particularly concerned with direct impacts on their health and well- being. Loss of biological resources is often of greatest concern when it affects livelihood options; pollution of air and water is of concern when it has health impacts. Communities are also concerned with the indirect drivers of ecosystem change (such as economic and social justice and equity, population, and education), and they play critical roles in responding to both direct stresses and indirect drivers.

When considering community responses to the scenario outcomes, it is important to consider the impacts on different types of communities (indigenous peoples, fisherfolk, farmers, women's groups, and so on) and on the communities that are most vulnerable (such as poor communities in developing nations that are directly dependent on local biodiversity for survival). In order to determine which communities, in which locations, will be most vulnerable, it will be necessary to integrate the level of exposure to stresses with how sensitive and resilient people and ecosystems are to those stresses. Local communities are often able to determine what impacts will be, but they are challenged to obtain the necessary access to those with the political power or funding to pursue the necessary response options.

14.6.1.1.1 Biodiversity: habitat loss and overexploitation

Important links exist between biodiversity loss, loss of ecosystem services, and human livelihood impacts. All the scenarios indicate that habitat loss and fragmentation, climate change, and pollution will result in the loss of biological diversity. Habitat loss is the greatest threat in general, though climate change is the major threat to desert and tundra biomes. TechnoGarden has the lowest potential impacts on biodiversity. At the same time, this scenario could lead to the greatest use of new technologies to replace declining ecosystem services. Some of these technologies, however, have potentially serious impacts on biodiversity, such as the outbreak of new pests or genetically modified organisms. NGOs and communities therefore need to consider seriously the benefits and risks of new technologies.

Climate change could have severe impacts on biodiversity, particularly under the Global Orchestration scenario. Biomes at special risk are boreal forests, tundra, shrub, and savanna. Many local communities, such as the reindeer-herding nomadic Evensk in the far east of the former Soviet Union, could have their livelihoods affected by changes in the tundra ecosystem that affect food and habitat for reindeer.

The scenarios have different implications for different regions. Higher-income nations that are largely far less dependent on local biological resources for immediate human needs will be less affected by the possible changes. Developing-country communities (particularly in sub-Saharan Africa and Latin America) are expected to experience the greatest risk of biodiversity loss in the short and long term.

Agricultural land increases at the expense of natural habitat in all scenarios. Loss of tropical savanna is most severe. While the amount of forested land shows some increase due to regrowth in most scenarios, tropical forests decrease in all scenarios by 2050 (11% loss in TechnoGarden and 22% loss in Order from Strength).

14.6.1.1.2 Provisioning and regulating ecosystem services

One of the most critical concerns for communities will be changes in provisioning and regulating ecosystem services and the associated changes in environmental security. While in most scenarios provisioning services improve while regulating services decline, in Order from Strength there is high vulnerability and collapse of both regulating and provisioning ecosystem services. Adapting Mosaic shows an increase in ecosystem services resulting from co-management strategies aimed at managing a whole range of ecosystem functions, while TechnoGarden also shows an improvement but from its reliance on innovative technology. The increase in the spatial heterogeneity of ecosystems in Adapting Mosaic could lead to greater use of genetic diversity by local communities. Pollination is expected to be worse than present in both North and South in all scenarios except Adapting Mosaic, where it is unchanged. Since most of the models that the scenarios are based on were not good at predicting specific thresholds for changes in ecosystem services, local monitoring will be important for all scenarios to allow timely community responses.

All the scenarios indicate increases in return flows of water, which is an indicator of pollution of fresh water and estuaries, with the highest risk in sub-Saharan Africa and Latin America. The water stress identified as a particular risk in Order from Strength could lead to construction of dams for water storage, potentially resulting in greater habitat alteration and biodiversity loss. Similar water stress in the

Table 14.16. Community and NGO Primary Stresses and Selected Response Options in MA Scenarios. All values are estimates of relative comparison among scenarios. Many responses apply to more than one stressor.

	Scenario			
Stresses and Responses	**GO**	**OS**	**AM**	**TG**
On communities				
Ecosystem stress—habitat loss and overexploitation of biodiversity	●●●●	●●●●●	●●●	●●●
Adapt local livelihood options: community forestry, ecotourism	✻✻	✻	✻✻✻✻	✻✻✻
Partnerships with NGOs, government, private sector to protect local habitats	✻✻	✻✻✻	✻✻✻	✻✻✻
Achieve more sustainable use of productive lands: IPM	✻✻	✻	✻✻✻	✻✻✻✻
Maintain and use traditional knowledge	✻	✻	✻✻✻✻	✻✻
Vulnerability of other ecosystem services (provisioning, regulating, cultural, and so on)	●●●● (D) ●●● (I)	●●●●●	●●	●●
Strengthen traditional community institutions	✻✻✻	✻	✻✻✻✻	✻✻✻
Seek resource tenure or use rights on state or private land and water	✻✻✻		✻✻✻✻	✻✻✻
Human health and well-being (livelihood, security, health, good social relations)		●●●● (D) ●●● (I)	●●	●
Participate in planning, implementation, and review of development projects	✻✻✻	✻✻	✻✻✻	✻✻
On nongovernmental organizations				
Ecosystems stress—habitat loss	●●●●	●●●●●	●●●●	●●●
Promote effective global network of protected areas for priority ecosystems	✻✻	✻	✻✻✻	✻✻✻✻
Publicize private-sector and government unsustainable resource use and impacts on communities (Home Depot store protests, certification, and so on)	✻✻✻✻	✻✻	✻✻✻	✻✻✻✻
Promote reduced pressure for agricultural expansion	✻	✻	✻✻✻	✻✻✻
Ecosystem stress—overexploitation and other ecosystem services	●●●●	●●●●	●●●	●●●
Promote sustainable use of productive lands	✻✻	✻	✻✻✻	✻✻✻✻
Promote more-effective education, incentives, regulation	✻✻	✻✻	✻✻✻	✻✻✻✻
Help maintain traditional knowledge	✻	✻	✻✻✻✻	✻✻
Obtain private-sector financial support and collaborate on voluntary environmental agreements	✻✻✻✻✻	✻	✻✻✻	✻✻✻
Human health and well-being (livelihood, security, health, good social relations		●●●● (D) ●●● (I)	●●	●
Monitor and report status of ecosystems and human well-being	✻✻✻✻	✻	✻✻	✻✻✻✻✻
Obtain public-sector financial support for advocacy to support public participation, and so on	✻✻✻	✻	✻✻	✻✻✻✻
Support capacity building	✻✻✻	✻	✻✻✻✻	✻✻✻✻

Key: GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden

D = developing countries; I = higher-income countries

Stresses: 5 ● = severe stress, 0 ● = no worse than 2004

Responses: 5 ✻ = success likely, 0 ✻ = unfeasible/ineffective

Adapting Mosaic scenario might lead to innovative conservation approaches as well as greater dam building.

