



TOM TIETENBERG

ENVIRONMENTAL
AND NATURAL
RESOURCE
ECONOMICS

THIRD EDITION



Environmental and Natural Resource Economics

Third Edition

Tom Tietenberg
Colby College

To Florence M. and Harry H. Tietenberg,
who provided me with a healthy environment conducive to development.

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PREFACE

*Saving the planet is very much in vogue.
It's also in Harper's Bazaar, Elle, and Mademoiselle.*

THE NEW YORK TIMES (March 25, 1990)

When I began writing the first edition of this book in 1981, environmental and natural resource economics was a well-developed but underutilized field. Its impact on environmental policy could most generously be described as "emerging." That is no longer the case. Economics has become an indispensable part of the education of anyone dealing with environmental policy. As *Our Common Future* put it in 1987, "Economics and ecology bind us in ever-tightening networks . . . economics and ecology must be completely integrated in decision-making and lawmaking processes . . ."¹

Signs of maturation abound. A number of journals are now devoted either exclusively or mostly to the topics covered in this book. One, *Ecological Economics*, is a new journal dedicated to bringing economists and ecologists closer together in a common search for appropriate solutions for environmental challenges. Interested readers can also find advanced work in the field in *Land Economics*, *Journal of Environmental Economics and Management*, *Environmental and Resource Economics*, and *Natural Resources Journal*, among others.

New resources for student research projects have been made available in response to the growing popularity of the field. Original research on topics

1 The World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987): 27, 37.

related to international environmental and natural resource issues was formerly very difficult for students because of the paucity of data. A number of good sources now exist including *World Resources: 1990-91* (Washington, DC: Oxford University Press, 1989), which has an extensive data appendix, and *OECD Environmental Data* (Paris: Organization for Economic Co-operation and Development, 1989).

Environmental and Natural Resource Economics attempts to bring those who are beginning the study of environmental and natural resource economics close to the frontiers of knowledge. Although it is designed to be accessible to students who have completed only a two-semester introductory course in economics or a one-semester introductory microeconomics course, it has been successfully used in several institutions in lower-level and upper-level undergraduate courses as well as lower-level graduate courses. Intertemporal optimization is handled within a discrete-time, mathematical programming framework, and all mathematics other than simple algebra is relegated to appendixes. Graphs and numerical examples are used to provide an intuitive understanding of the principles suggested by the math and the reasons for their validity. In this edition I have tried to retain the strengths that seem particularly valued by users, while expanding the number of applications of economic principles, clarifying some of the more difficult arguments, and updating the material to include the very latest developments around the world.

The structure and topical coverage of this book facilitate its use in a variety of contexts. For a survey course in environmental and natural resource economics, all chapters are appropriate, though many of us have found that the book contains somewhat more material than can be covered adequately in a quarter or even a semester. This surplus of material provides some flexibility for the instructor to choose those topics that best fit his or her course design. A one-term course in natural resource economics could be based on Chapters One to Thirteen and Twenty-one to Twenty-three. A brief introduction to environmental economics could be added by including Chapter Fourteen. A single-term course in environmental economics could be structured around Chapters One to Four and Fourteen to Twenty. Chapter Six could be added if a brief introduction to natural economics seemed desirable.

New to This Edition

This edition has a much more international focus. Additional attention has been paid to environmental problems and policies in Eastern and Western Europe, Japan, and the developing nations than was the case in previous editions.

Two new chapters have been added—"Growth, Poverty, and the Environment" and "The Quest for Sustainable Development"—reflecting the demonstrated, current global interest in sustainable development as a guide for the future. These new chapters include the latest research on the appropriateness of the traditional model of development for low-income countries, the relationships

among trade policies, debt, poverty, and environmental degradation, and the role for economic incentives policies in achieving sustainable development. These chapters replace two chapters in the previous edition entitled "Growth in a Finite Environment" and "Further Economic Growth?" This edition also contains a completely new mathematical appendix entitled "The Simple Mathematics of Cost-Effective Pollution Control."

