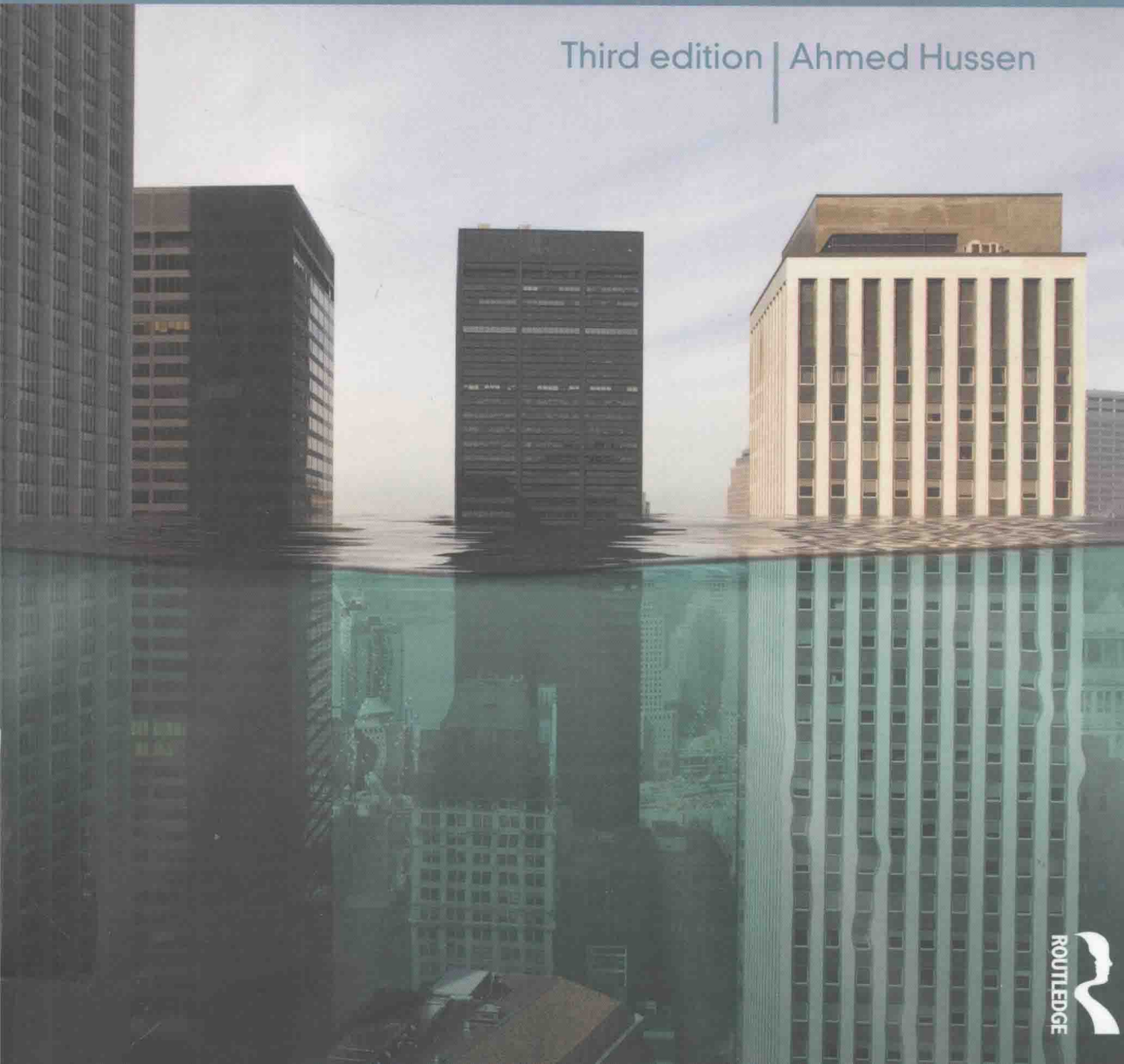


# Principles of Environmental Economics and Sustainability

An integrated economic and ecological approach

Third edition | Ahmed Hussen





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**Ahmed Hussen**

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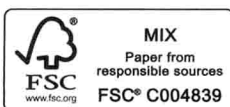
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# Principles of Environmental Economics and Sustainability

Recent years have witnessed considerable consolidation between the disciplines of environmental and ecological economics at research level, but until now textbooks in the area have done little to reflect this. Ahmed Hussien's book is to date the only one to reconcile the two standpoints.