14.6.1.1.3 Human health and well-being

While per capita ecosystem services decline, per capita income increases in all scenarios, and the relative income differences across the globe narrow in all but the Order from Strength scenario. Global Orchestration's focus on the social and environmental policies that can improve well-being for the poorest communities will lead to the greatest improvement in human well-being for the communities currently the poorest and most vulnerable. Nevertheless, in this scenario the risk of unexpected environmental changes also increases due to a lack of attention to long-term environmental changes. The fact that the consequences of these changes will be first experienced by local communities underlines the importance of communities monitoring change.

Human well-being improves for the most part early in all scenarios, but this is coupled with significant inequalities in distribution, and human well-being then declines in the scenarios that experience greater ecosystem service loss and

social instability (Order from Strength). All the scenarios indicate agricultural intensification and greater food production. TechnoGarden does so with the lowest increase in land under agriculture due to a strong focus on intensification efforts (Order from Strength shows a 24% increase in the area of agricultural land by 2050).

Ecosystems also supply many cultural services to local communities (such as recreation and sacred trees), which are directly connected to their well-being and often constitute an important part of their culture. The maintenance of local culture will be a challenge in the globalized worlds of Global Orchestration and TechnoGarden. In particular, TechnoGarden's reliance on spreading emerging technology globally could undermine the use of local techniques and practices for ecosystem management.

Also related to human health issues are land use change by humans, which will continue to have potentially adverse effects on community health by creating habitats (including dams and irrigation systems) in which mosquitoes can thrive. Mosquitoes are vectors of a wide variety of human and animal pathogens, including malaria, dengue, and filariasis. Current deforestation appears to be associated with the expansion of mosquito distributions and the increase in mosquito-borne disease transmission. The higher deforestation rates in Order from Strength could potentially lead to a greater incidence of mosquito-borne diseases in communities near tropical forests.

14.6.1.2 Priorities for Near-term and Long-term Community Responses

While the challenges of integrated responses are discussed in the *Policy Responses* volume, there are benefits to communities examining what the ''worst-case scenario'' might be for all stressors and exploring whether they could respond in an integrated way that involves various sectors and focuses on different stressors at a same time. An integrated response might involve multiple actors (community, government, NGOs, the private sector), multiple sectors and scales (water, biodiversity, human well-being), and multiple knowledge systems.

14.6.1.2.1 Biodiversity conservation

Communities can support policies that integrate biodiversity conservation with development policy at the local level by exercising their available opportunities for voice and vote (participating in opportunities to comment on programs, pressuring decision-makers, communicating with NGOs and the media, and so on). The local/regional and proactive focus of the Adapting Mosaic scenario indicates positive benefits for biodiversity and communities.

Many resource management practices of indigenous and local peoples are directly related to conserving biodiversity over much of the globe, yet many communities are socially marginalized and have lost rights to their resources and lands. Recently, indigenous and local communities have begun to obtain the recognition they deserve in global treaties (in the CBD, the Rio Declaration, the World Heritage Convention, and so on). Expanding community land and resource tenure (or acknowledging customary land tenure, such as the case for most of Papua New Guinea) is often seen as one of the best ways to conserve local biodiversity. However, just as is the case when the state retains those property rights, those rights could then be traded or sold or used in an unsustainable manner in the view of outsiders. Many studies have shown that local community resource management can effectively integrate local stakeholders into environmental governance and that integration of local environmental knowledge can lead to more effective resource management. The Adapting Mosaic scenario portrays one possible pathway for greater local control over resource management and depicts a variety of plausible outcomes.

14.6.1.2.2 Other ecosystem services

Land use change directly determines provisioning, supporting, and regulating ecosystem services. The scenarios differ in the role of institutions and property rights in local management of ecosystem services. Indigenous peoples' movements, with support from NGOs, can work with decision-makers to advocate and create polices that require governments to work in partnerships with indigenous peoples. The New Zealand Resource Management Act and Treaty of Waitangi requires local government to work in partnership with indigenous Maori peoples for local land and resource management, for example, and the Canadian government acknowledges property rights for indigenous peoples through individual tradable permits for fishing rights.

A response that could be used by communities in all four scenarios is to seek partnerships with their respective governments to integrate protection of ecosystem services with income generation. The Working for Water program initiated by the government of South Africa in 1995 is an excellent example of an innovative approach to maintaining water security, restoring the productive potential of land, and decreasing unemployment in marginalized communities. Over 300 projects help generate income for local people who remove alien species and maintain vegetative cover.

The knowledge of traditional and local managers, provided as a part of an informed public participation process, can be invaluable in defining ecological risks and ways of avoiding them. The Bedouin people in the deserts of Egypt, for instance, have thousands of years of experience managing limited water resources that would be of benefit to engineers designing irrigation schemes. Communities can use existing mechanisms for public participation in national and local environmental impact assessments and also seek to have such participation expanded. While public participation has greatly expanded in many nations in the last 15 years, there is still considerable room for improvement. Local people participate in reporting on the state of the environment in many countries in Africa, though the participation of women is still low.

14.6.1.2.3 Human health and well-being

The feedback links between ecosystem change and human health and well-being are frequently most obvious in impoverished communities that cannot afford the same ''buff-

ers'' to a decline in ecosystem services as wealthy communities. Communities, through capacity-building initiatives of government, NGOs, and the private sector, can strengthen their understanding of the contribution of human landscape and habitat change to many human health outcomes and of options for disease management. This might result in changed community land use practices or community response to government or private development plans. For example, urban communities might respond to vector-borne transmission of disease by urging development planning to include consultation with entomologists, epidemiologists, and health care specialists to address issues such as storm water management and vector control.

Many of the options for the near term also apply to the long term, particularly developing partnerships between communities and NGOs in order to develop stronger voices with governments and international treaties. Capacity-building support will be essential in the long term. While it is an obvious point, the long-term scenarios continue to emphasize the importance of more proactive policies that integrate environmental issues with development issues. Communities and NGOs (both environment and development NGOs) can work together effectively to support such policies.

The global MA scenarios did not fully meet the expectations of civil society stakeholders to have the MA address the impact of ecosystem change on the vulnerability and resilience of human communities and on their cultural concerns. These issues were more successfully addressed in the MA sub-global assessments. Communities are interested in learning about site-specific impacts in relation to global changes, but integrating information across multiple geographical scales is a new challenge in the development of global scenarios. The global MA scenarios can be used to describe the main boundary conditions under which local communities are likely to operate in each of the described pathways, but they do not have the specific details that local or regional scenario exercises are able to portray.

14.6.1.3 Additional Community Response Strategies and Options by Scenario

14.6.1.3.1 Global Orchestration

This scenario attempts to improve the well-being of poorer countries by removing trade barriers and increasing investments in social and education policies, with the risk that local and regional environmental problems can become worse. One risk of Global Orchestration to biodiversity is that a narrow selection of high-yield commercial crops could spread around the globe, resulting in wild varieties existing only in gene banks that do not offer complete protection from extinction. A community priority for the near term might be to apply local ecological knowledge to helping conserve landraces and local varieties of agricultural species, possibly in partnership with NGOs, governments, and the private sector. Increased community focus on energy conservation and efficiency could help mitigate some of the adverse impacts expected to result from the development path described in this scenario.

