

ECOSYSTEMS AND HUMAN WELL-BEING

VOLUME 3

POLICY RESPONSES



Findings of the Responses Working Group

MILLENNIUM ECOSYSTEM ASSESSMENT

Ecosystems and Human Well-being: Policy Responses, Volume 3

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Findings of the Responses Working Group
of the Millennium Ecosystem Assessment



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Millennium Ecosystem Assessment: Objectives, Focus, and Approach

The Millennium Ecosystem Assessment was carried out between 2001 and 2005 to assess the consequences of ecosystem change for human well-being and to establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being. The MA responds to government requests for information received through four international conventions—the Convention on Biological Diversity, the United Nations Convention to Combat Desertification, the Ramsar Convention on Wetlands, and the Convention on Migratory Species—and is designed also to meet needs of other stakeholders, including the business community, the health sector, nongovernmental organizations, and indigenous peoples. The sub-global assessments also aimed to meet the needs of users in the regions where they were undertaken.

The assessment focuses on the linkages between ecosystems and human well-being and, in particular, on “ecosystem services.” An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. The MA deals with the full range of ecosystems—from those relatively undisturbed, such as natural forests, to landscapes with mixed patterns of human use and to ecosystems intensively managed and modified by humans, such as agricultural land and urban areas. Ecosystem services are the benefits people obtain from ecosystems. These include *provisioning services* such as food, water, timber, and fiber; *regulating services* that affect climate, floods, disease, wastes, and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and *supporting services* such as soil formation, photosynthesis, and nutrient cycling. The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services.

The MA examines how changes in ecosystem services influence human well-being. Human well-being is assumed to have multiple constituents, including the *basic material for a good life*, such as secure and adequate livelihoods, enough food at all times, shelter, clothing, and access to goods; *health*, including feeling well and having a healthy physical environment, such as clean air and access to clean water; *good social relations*, including social cohesion, mutual respect, and the ability to help others and provide for children; *security*, including secure access to natural and other resources, personal safety, and security from natural and human-made disasters; and *freedom of choice and action*, including the opportunity to achieve what an individual values doing and being. Freedom of choice and action is influenced by other constituents of well-being (as well as by other factors, notably education) and is also a precondition for achieving other components of well-being, particularly with respect to equity and fairness.

The conceptual framework for the MA posits that people are integral parts of ecosystems and that a dynamic interaction exists between them and other parts of ecosystems, with the changing human condition driving, both directly