The central focus of the book will continue to be on this systematic integration of both mainstream and ecological approaches to environmental economics, and an acknowledgement that enduring solutions to major contemporary environmental challenges can be obtained through studies based on a well-conceived and balanced interdisciplinary approach. However, this third edition also contains much that is new. Chiefly, brand new chapters appear covering the following topics:

- The economics of climate change
- The economics of biodiversity and ecosystem services
- 'Green' accounting and alternative economic and social indicators of sustainability
- The business case for environmental sustainability
- An Appendix that provides a brief historical account of the development of ecological economics

The result is a comprehensive introduction to the main facets of environmental and ecological economics—a text that boldly refuses to put up barriers between disciplines and takes a holistic approach to vital issues.

This student-friendly textbook contains a variety of study tools including learning points, boxed features, case studies, revision questions and discussion questions, and an Appendix that provides students with a review of basic economic principles relevant to the study of the environment and its management. Written in a clear and accessible style, this book will prove an excellent choice for introducing both students and academics to the world of environmental economics.

**Ahmed Hussien** is Professor of Economics at Kalamazoo College, Michigan, USA.



# Preface

The third edition of this textbook is motivated by the same objective as the two editions before it. It is written to present the economic and ecological principles essential for a clear understanding of complex contemporary environmental issues and policy considerations. However, the third edition introduces several additional features, including *four* new chapters. These new chapters cover the following topics: the economics of climate change; biodiversity conservation; alternative monetary and physical indicators of sustainability; and the business cases for sustainability. The title of the book is modified and adds the term ‘sustainability’ as part of the main heading. This is done to reflect the expanded and comprehensive coverage of environmental sustainability in this edition.

In addition, there is no chapter from the previous edition that has not been modified and updated, and the modifications made to six of the chapters (Chapters 2, 3, 6, 7, 11 and 12) have been extensive.

## ORGANIZATION

The book consists of *sixteen* chapters, which are grouped into *five* parts. What follows is a brief description of each part:

### Part I Environmental economics: perspectives

This part consists of the first three chapters. These chapters introduce students to fundamental economic, ecological and institutional concepts and theories that are essential for a course in environmental economics with an interdisciplinary perspective. Chapters 1 and 2 explore the economic and ecological perspectives on the relationship between the human economy and the natural environment. In Chapter 3, the economic, technological and ecological determinants of the waste absorptive capacity of the environment are explored. In addition, this chapter explains the basic economic and institutional factors essential in unraveling the root causes for market failure and its possible remedies. The three chapters in Part I attempt to cover all the *core* concepts and theories that will be repeatedly used throughout the rest of the book.

### Part II The economics of pollution control and environmental valuation

This part consists of *five* chapters (Chapters 4 to 8). These chapters cover the basic topics included in a standard environmental economics course, including: the costs of environmental pollution-control technologies; the determinants of environmental-damage costs; the design of and choice of policy instruments; the macroeconomic effects of environmental regulation; the economic valuation of environmental amenities and

disamenities; and the economics of environmental project appraisal and valuation (i.e., cost–benefit analysis and other alternative methods of project evaluation).

The analysis in this part of the book is done from a predominantly neoclassical perspective using both comparative static equilibrium analysis and the framework of welfare economics. However, even in this seemingly traditional part of the book, concerted efforts are made to critically evaluate the major findings of each chapter from an ecological perspective.