14.6.1.3.2 Order from Strength

This scenario describes a world in which rich nations focus on protecting their borders, and environmental services are only protected (inadequately) in formal protected areas. In this regionally focused, reactive world, communities would benefit from more strategic understanding of how to influence government and private sector policy. This would be necessary to encourage policies that can create an enabling environment to stimulate and support changes in individual incentives for better resource management. This could include, for example, passing laws that mandate greater community management of protected areas, acknowledging the value of traditional approaches to conserving land such as sacred groves, or upholding community taboos and special resource harvest levels and/or seasons.

14.6.1.3.3 Adapting Mosaic

This scenario favors local management and control of ecosystems and offers communities the greatest opportunities to adapt to changing conditions and take control of managing their resources. There are many examples of local communities using traditional knowledge to alter their resource use patterns in response to the abundance or scarcity that they observe. For example, levels of family harvests from forest gardens in Southeast Asia are altered depending on actual fruit abundance to ensure sufficient fruits are left for wildlife support and for regeneration. The Adapting Mosaic scenario will increase success of this response for biodiversity conservation and other resource uses, as local success begins to be shared at the global level later in the scenario. However, the lack of early focus on global policy might cause effective local efforts to be less successful because of global problems. Success in conserving a local coral reef, for example, might be adversely affected by global changes in pollution, temperature, or exotic species.

Communities can encourage governments to expand policy options that acknowledge a role for traditional knowledge in management and conservation of local ecosystems. In South Africa, the value of both participation and traditional knowledge are encompassed in programs like CAMPFIRE (Communal Areas Management Program for Indigenous Resources). In India, joint forest management is an example of government devolving resource management to local communities. Empowering local communities and legitimizing their traditional knowledge can also be an effective way to control exotic species introduction and removal at local levels. Communities can also help demonstrate the importance of conserving cultural diversity along with biological diversity.

14.6.1.3.4 TechnoGarden

This scenario outlines how technology can maximize production of ecosystem services for humans. The implications for biodiversity indicate greater need for community policies for managing biodiversity sustainably for local consumption and other benefits (from ecosystems services such

as water and nutrient cycling to generation of income from ecotourism). There is less that communities can do to affect climate change beyond working to influence national and global policies via election of government representatives and participating in opportunities to comment on government policies and plans.

Communities, in partnership with local NGOs and others, can draw attention to cases where the conservation priorities and policies of international NGOs and the foundations and governments who support them are not a reflection of local interests. For example, global-scale priorities for ''hot spots'' for conservation often do not acknowledge that most local biodiversity has local importance for livelihoods and other ecosystem services.

14.6.2 Nongovernmental Organizations

14.6.2.1 NGO Values and Concerns and Specific Scenario Implications

NGOs have a wide range of concerns and values, depending on the scale of their work (local, national, regional, or international) and their focus (environmental, social, or economic; policy or on-the-ground work). NGOs also play many roles, from protesting outside meetings like the World Economic Forum to having a ''seat at the table'' in crafting policy. Many NGOs work to support communities that might lack the capacity to protect ecosystems directly. International environmental NGOs often focus on global environmental resources regardless of national boundaries. Many international NGOs seek to conserve representative samples of biologically diverse habitats, with less focus on habitats that might be extremely important to local communities. NGOs and other civil society groups are actively involved in mobilizing public support for international environmental agreements. Environmental NGOs are increasingly advocating economic policies that provide incentives for improved conservation, such as taxation and subsidies, and that can help alter market-based incentives for overexploitation.

NGOs play an increasingly important role in protecting environmental resources and processes. While they do not have uniform approaches or views on environmental protection policies, they can play important roles in raising public awareness; organizing communities; pressuring governments, the private sector, foundations, and multilateral organizations in the design of international treaties; and providing legal assistance to local and indigenous communities. NGOs also directly own or help to co-manage protected reserves in many nations. The Nature Conservancy, for instance, manages reserves it owns in Latin America and elsewhere.

NGOs can help to monitor implementation and compliance with environmental policies from local-scale to global multilateral environmental agreements. They tend to support public participation (or at least transparency to increase the awareness of civil society) in government and private-sector decision-making, which can help enforce existing environmental policies and develop support for improved policies.

14.6.2.1.1 Biodiversity loss and overexploitation

The scenario implications for biodiversity loss as a result of land use change, exotic species introductions, and climate change create many imperatives for NGO action, since the impacts of such changes will be felt across political boundaries. Many impacts are particularly severe in developing nations, where financial resources are more limited. International NGOs can assist where national NGOs are weak, and they have a particular opportunity to focus attention on important conservation areas that cross multiple political boundaries, which no one state is likely to take responsibility for. While NGOs lack the ability to directly create and enforce biodiversity policies, they have an enormous opportunity to help shape international and national government and private-sector policy by raising awareness and conducting advocacy initiatives and then helping to implement and monitor those policies.

14.6.2.1.2 Ecosystem services: provisioning and regulating services

All the scenarios indicate decreases in provisioning and regulating ecosystem services, with more severe stress in Global Orchestration and Order from Strength than in Techno-Garden and Adapting Mosaic. Many creative approaches to conserving ecosystem services have been and can be stimulated by NGOs, which often can help to ''broker'' agreements between the private sector and government (as in the many market-based mechanisms for protecting environmental services provided by forests, including certification of sustainably harvested timber, or protection of water or biodiversity from forests). NGOs can play an important role in stimulating market-based responses to climate change, such as carbon investment funds. For example, in 2004 the NGO Rainforest Action Network helped Citigroup agree to social and environmental investment policies that help stem climate change and habitat loss in vulnerable ecosystems.

14.6.2.1.3 Human health and well-being

The scenario implications for human well-being indicate that there will be even greater need for NGOs to play a role translating and disseminating information on the state and sustainability of ecosystems and links to human well-being, including results from sub-global assessments and global scenarios, to communities and governments in the context of options for policy responses. For example, NGOs have played a major role in such communications at Conference of the Parties meetings for international treaties and at international fora such as the World Social Forum.

14.6.2.2 Priorities for Near-term and Long-term NGO Responses

14.6.2.2.1 Biodiversity loss and overexploitation

One of the most important policies for NGOs to support in the near term is the creation and maintenance of protected areas for biodiversity conservation. This can be done via policy advocacy, by directly purchasing or co-managing protected lands, by conservation easement management, and by partnerships with government, the private sector,

and communities. International and national NGOs will increasingly need to develop and campaign for policies that address both the need for conservation in protected areas as well as the need for local and indigenous community access to common property or state- controlled biological resources. Policy incentives for conservation of the unprotected portions of the landscape will also be important and can involve public-private sector partnerships.