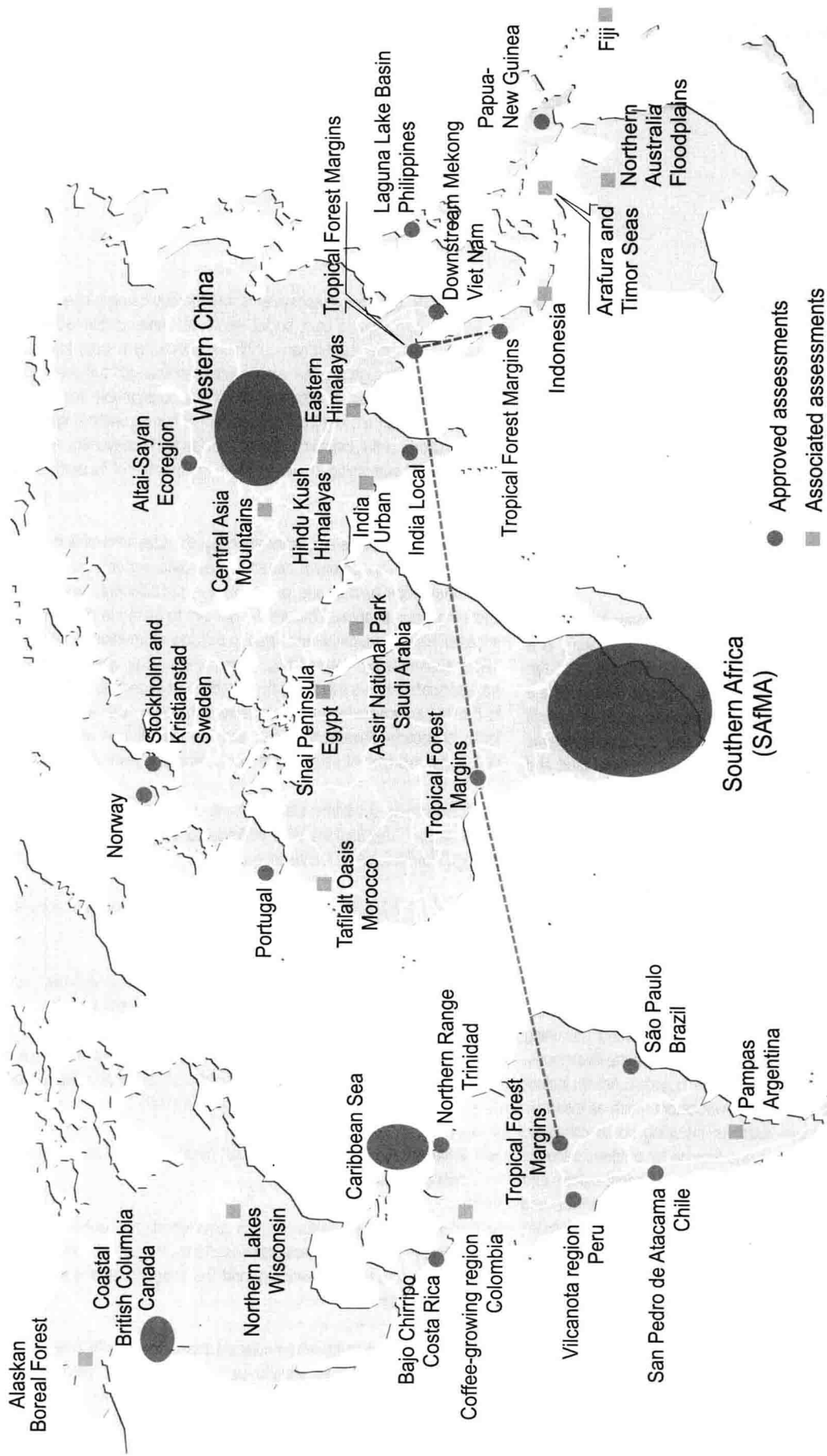
and indirectly, changes in ecosystems and thereby causing changes in human well-being. At the same time, social, economic, and cultural factors unrelated to ecosystems alter the human condition, and many natural forces influence ecosystems. Although the MA emphasizes the linkages between ecosystems and human well-being, it recognizes that the actions people take that influence ecosystems result not just from concern about human well-being but also from considerations of the intrinsic value of species and ecosystems. Intrinsic value is the value of something in and for itself, irrespective of its utility for someone else.

The Millennium Ecosystem Assessment synthesizes information from the scientific literature and relevant peer-reviewed datasets and models. It incorporates knowledge held by the private sector, practitioners, local communities, and indigenous peoples. The MA did not aim to generate new primary knowledge but instead sought to add value to existing information by collating, evaluating, summarizing, interpreting, and communicating it in a useful form. Assessments like this one apply the judgment of experts to existing knowledge to provide scientifically credible answers to policy-relevant questions. The focus on policy-relevant questions and the explicit use of expert judgment distinguish this type of assessment from a scientific review.

Five overarching questions, along with more detailed lists of user needs developed through discussions with stakeholders or provided by governments through international conventions, guided the issues that were assessed:

- What are the current condition and trends of ecosystems, ecosystem services, and human well-being?
- What are plausible future changes in ecosystems and their ecosystem services and the consequent changes in human well-being?
- What can be done to enhance well-being and conserve ecosystems? What are the strengths and weaknesses of response options that can be considered to realize or avoid specific futures?
- What are the key uncertainties that hinder effective decision-making concerning ecosystems?
- What tools and methodologies developed and used in the MA can strengthen capacity to assess ecosystems, the services they provide, their impacts on human well-being, and the strengths and weaknesses of response options?