### **Part III The new scarcity**

This part consists of *two* chapters (Chapters 9 and 10). These are *new* chapters and cover two pressing contemporary global environmental issues. Chapter 9 offers an extensive and comprehensive discussion of both the science and economics of climate change. Chapter 10 presents theoretical arguments for biodiversity conservation. The main objectives of this chapter are to understand: (1) the factors contributing to the loss in biodiversity; and (2) the link between losses in biodiversity and the supply of ecosystem services.

### **Part IV Sustainable development and the limits to growth**

This part is composed of five chapters (Chapters 11 to 15). The unifying theme of these five chapters is *sustainability*, that is, major concerns arising from the unintended social, environmental and economic consequences of rapid population growth, economic growth and consumption of natural resources. It is a long-term view of resource adequacy (or wellbeing) and generally implies conflict between present and future generations.

Chapter 11 provides extensive discussion on the Malthusian ‘variations’ of the arguments on limits to economic growth. The causes for the impending limits are primarily discussed on the basis of population growth and resource scarcity.

Chapter 12 presents the view that neoclassical economists have taken, primarily to show why there are no limits to economic growth. This optimism is principally based on the viability of continued technological advances.

Chapter 13 presents the theoretical foundation for the economics of sustainability. This chapter establishes *three* specific sustainability rules with varying implications on intertemporal resource use and/or conservation.

In Chapter 14 the concept of environmentally adjusted national income accounting is explored. In addition, this chapter includes extensive discussion of *four* sustainability indexes that can be used as a measure of sustainability or unsustainability at an aggregate level.

Chapter 15 examines how the private sector can be a constructive partner in achieving sustainable development goals. The focus of this chapter is to show real-world cases in which private firms, inspired by visions of eco-efficiency and/or eco-effectiveness, are beginning to substantially reduce the material and energy wastes in their production activities.

### **Part V Environmental sustainability in developing countries**

This part is composed of a single chapter, Chapter 16, which analyzes the population, resources and environmental problems of the developing nations. The main focuses are on poverty and environmental degradation. The solution to the rapid and continued environmental degradation that is evident in poor nations requires not only economics and ecological understanding of the problem(s) under consideration, it also requires an understanding of the social, cultural and political circumstances of the most relevant

stakeholders—the people living in developing countries. This book makes a concerted effort to discuss the significance of several social, cultural and political factors that are identified as being crucial to the ongoing search to find lasting solutions to the environmental woes in developing countries.

## UNIQUE FEATURES OF THE BOOK

Unlike other textbooks in this area, this book is written with the belief that *a course in environmental economics cannot be treated as just another applied course in economics*. It must include both economic and ecological perspectives and, in so doing, must seek a broader context within which environmental and natural resource issues can be understood and evaluated. In this regard, the book does not approach environmental and natural resource problems from only, or even predominantly, a standard economic perspective. To emphasize this point, the new edition has a subtitle that reads ‘An Integrated Economic and Ecological Approach’.

The book contains a chapter, Chapter 2, that is exclusively devoted to providing students with basic concepts and principles of ecology. This chapter has been revised extensively and it has a sharp focus on *three* important principles of ecology and their broad implications for the functioning of the human economy and the biosphere. These three principles are: ecological interdependencies; the laws of thermodynamics of matter–energy; and ecological succession. This chapter also contains discussion of the broader implications of the growing dominance of a single species, humans, on natural ecosystems.