NGOs could ensure that the outcomes of their own projects are monitored. They could also advocate for government and private-sector policies to support appropriate monitoring, which can then provide data on specific conservation approaches that are seen as being more successful than others. If NGOs want to support adaptive management approaches, then it will be important, as threats to biodiversity increase, that policies to support monitoring are in place. NGOs have often been guilty of moving their support and advocacy from one conservation approach to another (from community-based conservation in the early 1990s to ''direct payment'' for conservation) without adequate information that any one particular approach actually works better than another.

NGOs have the opportunity in the near term to examine how geographic priorities for international, national, and local conservation are determined by international conventions, NGOs, and governments. The questions they can ask include: Where do various systems for setting global priorities for biodiversity conservation agree and disagree and why? Global ''hot spot'' declarations by NGOs do not necessarily overlap with local priorities, though they have been successful in attracting global financial resources. Also, how can global priorities among countries be reconciled with national priorities within countries? The scenarios indicate that sub-Saharan Africa, Latin America, and Asia are most at risk of species loss before 2010. Some NGOs will want to focus on policies in these most threatened areas. NGOs also have the opportunity in the near term to emphasize policies that will enhance the ability of institutions and ecosystems to adapt to the long-term changes highlighted in the scenarios.

In terms of policy, NGOs can advocate enhanced enforcement of the many international treaties that can help to conserve biodiversity (including the CBD, the International Tropical Timber Agreement, Convention on the Non-navigational Uses of International Watercourses, and the International Treaty on Plant Genetic Resources for Food and Agriculture, and CITES). The CBD, if enforced, could help prevent or mitigate the long-term threats to biodiversity by encouraging global accountability and local action.

14.6.2.2.2 Ecosystem services: provisioning and regulating services

NGOs can advocate incorporation of consideration of ecosystem services and biodiversity in integrated regional planning in order to demonstrate the important linkages to human health. Finding ways to conserve the ecosystem services of protected areas while also meeting the immense human needs that exist near most protected lands in developing nations will continue to be one of the major policy challenges.

NGOs can also develop and promote innovative approaches to ecosystem protection, many of which depend on market forces and partnerships with the private sector and government, such as tradable permits for species protection, debt-for-nature swaps, certification programs for sustainably produced timber and marine and food resources, and appropriate pricing of services and resources in order to create incentives for conservation.

14.6.2.2.3 Human health and well-being

One way to better integrate sectors and achieve more adaptive policies would be for partnerships to emerge between NGOs with a primarily environmental mission and those with a primarily social focus. The scenarios indicate the need for more interdisciplinary policies concerning both direct and indirect drivers of environmental changes. Missions of social and environmental NGOs might conflict in some cases and reinforce each other in others. The results in Chapter 9, for example, might lead social NGOs concerned with food availability and child health to support policies to raise agricultural production by increasing agricultural land area or policies to increase productivity on existing land already being used for agriculture. However, environmental NGOs might support land conservation to protect biodiversity along with increased productivity on already disturbed land. Yet both social and environmental NGOs might share common objectives in supporting polices for sustainable agricultural practices to decrease risks to biodiversity or in working to decrease deforestation in malaria areas, since deforestation has been linked to an increase in malaria. Support for technologies such as sustainable agriculture and pollution abatement systems can be included among the policy options for protecting food supplies and human health.

All the scenarios indicate that due to the threats emerging over the longer term (2030–50) it would be important for NGOs to support policies aimed at monitoring ecosystems in order to be better prepared for opportunities to act on the observed changes. Regularly updated indicators of ecosystem structure and function will allow communities and NGOs to engage in better prevention, mitigation, adaptation, or restoration of ecosystems. This monitoring would be enhanced if the institutions that emerge and evolve for global environmental management begin to focus more on biological/ecosystem units rather than political/national boundaries. Such a focus would also help in assessing ecosystem vulnerability, which is expected to grow and to have a disproportionately adverse impact on the poor.

The synthesis of changes in ecosystem services (Chapters 8 and 9) indicates that in 2050 the trade-offs between ecosystem services will be more intense than at present and that greater inequities between rich and poor nations and regions and greater adverse impacts from unanticipated disasters are very plausible future developments. This implies that environmental justice and ethics should be of even greater concern to communities and NGOs than they are at present.

One of the most useful aspects of the scenarios for NGOs and communities is the effort to assess the relationship between ecosystem changes and human health and well-being. Given their global nature, however, the scenarios are not able to fully describe all the trade-offs and interactions between ecosystems services and human well-being, especially in response to specific response options and adaptation possibilities.

14.6.2.3 Additional NGO Response Strategies and Options by Scenario

One of the important implications of all the scenarios is the opportunity that NGOs have now to help craft policy solutions that will support conservation before more irreversible loss occurs in species, habitat, and ecosystem function. Given that many of the areas of global conservation importance also have growing populations and poverty (such as South and Southeast Asia, the far eastern former Soviet Union, Equatorial Africa/the Congo Basin, and the Upper Amazon), there is opportunity to integrate conservation with the agendas to alleviate poverty, increase equity, sustain health, and so on.

14.6.2.3.1 Global Orchestration

While support for international treaties is expected to continue, the Global Orchestration scenario also points out the difficulty of adjusting global-scale policies to deal with local and regional issues as they arise.

This scenario also addresses the issue of global trade and its implications for different actors in society. It portrays a continuation of globalization, in which trade, information, and technology flows increase. But these are coupled with mechanisms to enhance the equal participation of all in global markets by, for example, decreasing market-distorting subsidies and focusing on global public goods creation and protection. NGOs and community groups might want to work with other actors to explore how to harness the best aspects of free-market capitalism while addressing those aspects that lead to negative environmental outcomes. An examination of the conditions under which free-market economies produce better environmental outcomes would be valuable. In addition, NGOs can take a lead in exploring mechanisms for protecting public goods and for developing social policies that enhance the chances of different groups in society for equal participation in global markets.

14.6.2.3.2 Order from Strength

The perennial challenge for NGOs to find funding support will be heightened under the regional, reactive focus in Order from Strength. International NGOs are likely to find less support from multilateral sources (the United Nations or the World Bank) and less interest in work on international treaties. That said, in this scenario decision-makers focus on use of protected areas to conserve biodiversity and ecosystem services. Thus NGOs will likely find support for parks creation, though funding for enforcement and monitoring will probably be limited. NGOs will also need to focus more attention on obtaining resources for conservation outside parks.

A theme across all the priorities for action by NGOs and communities is being able to adapt to emerging approaches and outcomes for environmental policy and to focus first on direct drivers of ecosystem change (with perhaps the exception of climate change). The regional, reactive focus in Order from Strength will require national NGOs that can change to focus from international treaties to more local issues. Social unrest could result from the large income inequities in this scenario, and NGOs will need to support vulnerable communities.

14.6.2.3.3 Adapting Mosaic

This scenario offers the greatest opportunity for NGOs to work with communities to develop ways to adapt and respond to changes in ecosystems and human health. Adapting Mosaic is likely to result in lower levels of global financial resources being available to NGOs, and less support for international environmental agreements. The scenario might result in more financial support from regional bodies for the work of national and local NGOs, and regional environmental agreements will require more NGO attention.