The MA was conducted as a multiscale assessment, with interlinked assessments undertaken at local, watershed, national, regional, and global scales. A global ecosystem assessment cannot easily meet all the needs of decision-makers at national and sub-national scales because the management of any



Trade, poverty, and environment: sites in Chile, China, India, Madagascar, Mexico, South Africa, and Viet Nam

Eighteen assessments were approved as components of the MA. Any institution or country was able to undertake an assessment as part of the MA if it agreed to use the MA conceptual framework, to centrally involve the intended users as stakeholders and partners, and to meet a set of procedural requirements related to peer review, metadata, transparency, and intellectual property rights. The MA assessments were largely self-funded, although planning grants and some core grants were provided to support some assessments. The MA also drew on information from 16 other sub-global assessments affiliated with the MA that met a subset of these criteria or were at earlier stages in development.

ECOSYSTEM SERVICES

ECOSYSTEM TYPES

SUB-GLOBAL ASSESSMENT

	COASTAL	CULTIVATED	DRYLAND	FOREST	INLAND WATER	ISLAND	MARINE	MOUNTAIN	POLAR	URBAN	FOOD	WATER	FUEL and ENERGY	BIODIVERSITY- RELATED	CARBON SEQUESTRATION	FIBER and TIMBER	RUNOFF REGULATION	CULTURAL SPIRITUAL AMENITY	OTHERS
Altai-Sayan Ecoregion			•	•	•			•			•		•	•		•		•	
San Pedro de Atacama, Chile			•		•						•	•		•			•	•	•
Caribbean Sea	•					•	•				•	•		•				•	
Coastal British Columbia, Canada	•			•	•			•			•			•		•	•		
Bajo Chirripo, Costa Rica		•		•	•						•	•		•		•		•	•
Tropical Forest Margins		•		•							•	•		•	•	•	•	•	•
India Local Villages		•		•	•						•	•	•	•		•	•	•	•
Glomma Basin, Norway		•		•	•			•			•		•			•		•	•
Papua New Guinea	•	•				•	•				•	•	•	•		•	•	•	•
Vilcanota, Peru		•	•					•			•	•		•			•	•	•
Laguna Lake Basin, Philippines		•		•	•						•	•		•	•			•	•
Portugal	•	•	•	•	•	•	•	•		•	•	•		•	•	•	•	•	•
São Paulo Green Belt, Brazil	•	•		•	•					•	•	•		•	•	•	•	•	•
Southern Africa	•	•	•	•	•					•	•	•	•	•		•		•	•
Stockholm and Kristianstad, Sweden		•			•					•	•	•		•	•	•	•	•	•
Northern Range, Trinidad	•			•	•			•			•	•		•		•	•	•	•
Downstream Mekong Wetlands, Viet Nam	•	•		•							•	•	•	•	•	•	•	•	•
Western China		•	•	•	•			•			•	•		•	•		•	•	•
Alaskan Boreal Forest				•	•						•					•		•	•
Arafura and Timor Seas	•					•	•				•			•	•				•
Argentine Pampas		•									•	•						•	•
Central Asia Mountains								•			•	•		•					•
Colombia coffee-growing regions		•						•			•	•		•				•	
Eastern Himalayas				•				•			•	•	•	•				•	•
Sinai Peninsula, Egypt			•					•						•			•	•	•
Fiji	•					•					•	•	•					•	•
Hindu Kush-Himalayas					•			•			•	•		•			•	•	•
Indonesia	•					•	•				•			•				•	•
India Urban Resource									•		•	•	•	•	•			•	•
Tafilaft Oasis, Morocco		•	•								•	•						•	•
Northern Australia Floodplains					•						•	•		•			•	•	•
Assir National Park, Saudi Arabia		•		•				•			•						•	•	•
Northern Highlands Lake District, Wisconsin				•	•							•				•	•	•	•

particular ecosystem must be tailored to the particular characteristics of that ecosystem and to the demands placed on it. However, an assessment focused only on a particular ecosystem or particular nation is insufficient because some processes are global and because local goods, services, matter, and energy are often transferred across regions. Each of the component assessments was guided by the MA conceptual framework and benefited from the presence of assessments undertaken at larger and smaller scales. The sub-global assessments were not intended to serve as representative samples of all ecosystems; rather, they were to meet the needs of decision-makers at the scales at which they were undertaken. The sub-global assessments involved in the MA process are shown in the Figure and the ecosystems and ecosystem services examined in these assessments are shown in the Table.