What are the justifications for a chapter that deals exclusively with ecology in a textbook that is written for students who may not be in science fields? The simple and straightforward answer to this question is that it provides students with a scientific foundation for understanding key themes covered in other chapters, such as: (1) the waste assimilative (absorptive) capacity of the natural environment (Chapter 3); (2) the biophysical determinants of the pollution-damage function (Chapters 4 and 7); (3) the causes and impacts of climate change (Chapter 9); (4) the contributions of ecosystem services to the economy and the causes of biodiversity loss (Chapters 7 and 10); (5) the nature of the biophysical limits to economic growth (Chapters 11, 13 and 14); (6) the limits to energy savings through technological advances (Chapters 11, 12, 13 and 14); (7) the design of products and production processes that are eco-friendly and the evaluation of product and material lifecycles (Chapter 15); (8) the biophysical (i.e., in terms of flow of matter–energy) interactions between the biosphere and the human economy (Chapters 11 and 14); and (9) the design of physical indicators of sustainability and the physical symptoms of unsustainable systems (Chapters 14 and 16). Furthermore, there is no chapter in this textbook that does not in some way include concepts covered in Chapter 2.

However, incorporating a single chapter on ecology *per se* would not be sufficient justification for the claim that this book differentiates itself from its competitors by taking ‘an integrated economic and ecological approach’ to the study of environmental economics. Thus, in addition to providing a stand-alone chapter on ecology, this text incorporates concepts, theories, methodologies and perspectives that are uniquely attributable to ecological economics—a relatively new subfield in economics.

Ecological economics was founded with the belief that pressing environmental problems require interdisciplinary approaches that focus on the links between economic, social and ecological systems. This book seriously engages the ecological economic position that views the human economy as a subsystem of the biosphere (i.e., the earth’s life support system), implying that biophysical reality has implications for the functioning of human economy that are much more far-reaching than has been acknowledged by the proponents of mainstream economic thought. Appendix B presents a brief historical sketch of the development of ecological economics. This appendix should be read after reading Chapter 2.

Another important feature of this book, which may seem somewhat at odds with the position expressed above is this: no compromise is made in the use of relevant mainstream economic theories and methodologies.

The text is written with an assumption that students have completed a one-semester course in microeconomics. Furthermore, Appendix A at the end of the text provides explanations of fundamental economic concepts that are specifically relevant to environmental economics. In Appendix A, economic concepts such as basic demand and supply analysis, willingness to pay, consumers' and producers' surplus, Pareto optimality, and alternative economic measures of scarcity are thoroughly and systematically explained. The material in this Appendix is referenced throughout the text (especially in Chapter 1 and Chapters 3 to 8). Appendix A could also serve as a good review for economics students and a very valuable foundation for students specializing in fields other than economics.

Finally, this book is primarily a theoretical exposé of environmental and resource economics. The emphasis is on the systematic development of theoretical principles and conceptual frameworks essential for a clear understanding and analysis of environmental and resource issues. To catch the imagination and attention of students, as well as to reinforce their understanding of basic theoretical principles, case studies and 'exhibits' are incorporated into most of the chapters. These are taken from brief magazine articles, newspaper clippings, articles and summaries of empirical studies from professional journals, and publications from government and private research institutions.

Let me end this part of the book with these important remarks. This textbook is not written to defend or promote a particular brand of economic perspective on the environment. While it should be left for others to judge whether a balanced approach has been used in analyzing and discussing pressing environmental issues from different perspectives, at the very least readers will notice the concerted efforts that have been made to expose the mainstream views of environmental economics, as well as the arguments of its most ardent critics. This is not intended to make the mainstream economics perspectives on the environment less useful, but rather to make them more tenable and complete.

### **OTHER NOTABLE FEATURES**

The book is well-researched, as is evident by the long list of references at the end of most of the chapters, and it includes carefully thought out review and discussion questions at the end of chapter.

Each chapter of this book is written to stand on its own. This is done so that users of the book can freely move from chapter to chapter without significant loss of continuity. However, this comes at a cost, i.e., some degree of repetitiveness.





# Acknowledgements

The experience of being the sole author of a textbook on a subject matter which requires an interdisciplinary focus has indeed been daunting. Undoubtedly, the completion of this project would not have been possible without the help and encouragement of many professional associates, students and family members. In this sense, I cannot truly claim to be the sole author of this text.