Ten new boxed examples highlight special topics, including (1) The Economics of Recycling: The Japanese Experience; (2) New Markets for Trash: Tires; (3) Using Economic Principles to Conserve Water in California; (4) Protecting Instream Uses of Water through Economics; (5) Success Stories in Conserving Tropical Forests; (6) Restricting Access to Common Property Resources: Harbor Gangs of Maine; (7) Geochemically Scarce Minerals: How Would the Economy React to Impending Scarcity?; (8) Innovative Mobile Pollution Control Strategies: Singapore and Hong Kong; (9) Anatomy of An Oil Spill: *Amoco Cadiz*; (10) Sustainable Development: Three Success Stories.

Several previously included topics have received considerably more attention in this edition, including the economics of recycling; the causes, consequences, and potential solutions for global deforestation; and economic incentive policies. The new material on economic incentive policies includes the actual experience with their use in France, Sweden, the Netherlands, and Japan; new applications in the United States (acid rain and ozone depletion) and potential applications to global warming and declining biodiversity.

New topics covered in this edition include oil spills and ocean dumping; the economics of limited liability for oil spills; the Gaia hypothesis; ethics of present value calculations for the allocation of depletable resources, including a new numerical example; informal arrangements for restricting access to common property resources; nuclear power around the world; new approaches by electric utilities to internalize environmental costs; the economics of renewable energy sources; the magnitude of subsidies for irrigation water; emerging water markets in the western United States; sustainable agriculture in the United States and Europe; economics of organic farming; debt-nature swaps; extractive reserves; policies for stemming decline of elephant populations; indoor air pollution; results from the National Acid Rain Precipitation Assessment Program; the London agreement on ozone depletion; citizen suits and the private enforcement of environmental laws; cost-benefit analysis of global warming; the cost effectiveness of alternative automobile fuels; joint and several liability doctrine for hazardous wastes; deficiencies of national income accounting from the point of view of sustainable development; examples of industrial waste reduction; strategies for preserving biodiversity; and the World Heritage Fund.

All data and references to governing legislation in the previous edition have been updated. Some completely new data have been included: global oil reserves, types of pricing systems used by U.S. public and private water utilities, global air quality comparisons, international comparison of gasoline taxes, noteworthy oil spills, and opportunities for enhanced energy efficiency.

This edition retains a strong policy orientation. Though a great deal of theory and empirical evidence are discussed, both are motivated by the desire to increase understanding of intriguing policy problems and are discussed in the context of those problems. This explicit integration of research and policy within each chapter avoids the problem frequently encountered in applied economics textbooks in which the theory developed in earlier chapters is only loosely connected to the rest of the book.

This is an economics book, but it goes beyond economics. Insights from the natural and physical sciences, literature and political science, as well as other disciplines, are scattered liberally through the text. In some cases these references raise unresolved issues that economic analysis can help resolve, while in others they affect the structure of the economic analysis or provide a contrasting point of view. They have an important role to play in overcoming the tendency to accept the material uncritically at a superficial level by highlighting those characteristics that make the economics approach unique.

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Perhaps the most rewarding part of writing this book has been that it has put me in touch with so many thoughtful people I had not previously met. I very much appreciate the faculty and students who pointed out areas of particular strength or areas where coverage could be expanded in this edition. The support that my approach has received from faculty and students has been gratifying and energizing. One can begin to understand the magnitude of my debt to my colleagues by glancing at the several hundred names in the lists of references contained in the name index. Because their research contributions make this an exciting field, full of insights worthy of being shared, my task was easier and a lot more fun than it might otherwise have been.

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Finally, I should like to say a deeply felt word of thanks to my family for putting up with a father and husband who spent time in writing that they deserved. I couldn't have done it without their support.

TOM TIETENBERG

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