The work of the MA was conducted through four working groups, each of which prepared a report of its findings. At the global scale, the Condition and Trends Working Group assessed the state of knowledge on ecosystems, drivers of ecosystem change, ecosystem services, and associated human well-being around the year 2000. The assessment aimed to be comprehensive with regard to ecosystem services, but its coverage is not exhaustive. The Scenarios Working Group considered the possible evolution of ecosystem services during the twenty-first century by developing four global scenarios exploring plausible future changes in drivers, ecosystems, ecosystem services, and human well-being. The Responses Working Group examined the strengths and weaknesses of various response options that have been used to manage ecosystem services and identified promising opportunities for improving human well-being while conserving ecosystems. The report of the Sub-global Assessments Working Group contains lessons learned from the MA sub-global assessments. The first product of the MA—*Ecosystems and Human Well-being: A Framework for Assessment*, published in 2003—outlined the focus, conceptual basis, and methods used in the MA. The executive summary of this publication appears as Chapter 1 of this volume.

Approximately 1,360 experts from 95 countries were involved as authors of the assessment reports, as participants in the sub-global assessments, or as members of the Board of Review Editors. The latter group, which involved 80 experts, oversaw the scientific review of the MA reports by governments and experts and ensured that all review comments were appropriately addressed by the authors. All MA findings underwent two rounds of expert and governmental review. Review comments were received from approximately 850 individuals (of which roughly 250 were submitted by authors of other chapters in the MA), although in a number of cases (particularly in the case of governments and MA-affiliated scientific organizations), people submitted collated comments that had been prepared by a number of reviewers in their governments or institutions.

The MA was guided by a Board that included representatives of five international conventions, five U.N. agencies, international scientific organizations, governments, and leaders from the private sector, nongovernmental organizations, and indigenous groups. A 15-member Assessment Panel of leading social and natural scientists oversaw the technical work of the assessment, supported by a secretariat with offices in Europe, North America, South America, Asia, and Africa and coordinated by the United Nations Environment Programme.

The MA is intended to be used:

- to identify priorities for action;
- as a benchmark for future assessments;
- as a framework and source of tools for assessment, planning, and management;
- to gain foresight concerning the consequences of decisions affecting ecosystems;
- to identify response options to achieve human development and sustainability goals;
- to help build individual and institutional capacity to undertake integrated ecosystem assessments and act on the findings; and
- to guide future research.

Because of the broad scope of the MA and the complexity of the interactions between social and natural systems, it proved to be difficult to provide definitive information for some of the issues addressed in the MA. Relatively few ecosystem services have been the focus of research and monitoring and, as a consequence, research findings and data are often inadequate for a detailed global assessment. Moreover, the data and information that are available are generally related to either the characteristics of the ecological system or the characteristics of the social system, not to the all-important interactions between these systems. Finally, the scientific and assessment tools and models available to undertake a cross-scale integrated assessment and to project future changes in ecosystem services are only now being developed. Despite these challenges, the MA was able to provide considerable information relevant to most of the focal questions. And by identifying gaps in data and information that prevent policy-relevant questions from being answered, the assessment can help to guide research and monitoring that may allow those questions to be answered in future assessments.

Foreword

The Millennium Ecosystem Assessment was called for by United Nations Secretary-General Kofi Annan in 2000 in his report to the UN General Assembly, *We the Peoples: The Role of the United Nations in the 21st Century*. Governments subsequently supported the establishment of the assessment through decisions taken by three international conventions, and the MA was initiated in 2001. The MA was conducted under the auspices of the United Nations, with the secretariat coordinated by the United Nations Environment Programme, and it was governed by a multistakeholder board that included representatives of international institutions, governments, business, NGOs, and indigenous peoples. The objective of the MA was to assess the consequences of ecosystem change for human well-being and to establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being.