I would like to extend my thanks to several individuals who read and edited a section or a full chapter(s) at some stage of my effort to write this book. Most notable among these people are: Paul Olexia, Rajaran Krishnan, Chuck Stull, Tim Moffit, Jacquelyn Gardner, Fumie Hussen, Sophia Hussen, Cynthia Leet and Genevieve Leet.

I would also like to thank my students Molly Waytes K'12 for her significant contributions to Exhibit 10.3, and Samantha Weaver K'09 for reading and providing me with valuable comments on Chapter 9.

As was the case in the previous two editions, the new edition uses numerous quoted remarks, exhibits and case studies. These items are not included for mere appearance or style; they significantly contribute to the effectiveness of the book in conveying certain important ideas. Obviously, my debt to those whose work I have quoted and summarized is immeasurable. However, I have the sole responsibility for the interpretation placed on these works.

I would like to express my sincere gratitude for the valuable comments I received from four anonymous reviewers during two separate stages of the review process for the third edition. I am especially indebted to the two reviewers who read the entire manuscript and provided me with specific and detailed comments and suggestions. Not only did the book benefit from these comments and suggestions, but it was also personally gratifying to realize that there are people within my own profession who both appreciate my work and take it seriously.

It would have been impossible to start and complete this project without the encouraging words and substantive support that I have received from my editor, Robert Langham. As always, it has been a real pleasure to work with Rob and his two editorial assistants, Louisa Earls and Natalie Tomlinson. I would also like to thank Dan Harding for his meticulous and masterful work in copy-editing the book, and for the personal interest he has exhibited regarding its content. My sincere gratitude goes also to Stewart Pether, the production editor, not only for effectively shepherding the production stage of the book but also for involving me in every step of the production process'.

Finally, I would like to dedicate this edition to Fumie, my wife. I am forever indebted to her unconditional commitment to my personal wellbeing and professional growth.



# Acronyms

As a general rule, my preference is to use acronyms only when they are absolutely needed. Below are the acronyms that are used on more than a few occasions.

ARP	acid-rain program
BAU	'business as usual' approach
CBA	cost-benefit analysis
CBD	Convention on Biological Diversity
CD	sustainable development
CDM	Clean Development Mechanism
CEA	cost-effectiveness analysis
CFCs	chlorofluorocarbons
CNC	critical natural capital
CSR	corporate social responsibility
CVM	contingent valuation method
DfE	design for the environment
DICE	Dynamic Integrated Model of Climate and the Economy
EANIA	environmentally adjusted national income accounting
EDP	environmentally adjusted net domestic product
EFP	ecological footprint
EIA	environmental impact assessment
EKC	environmental Kuznets curve
EPA	Environmental Protection Agency
EPE	environmental protection expenditures
ESS	ecosystem services
FCCC	Framework Convention on Climate Change
GDP	gross domestic product
GHGs	Greenhouse gases
GS	genuine net savings
GW	Global warming
IAS	Invasive alien species
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISEW	index of sustainable economic welfare

LCA	life cycle assessment
LCD	life cycle design
MCC	Marginal control cost
MD	Millennium Development Goals
MDC	Marginal damage cost
MSB	Marginal social benefit
MSC	Marginal social cost
NGOs	non-governmental organizations
NIE	New Institutional Economics
NNP	net national product
NPV	net present value
OECD	Organization for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
ppm	parts per million
RFF	Resources for the Future
SEEA	System of integrated Environmental and Economic Accounting
SMS	safe minimum standard
SNA	system of national accounts
SP	stated preference
SSE	steady-state economy
TDT	theory of demographic transition
TEC	transferable emission credit
TPI	turning-point income
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNSD	United Nations Statistical Division
WB	World Bank
WBCSD	The World Business Council for Sustainable Development
WCED	World Commission on Environment and Development
WMO	World Metrological Organization
WTA	willingness to accept
WTP	willingness to pay



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