ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS:
A CONTEMPORARY APPROACH

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CHAPTER 1

Changing Perspectives on the Environment

CHAPTER 1 FOCUS QUESTIONS

- What major environmental issues do we face in the twenty-first century?
- What are the main frameworks that economists use to understand these issues?
- What principles can promote economic and ecological sustainability?

1.1 OVERVIEW OF ENVIRONMENTAL ISSUES

Over the past five decades, we have become increasingly aware of environmental problems at the local, national, and global levels. During this period, many natural resource and environmental issues have grown in scope and urgency. In 1970, the Environmental Protection Agency was created in the United States to respond to what was at that time a relatively new public concern with air and water pollution. In 1972, the first international conference on the environment, the United Nations Conference on the Human Environment, met in Stockholm. Since then, growing worldwide attention has been devoted to environmental issues. (See Box 1.1 for more important events in modern environmental history.)

In 1992 the United Nations Conference on Environment and Development (UNCED) met in Rio de Janeiro, Brazil, to focus on major global issues, including depletion of the earth's protective ozone layer, destruction of tropical and old-growth forests and wetlands, species extinction, and the steady buildup of carbon dioxide and other "greenhouse" gases causing global warming and climate change.

Twenty years later, at the United Nations Rio + 20 Conference on Sustainable Development, countries of the world reaffirmed their commitment to integrating environment and development but acknowledged limited progress toward these goals.[1] In 2012, the United Nations Environmental Programme (UNEP) report *Global Environmental Outlook 5* found that "burgeoning populations and growing economies are pushing ecosystems to destabilizing limits." According to the report:

> [The twentieth century] was characterized by exceptional growth both in the human population and in the size of the global economy, with the population quadrupling to 7 billion [in 2011] and global economic output increasing about 20-fold. This expansion

has been accompanied by fundamental changes in the scale, intensity, and character of society's relationship with the natural world. … Drivers of environmental change are growing, evolving, and combining at such an accelerating pace, at such a large scale and with such widespread reach that they are exerting unprecedented pressure on the environment. [2]

Box 1.1 Important Events in Modern Environmental History

1962: The publication of Rachel Carson's *Silent Spring*, widely recognized as the catalyst of the modern environmental movement, details the dangers posed by excessive pesticide use.

1964: The passage of the Wilderness Act in the United States, which protects public lands that are "untrammeled by man, where man himself is a visitor who does not remain."

1969: The Cuyahoga River in Ohio is so polluted by oil and other chemicals that it catches on fire, prompting widespread concern about water pollution and eventually the passage of the Clean Water Act in 1972.

1970: The creation of the Environmental Protection Agency by President Richard Nixon. Also, over 20 million participate in the first Earth Day on April 22.

1972: The creation of the United Nation's Environment Programme (UNEP), headquartered in Nairobi, Kenya.

1979: The partial meltdown of the Three Mile Island nuclear reactor in Pennsylvania raises concerns about the safety of nuclear energy. These concerns are exacerbated by the explosion of the Chernobyl reactor in the Soviet Union in 1986.

1987: The United Nations' Brundtland Commission publishes "Our Common Future," which defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

1992: The Rio Declaration on Environment and Development recognizes "the integral and independent nature of the Earth, our home," and lists 27 principles of sustainable development including reducing global inequities, international cooperation, and the promotion of an economic system that addresses environmental problems.

1997: The Kyoto Protocol is negotiated, the first international treaty that commits ratifying nations to reduce their greenhouse gas emissions. Although rejected by the United States, the treaty was ratified by 191 nations and entered into force in 2005.

2002: The Johannesburg Declaration on Sustainable Development recognized that "humanity is at a crossroads" and there exists "a collective responsibility to advance and strengthen the … pillars of sustainable development – economic development, social development, and environmental protection."

2009: Nations participating in climate change talks in Copenhagen agree that actions should be implemented to limit eventual global warming to no more than 2 degrees Celsius, though no binding commitments are made to reduce emissions.

2015: The Paris Agreement on climate change, approved by 195 countries, calls for a "global peaking of greenhouse gas emissions as soon as possible" with a goal of "holding the increase in global average temperature to well below 2°C above pre-industrial levels." Over 150 countries submit plans to limit their greenhouse gas emissions.

With the exception of ozone depletion, an area in which major reductions in emissions have been achieved by international agreement, the UNEP report offers evidence that the global environmental problems identified at UNCED in 1992 in the areas of atmosphere,

land, water, biodiversity, chemicals, and wastes have continued or worsened. Other UNEP Global Environmental Outlook reports have identified nitrogen pollution in freshwater and oceans, exposure to toxic chemicals and hazardous wastes, forest and freshwater ecosystem damage, water contamination and declining groundwater supplies, urban air pollution and wastes, and overexploitation of major ocean fisheries as major global issues.