This volume has been produced by the MA Responses Working Group and examines the strengths and weaknesses of various response options that have been used to manage ecosystem services, as well as identifying promising opportunities for improving human well-being while conserving ecosystems. The material in this report has undergone two extensive rounds of peer review by experts and governments, overseen by an independent Board of Review Editors.

This is one of four volumes (*Current State and Trends*, *Scenarios*, *Policy Responses*, and *Multiscale Assessments*) that present the technical findings of the Assessment. Six synthesis reports have also been published: one for a general audience and others focused on issues of biodiversity, wetlands and water, desertification, health, and business and ecosystems. These synthesis reports were prepared for decision-makers in these different sectors, and they synthesize and integrate findings from across all of the working groups for ease of use by those audiences.

This report and the other three technical volumes provide a unique foundation of knowledge concerning human dependence on ecosystems as we enter the twenty-first century. Never before has such a holistic assessment been conducted that addresses multiple environmental changes, multiple drivers, and multiple linkages to human well-being. Collectively, these reports reveal both the extraordinary success that humanity has achieved in shaping ecosystems to meet the need of growing populations and econo-

mies and the growing costs associated with many of these changes. They show us that these costs could grow substantially in the future, but also that there are actions within reach that could dramatically enhance both human well-being and the conservation of ecosystems.

A more exhaustive set of acknowledgements appears later in this volume but we want to express our gratitude to the members of the MA Board, Board Alternates, Exploratory Steering Committee, Assessment Panel, Coordinating Lead Authors, Lead Authors, Contributing Authors, Board of Review Editors, and Expert Reviewers for their extraordinary contributions to this process. (The list of reviewers is available at www.MAweb.org.) We also would like to thank the MA Secretariat and in particular the staff of the Responses Working Group Technical Support Unit for their dedication in coordinating the production of this volume, as well as the Institute of Economic Growth (India) and the National Institute of Public Health and the Environment (Netherlands), which housed this TSU.

We would particularly like to thank the Co-chairs of the Responses Working Group, Kanchan Chopra and Rik Leemans, and the TSU Coordinators, Pushpam Kumar and Henk Simons, for their skillful leadership of this working group and their contributions to the overall assessment.



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Preface

The focus of the MA is on ecosystem services (the benefits people obtain from ecosystems), how changes in ecosystem services have affected human well-being in the past, and what role these changes could play in the present as well as in the future. The MA is an assessment of responses that are available to improve ecosystem management and can thereby contribute to the various constituents of human well-being. The specific issues addressed have been defined through consultation with the MA users. Broadly, the MA applies an integrated systems' approach to evaluate trade-offs involved in following alternate strategies and courses of action to use ecosystem services for enhancing human welfare.

The overall aims of the MA are to:

- identify priorities for action;
- provide tools for planning and management;
- provide foresight concerning the consequences of decisions affecting ecosystems;
- identify response options to achieve human development and sustainability goals; and
- help build individual and institutional capacity to undertake integrated ecosystem assessments and to act on their findings.

The MA synthesizes information from scientific literature, data sets, and scientific models, and utilizes knowledge held by the private sector, practitioners, local communities, and indigenous peoples. All of the MA findings have undergone two rounds of expert and governmental review.

This report of the MA Responses Working Group evaluates the current understanding of how human decisions and policies influence ecosystems, ecosystem services, and consequently, human well-being. The assessment identifies and critically evaluates past, current, and possible future policy and management options for maintaining ecosystems (including biodiversity) and sustaining the flow of ecosystem services. The Responses Working Group is one of four MA working groups, each of which has contributed an assessment report. The Condition and Trends Working Group reviewed the state of knowledge on ecosystems, ecosystem services, and associated human well-being in the present, recent past, and near future. The Scenarios Working Group considered the evolution of ecosystem services during the first half of the twenty-first century under a range of plausible narratives. The Sub-global Working Group carried out assessments at different levels to directly meet needs of local and regional decision-makers and strengthen the global findings with finer-scale detail. Together, the working group reports provide local, national, regional, and global perspectives and information.