In addition, NGOs will be one of the key players to make the future world portrayed in this scenario work. They will have to play an important role in capacity building and monitoring activities for ecosystem change in this scenario. Furthermore, helping to build or rebuild community structures for ecosystem management will be one of the major tasks for NGOs in this scenario. Developing adaptive management systems requires a thorough understanding of ecosystem functions and possible management options. Communities will have to organize themselves to be active partners in management schemes and in order to negotiate with other actors. NGOs are likely to be very important in providing support for these activities.

As many NGOs also work in a variety of communities or areas, they will need to act as bridges for building networks with other communities, research agencies, and so on that can help in developing monitoring and management options. Particularly in poorer countries in which well-functioning governance structures will first have to be developed, this role of NGOs will be extremely important in an Adapting Mosaic world.

14.6.2.3.4 TechnoGarden

Monitoring of project and policy outcomes by NGOs will be important in this future world since there will be uncertainty about the degree to which ecosystem services can be replaced by technical alternatives.

In response to loss of biological diversity and associated ecosystem services, NGOs might have more success in this scenario advocating precautionary conservation policies that can justify action to regulate potentially irreversible environmental and social harms. NGOs might have success in encouraging increased attention to creation of a global network of protected areas to help stem the loss of biodiversity. Monitoring of outcomes, particularly those that are unexpected, will be important in this scenario.

14.6.3 Interactions between Communities, NGOs, and Other Response Actors

Local communities and NGOs can work together with government and the private sector to advocate policies and to execute on-the-ground practices that protect, mitigate, and restore some of the ecosystem services that are threatened by the development paths and assumptions in the four scenarios. Government and the private sector play important roles in creating the enabling environment for community and NGO action through policies and funding. NGOs and communities often know what needs to be done; they just need such partnerships to make it happen. In all scenarios, NGOs and communities can be more strategic in their efforts to integrate environmental imperatives with political reality.

Communities and NGOs bear twin burdens that must be addressed separately: determining what actions they can take to sustain ecosystems and human well-being and then obtaining the political and financial support for that course of action. Contributing to or developing the best course of action from a technical perspective, given the uncertainties and the array of possible options, is difficult enough. The bigger challenge, however, may be getting the sustained political will and financial resources needed for adoption and implementation. This becomes even more challenging in the face of uncertainty and the inevitable setbacks as different solutions are tried.

It is important therefore to look at what the scenarios indicate about the political sphere in which NGOs and communities will have to operate. Communities and NGOs work to address the incentives and structural problems in all sectors that produce harmful environmental and societal impacts. Whether communities and NGOs have any impact on powerful actors depends on a few key factors, some of which the scenarios infer and even address directly.

The particular strategies and degrees of success vary widely, of course, depending on a country's type of state, stage of economic development, and civil sector maturity and whether a particular NGO is local, national, regional, or international. Despite the best intentions, not all NGO and community efforts are successful. In general, though, NGOs' key instruments of success include using the power of community organizing, the media, science, government-mandated public participation forums, coordination between NGOs from economically developed countries and economically challenged ones, and, more recently, strategic collaboration with the private sector. Communities often do not have access to or knowledge of the powerful political elites, and thus they benefit from partnerships with NGOs and the private sector in obtaining this access.

Financial grant support from the philanthropy sector is critical to success for most NGO efforts, so the interests and assets of foundations in each scenario must also be considered. NGOs are sometimes considered to include foundations; there are over 60,000 registered foundations in the United States alone, and many hundreds of community foundations across the globe. The implications of the scenarios for foundation assets, priorities, and spheres of operation are important because NGOs depend on foundation support. It is important to note that the financial assets of corporate foundations may be affected differently than privately endowed foundations in each scenario. Consideration needs to be given to how each scenario might affect the enormous remittances sent home by overseas workers, and how those remittances help sustain community well-being.

Foundations play an important role in funding the efforts of communities, NGOs, and other actors in civil society. The issues, approaches, and groups that foundations support send strong signals to the rest of society about needs and confidence in expected outcomes. Across all scenarios, NGOs and community groups will need to devote resources to gaining a better understanding of political realities and tailoring their strategies accordingly. Developing a sound understanding of the forces that influence decision-making and finding a way to participate effectively in those arenas will be as important, if not more important, than developing tailored, feasible solutions that address policy-makers' concerns. For instance, some of the recent progressive solutions developed for air quality problems were successful in receiving political support because NGOs helped demonstrate economic benefits in addition to individual health benefits, thus successfully countering corporate claims that the costs of regulation were too high.

In Adapting Mosaic, where tailored solutions on more local and regional scales are described, avenues for communities and NGOs can be expected to be open and inclusive. This can lead to failures, though, for environmental solutions that require international coordination. Foundation support for NGO work might remain high, but multilateral and bilateral support could decrease.

In TechnoGarden, where advanced technological solutions are aggressively implemented and environmental problems are explicitly addressed, it is likely that NGOs that can contribute to this will be able to have influence. However, NGOs that advocate for changing some of the underlying economic and government incentives that cause the problems may find themselves sidelined or challenged for funding for the kind of solutions they would hope to advocate.

Most challenging for NGOs and communities is likely to be the Order from Strength world, where those with economic and political power will ignore the social and environmental problems outside their nations in order to defend their own wealth. The international collaboration and funding that has been critical for NGOs in countries that are not economically wealthy are likely to be severely compromised. The funds required to make any kind of significant change on the ''outside'' will become even more difficult, since societal chaos will be greater. But when complete catastrophic breakdown on the ''outside'' threatens to overwhelm those inside the barriers, it is likely they will provide multilateral and bilateral funds to help address the widespread hunger, disease, and environmental problems that threaten their security. If foundation endowments are not adversely effected under Order from Strength,

foundations might increase NGO support when they see a decrease in bilateral and multilateral support.

The fortunes of communities and NGOs are most difficult to assess in the Global Orchestration scenario. The international coordination efforts are likely to be structured to provide for avenues of input for civil society. However, the degree to which environmental problems are seen as priorities is lower, so the results may be mixed. Global Orchestration could include greater international awareness of global environmental problems and result in more grants and other financial support for social and environmental NGOs and communities in poor nations. At the same time, it also describes the high risk of adverse impacts from climate change and little opportunity for NGOs and communities to foresee and prevent the thresholds at which further ecosystem degradation and reductions in human well-being might occur.

The many adverse outcomes envisioned for ecosystem services and human well-being under Global Orchestration and the other scenarios indicate that long-term sustainability will not result from policies that only address economic and social issues and that only focus on global scales. Current and future policies from local to global levels reflect complex relationships and interactions between governments, industry, NGOs, and, increasingly, civil society. By working together, all these actors might be able to create a world that integrates the best aspects of the various scenarios: a world that acknowledges the importance of natural and human capital and the fact that loss of some natural capital is completely irreversible, that uses adaptation and learning, and that fosters innovation in technology and institutions.