Climate change has emerged as perhaps the greatest environmental threat of our time. The 2014 report by the United Nations' Intergovernmental Panel on Climate Change concludes that:

> …continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.[3]

In December 2015, a United Nations conference held in Paris resulted in a 195-country agreement to limit and eventually reduce the greenhouse gas emissions that cause climate change. (Later chapters in this text will present a detailed analysis of the problem of climate change and attempts at policy solutions.)

Underlying all these problems is global population growth, which adds more than 70 million people a year. World population, which surpassed 7 billion in 2011, is expected to grow to around 9.7 billion by 2050, with almost all of the growth occurring in developing nations.[4]

Scientists, policy makers, and the general public have begun to grapple with questions such as: What will the future look like? Can we respond to these multiple threats adequately and in time to prevent irreversible damage to the planetary systems that support life? One of the most important components of the problem, which rarely receives sufficient attention, is an economic analysis of environmental issues.

Some may argue that environmental issues transcend economics and should be judged in different terms from the money values used in economic analysis. Indeed, this assertion holds some truth. We find, however, that environmental protection policies are often measured—and sometimes rejected—in terms of their economic costs. For example, it is extremely difficult to preserve open land that has high commercial development value. Either large sums must be raised to purchase the land, or strong political opposition to "locking up" land must be overcome. Environmental protection organizations face a continuing battle with ever-increasing economic development pressures.

Often public policy issues are framed in terms of a conflict between development and the environment. An example is the recent debate over "fracking," or hydraulic fracturing to obtain natural gas. Producing natural gas can be profitable and increase energy supplies, but there are social and environmental costs to communities. Similarly, opponents of international agreements to reduce carbon dioxide emissions argue that the economic costs of such measures are too high. Supporters of increased oil production clash with advocates of protecting the Arctic National Wildlife Refuge in Alaska. In developing countries, the tension between the urgency of human needs and environmental protection can be even greater.

Does economic development necessarily result in a high environmental price? Although all economic development must affect the environment to some degree, is "environment-friendly" development possible? If we must make a tradeoff between development and environment, how should the proper balance be reached? Questions such as these highlight the importance of environmental economics.

1.2 ECONOMIC APPROACHES TO THE ENVIRONMENT

While economists have thought about various natural resource issues for hundreds of years, the existence of **environmental economics**[5] as a specific field of economics dates back only to the 1960s, concurrent with the growing awareness of environmental issues discussed above.[6] Environmental economists apply mainstream economic principles to environmental and natural resource issues.

Even more recently (dating back to the 1980s), **ecological economics** has emerged as a field which brings together viewpoints from different academic disciplines to study the interactions between economic and ecological systems. Unlike environmental economics, ecological economics is defined not so much by the application of a particular set of economic principles, but by analyzing economic activity *in the context of* the biological and physical systems that support life, including all human activities.[7]

We will draw upon both approaches in this book. For most of the remainder of this chapter we will discuss the main differences between the two approaches. However, we should first emphasize that the boundary between environmental and ecological economics is a blurred one, with considerable overlap. A 2014 review of journal articles published in both fields finds that they have grown closer over time.[8] Some economists consider the two fields to have essentially merged into "environmental and ecological economics."[9] Others call for a new term, such as "sustainability economics" which "lies at the intersection of the two and uses concepts and methods of both."[10]

The economic and ecological analyses that we will review offer a spectrum of viewpoints which can all contribute to solving myriad environmental challenges. But enough differences still exist so that one can differentiate between environmental economics and ecological economics in several respects. We now try to do that in more detail.

environmental economics a field of economics which applies mainstream economic principles to environmental and natural resource issues
ecological economics a field which brings together viewpoints from different academic disciplines and views the economic system as a subset of the broader ecosystem and subject to biophysical laws.

Main Principles of Environmental Economics

Environmental economics is based on the application of several mainstream economic theories and principles to environmental issues. We can identify the core of environmental economics as being comprised of four concepts:

1. The theory of environmental externalities
2. The optimal management of common property and public goods
3. The optimal management of natural resources over time
4. The economic valuation of environmental goods and services

Economists since the time of Adam Smith in the 18th century have asserted that voluntary market exchanges between buyers and sellers leave both parties better off than when they started. But market exchanges can also impact parties other than the buyers and sellers, either in a positive or negative manner. For example, someone buying gasoline affects other people, such as those exposed to air pollution from producing and burning the gasoline. Economists have long recognized that these "third-party" impacts, known as **externalities**, need to be considered when assessing the overall costs and benefits of market activity. Economic theory

provides guidance on devising effective policies in the presence of externalities. We will explore externalities in more detail in Chapter 3.

Externalities are an example of **market failure** – situations in which an unregulated market fails to produce an outcome that is the most beneficial to society as a whole. Another important instance of market failure is the allocation of **common property resources** such as the atmosphere and the oceans, and **public goods** such as natural parks and wildlife preserves. Because these resources are not privately owned, we normally can't rely upon markets to maintain them in adequate supply, and in general the principles governing their use are different from those affecting privately owned and marketed goods. Environmental economists have developed a set of economic theories relevant to common property resources and public goods, which we will explore further in Chapter 4.