In the MA, responses are defined as the whole range of human actions, including policies, strategies, and interventions, to address specific issues, needs, opportunities, or problems. A response typically involves a "reaction to a perceived problem." It can be individual or collective; it may be designed to answer one or many needs; or it could be focused at different temporal, spatial, or organizational scales. In the context of managing ecosystems or ecosystem services, responses may be of legal, technical, institutional,

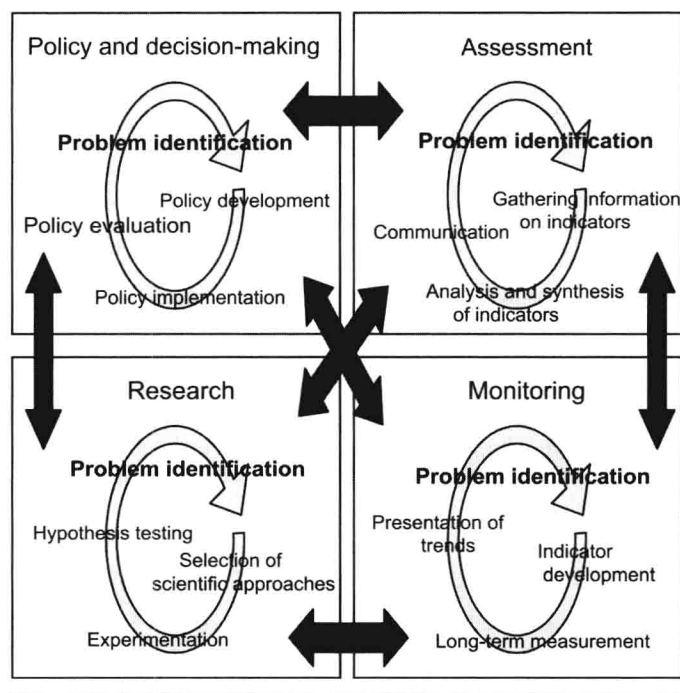
economic, or behavioral nature and may operate at local/micro, regional, national, or international level at the time scale of days to hundred of years. The assessment focuses on responses that are intended to ensure that ecosystems and biodiversity are preserved, that desired ecosystem services accrue, and that human well-being is augmented. This is one of the major objectives of all conventions targeted by the MA, the Millennium Development Goals, and others.

Focus of the Responses Assessment Report

The Responses assessment report is rooted in the MA conceptual framework, which provides an understanding of the causes and consequences of changes in ecosystems across scales (local, regional, and global) and over time (MA 2003; see also Chapter 1 of this volume). *Ecosystems, ecosystem services, human well-being, and direct and indirect drivers initiating the links among them constitute the main elements of the MA conceptual framework.* (See Chapter 1 for definitions of these concepts.) Human responses are outcomes of human decisions and they influence and change the key connecting links between these elements. They determine how individuals, communities, nations, and international agencies intervene or strategize, ostensibly in their own interests, to use, manage, and conserve ecosystems. There are many ways to categorize responses, which are often determined by the problem at hand, the decision-maker/actor associated with, or the tradition of, the discipline.

The organizational scales of responses can be international (for instance, the U.N. conventions), multilateral and bilateral (important for transboundary problems), national, state/provincial, community (urban or rural), family, or individual. Decisions taken at each of these levels can affect ecosystems and ecosystem services. For example, national policies initiated to comply with international trade treaties can impact local ecosystems. The assessment methodology developed by the Responses Working Group is comprehensive enough to be used to assess responses at all scales, as and when they are relevant to the context of the particular ecosystem service being studied. The Responses assessment consists of a three-stage approach. The first stage focuses on factors that may either rule out a particular response or may define the critical preconditions for its success. Constraints that render a policy option infeasible are called the *binding constraints*, which are context specific. In the second stage, responses are compared across multiple dimensions, identifying compatibility or conflict between different policy objectives. Here the acceptable costs associated with the implementation of a response (the *acceptable trade-offs*) are identified. Finally, responses are evaluated from different perspectives in order to provide guidance that is the best balanced from the point of view of decision-making as shown in the illustration below:

As shown in the illustration, research, assessment, monitoring, and policy-making are all components of a continuing interactive



process to support development and implementation of responses. Decision-making starts by identifying a problem, followed by collating the research findings to help in defining and choosing policy options. (See Chapter 18 of this volume.) Policies are selected, implemented, and then evaluated for their effectiveness. The process is iterative and involves interaction with all kinds of information providers. Ideally, the decision-making cycle entails obtaining feedback from all categories of stakeholders. Similar loops exist for the research, monitoring, and assessment process, each with its characteristic objectives, approaches, and dynamics. Under the best circumstances, research insights should yield adequate monitoring networks and indicators of change, to be taken up for assessment toward an informed decision process. Understandably, the dynamics and timing of each of these cycles do not always evolve in perfect coordination with each other. The dynamic nature of information exchange and feedback to and from these processes and their stakeholders are integral to developing responses.

This implies that decision-making processes are liable to change over time to improve effectiveness. A number of mechanisms can facilitate this. Ecosystem dynamics will never be completely understood, socioeconomic systems will continue to change, and drivers can never be fully anticipated. It is important therefore that decision-making processes incorporate, wherever possible, procedures to evaluate outcomes of actions and assimilate lessons learned from experience. Debate on exactly how to go about doing this continues in discussions on adaptive management, social learning, safe minimum standards, and the precautionary principle. But the core message of all approaches is the same: acknowledge the limits of human understanding, give special consideration to irreversible changes, and evaluate the multiple impacts of decisions as they unfold.

Organization of this Volume

This assessment report has a large canvas to cover. Various response options are selected on the basis of the impact they have on a set of ecosystems and ecosystem services. The report exam-

ines these different societal responses and evaluates them by using diverse methodologies. The results are analyzed from diverse perspectives to draw key conclusions regarding their impact on human well-being.

To facilitate the analysis, this report is divided into three parts. Part I (that is, Chapters 1 through 4) introduces responses and focuses mainly on conceptual and methodological issues. Chapter 1 summarizes the MA conceptual framework and defines some important concepts. Chapter 2 discusses alternative typologies of possible responses. It differentiates responses by, actors, disciplines, drivers, and scales, and further characterizes them in terms of the instruments for intervention—such as economic, institutional, governance, and technological—thus highlighting the multi-dimensional nature of responses.

Chapter 3 elaborates on alternate methods of assessing responses. It sets up a framework that can be used to evaluate whether particular responses are effective and desirable from social, political, and economic perspectives. It indicates how social, political, and economic factors and their actors can act as constraints to the ability of responses or strategies to meet intended goals and avoid unintended consequences.

Chapter 4 highlights specific decision-making criteria in the above context. It also focuses on the role of uncertainty in assessing the effectiveness of responses. This uncertainty is partly a function of the methodology and tools applied but also an inherent characteristic of decision-making that is always a leap into the future.

Part II consists of ten chapters (5 through 14), each focusing on one or more ecosystem service. These chapters relate specific case studies from the literature and the sub-global assessments to the response typology and evaluation methodology outlined in Part I. Chapter 5 focuses on responses concerning biodiversity, which underlies all other ecosystem services. This chapter has a strong spotlight on ecosystem management and conservation.

Chapters 6, 7, and 8 dwell on the provisioning ecosystem services. Different responses at all major decision-making levels, which alter ecosystems providing these services, are presented and assessed. Special emphasis is laid upon the trade-offs and synergies between specific responses and their consequences. Responses that contribute to the sustainable use of these ecosystems are highlighted. In a similar vein, Chapters 9 through 13 focus on regulating services, and Chapter 14 assesses cultural ecosystem services. These chapters correspond to chapters pertaining to ecosystem services presented by the Condition and Trends Working Group. Together, the ecosystem services chapters in this volume and in *MA Current State and Trends* provide a complete overview of the current understanding of where, how, and why ecosystem services are changing; in what way the selected responses are having an impact on drivers, ecosystems, ecosystem services; and the different constituent parts of human well-being.