All the scenarios point to the importance of NGOs and communities obtaining an understanding of the policies that affect ecosystems and human health and then finding ways to interact with the decision-makers who bring about change. NGOs and communities can help to create policies and practices that:

- adapt to deal with uncertain outcomes by allowing for learning from experience and by using enough precaution to avoid irreversible outcomes;
- are appropriate to the scale, region, and sector of society affected while also attending to cumulative impacts across scales;
- integrate multiple disciplines and examine trade-offs among both direct and indirect values of ecosystems;
- incorporate both quantitative science and perhaps more qualitative traditional and practitioner knowledge in the proposed solutions; and
- are based on principles of transparency, participation, equity, and attention to vulnerable groups.

The policy options that NGOs and communities can advocate in negotiations with international, national, and local governments include a primary focus on ways to reduce direct drivers of ecosystem change (such as policies to encourage the sustainable harvest of forests or marine resources, to reduce greenhouse gas emissions, or to create protected areas) or on ways to protect human well-being. Some policy options will do both, and others will involve trade-offs between short-term human needs and longer-term ecosystem services.

International NGOs can play an important role in helping local communities directly with conservation initiatives, particularly when national and local government is weak or does not give priority to conservation. It will be important, however, for NGOs to simultaneously help increase the capacity of those national governments to address conservation in an integrated way with other development objectives, in order to ensure that conservation investments are sustainable after NGO involvement ends.

The priority that international NGOs give as to which ecosystems, habitats, and species to conserve from a global perspective might not coincide with local communities' perspective on conservation priorities. The scenarios indicate the importance of strong local and national NGOs that are not just sub-offices implementing the missions of international NGOs. Worldviews and values are different among NGOs at different scales, and the policy priorities of international NGOs are most often appropriate for global-scale concerns.

While bearing in mind the challenges, costs, and benefits of integrated responses outlined in Chapter 15 of the *Policy Responses* volume, vertical and horizontal integration of responses across sectors should be explored by partnerships among actors. Sustainable forest management is one example of an integrated response that attempts to conserve a number of different ecosystem services (biodiversity, hydrological processes, climate regulation, forest products, tourism, cultural values, and so on) while also improving human well-being. Sustainable forest management typically involves a wide range of actors, including local communities, NGOs, government, and the private sector. NGOs and communities can profit from the lessons of these management practices.

14.7 Implications for the Private Sector

14.7.1 Linkages and Stakes

This section documents the important yet often misunderstood nexus between ecosystem goods and services and the private sector. ''Private sector'' is used here in the broadest sense possible to include relevant private actors involved in commercial business activities in local, national or regional, and global settings, although the primary audience might be firms and industries involved in food and agriculture, biotechnology and pharmaceuticals, resource extraction (forestry, mining, fisheries, and so on), and energy (petroleum, natural gas, and so on), as well as sectors with high environmental impacts (such as basic industries like steel and chemicals) and high material or resource dependence (such as semiconductor and other high-technology products dependent on water and other resources). In many countries, publicly owned companies also operate in these sectors. They may be mandated to provide some public services. However, if they have commercial concerns, they are similar to those of private enterprises. Hence the key points

summarized in this section are largely relevant for public companies as well.

Greater synergy between ecology and private-sector interests centers on two interrelated issues: first, how and under what circumstances can business interests ''internalize'' the ''negative externalities'' of resource extraction, production, and consumption even when there are no legal or short-term business interests to do so? Second, how can feedback mechanisms be created between ecological concerns and business interests through which signals of positive/negative trends can be channeled back between the two sectors without formal governmental interventions that are often too late and inadequate to prevent permanent environmental damage? Two other important issues or questions and implications from the MA process for the private sector are worth noting:

- What are the impacts of environmental change on firms and industries dependent on ecosystem services (such as private timber, fishing, and agriculture businesses) as well as firms and sectors affected by changes in ecosystem functions (such as private petroleum or other companies with high GHG impacts)?
- What key business opportunities and constraints are likely to arise under different scenarios based on local resource conditions (such as water availability and quality), public governmental rules (such as international environmental conventions and local resource conventions), and private governance regimes (such as international nongovernmental mechanisms like the Global Reporting Initiative and ISO 14001)?

14.7.2 Implications of Change in Ecosystem Services

14.7.2.1 Implications of Indirect and Direct Drivers of Ecosystem Services Change

The scenarios portray that an increase in per capita income and material well-being is likely to lead to higher consumption of electricity and production of industrial products. Whereas richer countries are expected to maintain or expand their control of local and regional air pollution, the same is not expected in poorer regions. For many multinational business enterprises, the rise in per capita income and material well-being in the poorer world are likely to translate into new business opportunities. These will be balanced everywhere by declines in the quality of the environment in which to conduct business. Due to the increased influence of local communities and NGO participation in global environmental governance, there is likely to be greater pressure, particularly on highly visible brand-driven multinational corporations, to go beyond prevailing rules and regulations and to play more of a role in improving local environmental conditions.

14.7.2.2 Implications of Change in Ecosystem Functions

World total production of grains increases around 50% for all scenarios, with larger differences between scenarios for the poorer world regions. Some of the gains in agriculture will be achieved through expansion of agricultural land and at the expense of uncultivated natural land. One robust finding across all scenarios is that, up to 2050, 10–20% of current grassland and forestland will be lost, mainly due to the expansion of agriculture (and, secondarily, because of the expansion of cities and infrastructure). While ecological degradation is often portrayed as a conflict between ''public environmental interests'' and ''private business goals,'' different types of ''business conflicts'' are likely to emerge in the future. With tourism becoming the world's largest employer and an important economic factor in many poorer countries, native forestland and other natural resources will be increasingly perceived as ''vital business assets'' of many private companies.

Although gains are made in access to fresh water, the MA scenarios suggest a likely increase in the volume of polluted fresh water, particularly in poor countries. Moreover, the expansion of irrigated land (which contributes to the increased production of grains) leads to substantial increases in the volume of water consumed in arid regions of Africa and Asia. The availability of and access to clean water is likely to change the way private enterprises in the poor and rich worlds conduct business in the twenty-first century. For industries as different as agriculture and high technology (semiconductor plants require enormous amounts of water for chip production, for instance), water will increasingly be a factor in determining where, how, and with whom private enterprises conduct business.

14.7.2.3 Implications of Change in Biodiversity across Scenarios

Despite continued conservation efforts of the international community, biodiversity loss is occurring at an unprecedented rate. A number of important issues and questions arise for the private sector from the impact on biodiversity across the scenarios. First, what is the connection if any between biodiversity decline and economics or business intensity? If tropical Africa, which is not known as a rapidly growing economic corner of the globe, is the region that has lost the most vascular-plant species, what connection is there between biodiversity loss on one hand and business intensity on the other hand? Is it the case of just using the wrong type of economic and business model?

Second, if land use change is the dominant driver of biodiversity change (followed by changes in climate and nitrogen and sulfur deposition), how can private companies best facilitate the prevention of biodiversity decline? Even for private companies that are involved in the commercialization of biodiversity resources (such as pharmaceutical companies), it is not always clear what role they can play in these complex global ecological dilemmas.

Third, how can the private sector as a group better mobilize its efforts to prevent the continuing decline in the quality of freshwater species, which are estimated to be components of the most threatened ecosystems in the world? It is undoubtedly more difficult to mobilize business support for an issue like the protection of freshwater species, which is rarely regarded as a business priority of most firms and organizations.

14.7.3 Possible Response Strategies and Options for the Private Sector

Several near-term (~2010) and long-term (2030~50) private-sector response strategies and options can be identified for the four MA scenarios. (See also Table 14.17.)

14.7.3.1 Global Orchestration

Under the near-term Global Orchestration scenario, most firms and industrial sectors are likely to continue their business as usual strategies. Existing global policy frameworks like CBD and international organizations like the World Bank will remain the key institutional focal points for the private sector. The private sector will aim to manage its environment-related business risks through involvement in business and civil society forums like the Global Reporting Initiative and by giving nominal financial and organizational support to global ecological dilemmas like water and biodiversity loss. Certain business sectors like the financial and insurance industries may prove to be more proactive if the environmental management risk of lending to and insuring other businesses increases.

Table 14.17. Private-Sector Response Strategies and Options in MA Scenarios

Scenario	Near Term (2010)	Long Term (2030–50)
Global Orchestration	continuing reliance on existing global civil society-business-NGO forums to address environmental concerns	"ineffectively" managed environmental multistakeholder forums may lead to greater reliance on more-exclusive private sector–oriented policy forums
Order From Strength	with increasing number of boycotts and protests of western business interests, increasingly difficult to resort to multistakeholder forums to address environmental policy concerns	multistakeholder forums and international organizations likely to be abandoned by developing countries as instruments to govern the global ecological commons
Adapting Mosaic	trends toward regionally based models of public-private partnerships and collaborative activities to address environmental management and policy concerns	greater use of and reliance on a regionally based corporate environmental management strategic framework
TechnoGarden	global environmental frameworks are likely to be accepted as part of a "normal" global corporate governance	even more than the Global Orchestration scenario, clean energy business sectors are likely to represent more-promising business opportunities

Under the long-term Global Orchestration scenario, the scope of private-sector involvement in environmental matters is likely to depend on the "success" of existing environmental policy and management frameworks. If the U.N. and international policy framework turns out to be ineffective or businesses perceive it as an inefficient way to manage environmental risks, the private sector may create a private, business-directed policy alternative (such as the World Economic Forum) with little to no accountability to civil society. Key global ecological dilemmas will continue to get nominal support from the private sector, but business firms will still view them as under the primary stewardship responsibility of U.N. and other international institutions.

Business–civil society forums in the Global Orchestration scenario may develop a much stronger role in global governance, but the development of these forums is likely to come at the expense of national governmental capacity and sovereignty as well as the ability of NGOs and community groups to influence policy design and development.

Clean-energy business sectors under Global Orchestration, including hydrogen, solar, wind, and small-scale hydropower, are likely to become major revenue streams for the private sector and may usher in a radical transformation of the global energy infrastructure and system. The likelihood of this trend may depend a great deal on the relative scarcity of and ongoing prices of petroleum and other fossil fuel products.

14.7.3.2 Order from Strength

Under Order from Strength, there will be increased conflict in the near term on strategies between firms and industries in rich countries and those in poorer ones as well as within the wealthy western block of countries (particularly between private actors in the United States versus Europe) on a wide range of issues including genetically modified food, climate change, and bio-intellectual property concerns. Whereas private firms and industries in wealthy countries will stress "efficiency" and "continued access," their counterparts in poorer nations (led by large emerging market countries like China, India, and Brazil), with support from their respective government and civil society actors, are likely to demand "equity" and improved "terms of trade."

Business-civil society forums and global business networks are likely to become even more dominated by business and NGO interests from rich countries, with corresponding declining interest and support from private and nongovernmental actors in poorer nations. International government-business-civil society forums like the Global Reporting Initiative and the U.N. Global Compact will be increasingly perceived as institutional tools under the control of western private enterprises and governments. North American and European multinational enterprises, particularly those from the extractive and consumer products industries, will be increasingly subject to a wide array of boycotts, protests, and civil actions from NGO and community groups in poorer nations.

In the long term, the conflicts in Order from Strength between private business interests in wealthier countries and those from the poorer world are likely to intensify to the

point that the work of the World Trade Organization and other global business and trade-setting bodies will be seriously impaired if not collapse altogether. Although the economies of poor countries are better integrated into the international political economy and more multinational corporations become ''local businesses'' in emerging markets, the recognition of mutual interests between multinational corporations and local businesses in those nations will be difficult to sustain in this scenario.

The serious deterioration and possible collapse of mutual interests between actors in the richer and poorer countries is likely to make it very difficult for different stakeholders to form much-needed partnerships and collaborative activities addressing sustainable ecosystem management. This situation will be further hampered by weakened global governance institutions that have traditionally helped ease tensions and broker collaborations between the public and private stakeholders in the two worlds. Highly visible multinational enterprises from North America and Europe are likely to be most negatively affected under this scenario.

14.7.3.3 Adapting Mosaic

In the near-term Adapting Mosaic scenario (as in TechnoGarden), there is likely to be great symmetry between the interests of the private sector, governments, and civil society actors in governing global ecological commons. Unlike the TechnoGarden scenario, however, there will be less emphasis on global environmental frameworks like the Convention to Combat Desertification and more emphasis on regional environmental policy mechanisms.

With the locus of governance moving toward individual regions around the world, regional organizations such as the Asian Development Bank, the U.N. Economic and Social Commission for Asia and the Pacific, Asia-Pacific Economic Cooperation, and so on as opposed to global organizations are more likely to serve as partners for the private sector in addressing sustainable development concerns. One impact of this trend is likely to be greater reliance on regional partnerships and collaborative activities in addressing ecosystem management. A wetland conservation project in Indonesia might involve such a diverse set of stakeholders as a Filipino NGO, a Japanese company, and the Asian Development Bank. In addition, the growing importance of local communities as co-managers of ecosystems and local resources in this scenario can open up new opportunities for partnerships with businesses, be they local, national, or international enterprises. Nevertheless, business will also have to seek new alliances with local communities in order to open up new opportunities, which might not always be an easy task.

Over the longer term, the threat of a global backlash to multinational corporations is lower under Adapting Mosaic due to the greater emphasis on a regional approach to environmental governance. At the same time, the likelihood of policy fragmentation, particularly in the way the private sector manages global environmental dilemmas like climate change, water, and biodiversity loss, is likely to increase. An important impact of Adapting Mosaic on the environmental strategy of the private sector might be greater reliance on and use of a regionally based corporate environmental strategic framework. A number of companies in Asia, North America, and Europe already use a regional environmental management framework, and under Adapting Mosaic this approach will probably become the environmental strategy of choice for many private enterprises, particularly for large multinational corporations.