Taking an ecosystem service approach proved difficult for some of the chapters in Part II. For instance, few responses focus directly on managing ecosystems services toward climate regulation or waste management. Additionally, there has been no or little experience in treating the topics in some chapters (for example, waste management and climate regulations) as ecosystem services. Adhering too strongly to an ecosystem services approach could, in some cases, lead to too narrow a focus while the user audiences expect a broader treatment. This became apparent after the first review. We have therefore permitted a more user-oriented treatment of certain ecosystem services to allow for more comprehensive discussions of responses related to areas such as climate regulation, waste management, and disease control.

Chapter 15 deals with responses that address (provision of) ecosystem services across a number of systems simultaneously, explicitly including objectives to enhance human well-being. Such integrated responses occurring across different scales could be oriented at different actors, generally employing a range of instruments for implementation. The assessment of sustainable management strategies and trade-offs between different responses is central here. The responses always integrate different aspects of ecosystems. Examples include integrated water, forest, or coastal management. Such responses may be at the international level in the form of framework conventions or at local levels in the form of concrete resource management projects. This chapter provides a comprehensive evaluation of such integrated responses.

Part III (Chapters 15 through 19) synthesizes the lessons learned from earlier chapters and provides an overarching evaluation of the interlinkages among drivers, ecosystems, ecosystem services, and ultimately, human well-being. Chapter 15 deals with responses that address (provision of) ecosystem services across a number of systems simultaneously, explicitly including objectives to enhance human well-being. Such integrated responses occurring across different scales could be oriented at different actors, generally employing a range of instruments for implementation. The assessment of sustainable management strategies and trade-offs between different responses is central here. The responses always integrate different aspects of ecosystems. Examples include integrated water, forest, or coastal management. Such responses may be at the international level in the form of framework conventions or at local levels in the form of concrete resource

management projects. This chapter provides a comprehensive evaluation of such integrated responses.

The other chapters within Part III take on a specific aspect of human welfare for analysis such as material and social security, health, freedoms, and choice. Chapter 16 takes a strong human health perspective, while Chapter 17 emphasizes poverty reduction. The central questions in these chapters are:

- How have responses that were aimed at protecting ecosystems and their services, impacted the different constituents and determinants of human well-being?
- Did policies initiated at national levels for promoting well-being have negative impacts on ecosystems or on the accrual of ecosystem services?

These two chapters thus strongly emphasize the trade-offs and synergies between different responses.

Chapter 18 provides general “guidelines” for choosing responses, assessing the required information and decision-tools by discussing the relative strengths and weaknesses of alternate sources of information. Chapter 19 evaluates the Millennium Development Goals from a responses perspective. Sustainable use of ecosystems and thereby accrual of ecosystem services for human well-being is central to these chapters as in all others.

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Reader's Guide

The four technical reports present the findings of each of the MA Working Groups: Condition and Trends, Scenarios, Responses, and Sub-global Assessments. A separate volume, *Our Human Planet*, presents the summaries of all four reports in order to offer a concise account of the technical reports for decision-makers. In addition, six synthesis reports were prepared for ease of use by specific audiences: Synthesis (general audience), CBD (biodiversity), UNCCD (desertification), Ramsar Convention (wetlands), business and industry, and the health sector. Each MA sub-global assessment will also produce additional reports to meet the needs of its own audiences.

All printed materials of the assessment, along with core data and a list of reviewers, are available at www.MAweb.org. In this volume, Appendix A contains color maps and figures. Appendix B lists all the authors who contributed to this volume. Appendix C lists the

acronyms and abbreviations used in this report and Appendix D is a glossary of terminology used in the technical reports. Throughout this report, dollar signs indicate U.S. dollars and ton means tonne (metric ton). Bracketed references within the Summary are to chapters within this volume.

In this report, the following words have been used where appropriate to indicate judgmental estimates of certainty, based on the collective judgment of the authors, using the observational evidence, modeling results, and theory that they have examined: very certain (98% or greater probability), high certainty (85–98% probability), medium certainty (65%–58% probability), low certainty (52–65% probability), and very uncertain (50–52% probability). In other instances, a qualitative scale to gauge the level of scientific understanding is used: well established, established but incomplete, competing explanations, and speculative. Each time these terms are used they appear in italics.

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Policy Responses, Volume 3*