14.7.3.4 TechnoGarden

In this scenario, there will be great symmetry in the near term between the interests of the private sector, governments, and civil society in governing the global ecological commons. Global environmental frameworks like the Convention on Biological Diversity and the Ramsar Convention are likely to be accepted as a normal part of doing business on a global scale and integrated into existing business regulatory frameworks like the ISO series. Even countries that are opposed to international environmental regimes will be pressured by companies in their own countries to accept prevailing global environmental norms.

Nongovernmental business policy forums and environmental business networks will grow in importance in terms of policy salience, especially those that have a strong technological component. Private-sector enterprises in the clean energy and technology sectors should benefit commercially from recognition of the economic value of ecosystem services and the mainstreaming of environmental technologies. Companies in the fossil fuel and carbon-intensive industries will be under growing pressure to reposition themselves and will possibly be forced to sell certain businesses (such as coal and certain carbon-intensive extractive sectors).

Over the long term, the proactive policies of TechnoGarden resulting from the recognition of the economic value of ecosystem services may be undermined if the bulk of the ''perceived'' benefits of these policies go to multinational corporations in wealthier countries at the expense of local businesses in poorer ones. There might also be increased global tensions if governments and private firms in North America and Europe block poor-country access to innovative green technologies due to intellectual property concerns. The type of criticism that is now leveled against western pharmaceutical companies for their role in posing barriers to AIDS medicine distribution in Africa may in the future extend to multinational companies involved in the research and development of green technologies.

A green technology fund similar to the model of establishing a global fund to finance the phaseout of ozone-depleting substances and to combat AIDS in the developing world may be established by private and public stakeholders to finance and disseminate cost-effective environmental technology systems to local communities in the poorer countries. Even more than in the Global Orchestration scenario, clean energy business sectors including hydrogen, solar, wind, and small-scale hydropower are likely to represent promising business opportunity in TechnoGarden, and the building blocks to establish a cleaner global energy infrastructure and system are likely to be established.

Table 14.18 summarizes the primary stresses and selected response options for the private sector under the four MA scenarios.

Table 14.18. Private-Sector Primary Stresses and Selected Response Options in MA Scenarios. All values are estimates of relative comparison among scenarios. Many responses apply to more than one stressor.

Stresses and Responses	GO	OS	AM	TG
Ecosystem stress—climate change	●●●●	●●●●●	●●●●	●●●
Reduce emissions of greenhouse gases	✻✻		✻✻	✻✻✻✻
Invest in clean energy and technologies	✻✻✻	✻	✻✻✻	✻✻✻✻
Ecosystem stress—food and land use	●●●	●●●●	●●●	●●
Reduce consumption of forestry and other ecological assets	✻✻	✻	✻✻✻	✻✻✻
Develop green labeling and purchasing policies	✻✻✻	✻	✻✻✻	✻✻✻✻
Ecosystem stress—water	●●●●	●●●●●	●●●	●●●
Reduce consumption of water	✻		✻✻	✻✻
Establish market-based pricing system	✻✻	✻	✻✻	✻✻✻
Ecosystem stress—biodiversity loss	●●	●●●●	●●	●●
Reduce economic activities around ecologically sensitive areas	✻✻		✻✻	✻✻✻
Invest in ecotourism, sustainable agriculture, and other forms of conservation enterprises	✻✻✻	✻✻	✻✻✻	✻✻✻✻✻

Key: GO = Global Orchestration; OS = Order from Strength; AM = Adapting Mosaic; TG = TechnoGarden

D = developing countries; 1 = higher-income countries

Stresses: 5 ● = severe stress, 0 ● = no worse than 2004

Responses: 5 ✻ = success likely, 0 ✻ = unfeasible/ineffective

14.8 Synthesis

The MA scenarios contain a huge amount of information about the possible directions of socioeconomic and environmental developments over the next few decades, including the direct and indirect driving forces of ecosystem changes. Model-based assessments and verbal scenario studies explore their implications for the condition and services of ecosystems in large world regions over time as well as the repercussions of ecosystem changes on human well-being. This chapter organizes this rich information base according to the explicitly declared or implicitly pursued interests, values, and mandates of selected key social groups and international organizations. The chapter's sections identify emerging ecosystems-related stresses, risks, and opportunities and provide assessments of conceivable response options to manage those threats in the contexts of the four MA scenarios for each stakeholder group.

Given the diversity of interests and mandates of the stakeholders on the one hand and the availability and prospective effectiveness of their response options on the other hand, the four futures hold rather different threats and reaction opportunities. Yet a meaningful attempt to synthesize the main insights for the global society as a whole needs to incorporate the scenario outcomes.

A comparative evaluation of the scenarios based purely on the nature and magnitude of ecosystem-related stresses would be inadequate. It is not only the threats and opportunities that count but also the capacity of the affected stakeholders to manage the risks and seize the opportunities. A seemingly minor ecosystem change might have grave implications if the affected stakeholders lack effective measures to cope with it, including the financial or other incapacity of implementing conceivable mitigation measures.

Although the implications of the MA scenarios for national governments constitute an important part of this chapter, governments are not included in the ranking of risks and response options of the four futures. There are two main reasons. The first is the multifaceted interests and responsibilities of governments in regulating how societies affect ecosystems and make use of their services. This encompasses an immense diversity of conceivable interventions, of which, however, the appropriateness of one or another depends on many societal and biophysical factors. But the main reason for not preparing a ranking for governments is that in the prevailing political structures governments have the largest potential to influence the driving forces that determine how the future will unfold. This means governments can best shape which of the four archetypes depicted in the MA scenarios will dominate the future of the global society. Accordingly, governments have the primary responsibility to foreclose unfavorable directions and to usher their nations toward sustainable development.

None of the scenarios can be singled out as the most desirable future. Each scenario has several positive and negative characteristics because each entails different combinations of relatively smaller or larger ecosystems stresses and more or less stakeholder capacity to cope with the emerging risks. Unfortunately, it is not possible to handpick a combination of drivers and ecosystems management strategies to achieve what might appear to be the best selection of features across scenarios because of the need to make socioeconomic choices among mutually exclusive options and the biophysical trade-offs among ecosystems functions and services. Chapter 12 provides ample evidence of the latter. Thus, not even the most brilliant and committed policymakers operating in a highly cooperative international community could achieve such dreamworld futures.

The cornerstone of masterly policy-making is finding the best compromises among conflicting objectives, making the appropriate interventions to achieve them, and doing regular reassessments of policies against anticipated and unanticipated outcomes. Our hope is that the MA scenarios in general and this chapter in particular provide useful insights for public policy-makers and private stakeholders to make informed choices and choose the appropriate measures now and as the future unfolds.

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