A third application of mainstream economic theory deals with the management of natural resources over time. According to this perspective, natural resources should be managed to provide society with the highest aggregate benefits summed across generations. A critical question in this analysis is how we value benefits that occur in the future relative to benefits received in the present. We present a basic model of resource management over time in Chapter 5.

The final core concept in environmental economics is that most environmental goods and services can, in principle, be valued in monetary terms. Environmental economists use a set of methods for estimating the monetary value of such things as asthma cases caused as a result of air pollution, the benefits of endangered species, or the value of a scenic view. By measuring these impacts in monetary terms, economists seek to determine the "optimal" degree of environmental protection based on a comparison of costs and benefits. We will discuss methods of valuation, and how they are applied, in Chapters 6 and 7.

externalities an effect of a market transaction that impacts the utility, positively or negatively, of those outside the transaction.
market failure situations in which an unregulated market fails to produce an outcome that is the most beneficial to society as a whole.
common property resources resources that are available to all and that are not subject to private ownership.
public goods goods that are available to all and whose use by one person does not reduce their availability to others.

Core Concepts of Ecological Economics

The core concepts in ecological economics are somewhat harder to define, as it is a broader field than environmental economics. There is also more variation in viewpoints and disciplinary approaches among ecological economists, including perspectives from biology, ecology, and other sciences, as well as engineering, systems modeling, history, and philosophy.

Nonetheless, we can identify a set of core concepts to which ecological economists generally subscribe. These three core concepts are:

1. The economic system is a subset of the broader ecological system
2. Sustainability should be defined according to ecological, rather than economic, criteria
3. It is essential to rely upon a range of academic disciplines and perspectives, in addition to economics, to provide insight into environmental issues

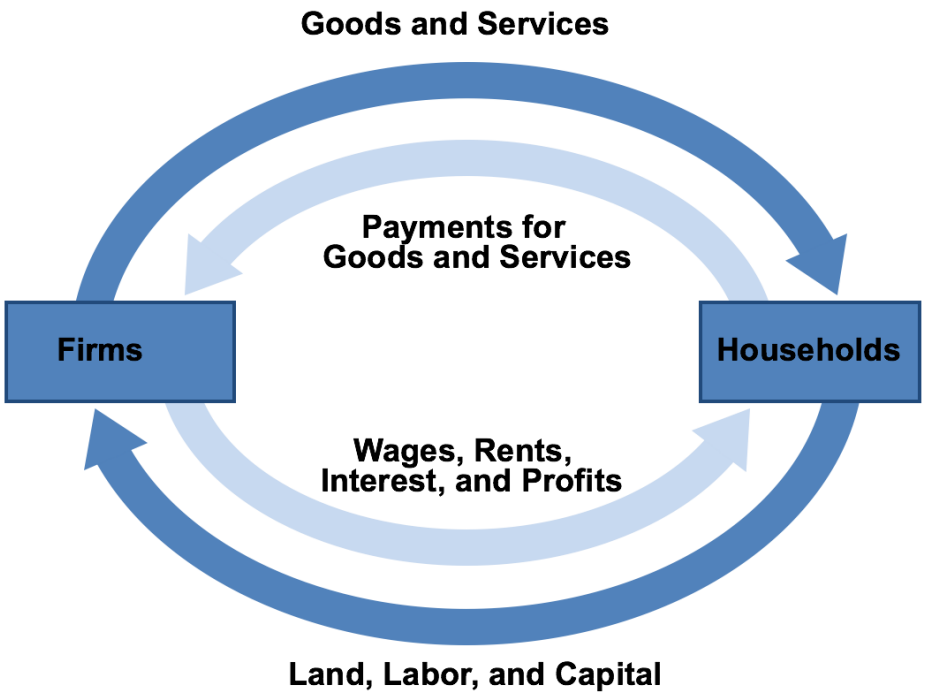
These core concepts have implications for both how economic analysis is conducted and for policy recommendations. We will explore each of these three core concepts in this chapter, comparing them to mainstream environmental economic approaches, and will return to their implications for analysis and policy in greater detail in Chapter 9.

1.3 Principles of Ecological Economics

The Economic System in an Environmental Context

A basic building block of mainstream economic theory is the **standard circular flow model** of an economic system. As illustrated in Figure 1.1, this simple model depicts the relationships between households and business firms in two markets: the market for goods and services and the market for factors of production. Factors of production are generally defined as land, labor, and capital. The services that these factors provide are "inputs" into the production of goods and services, which in turn provide for households' consumption needs. Goods, services, and factors flow clockwise; their economic values are reflected in the flows of money used to pay for them, moving counterclockwise. In both markets, the interaction of supply and demand determines a market-clearing price and establishes an equilibrium level of output.

Figure 1.1 The Standard Circular Flow Model



standard circular flow model a diagram that illustrates the ways goods, services, capital, and money flows between households and businesses.
natural resources the endowment of land and resources including air, water, soil, forests, fisheries, minerals, and ecological life-support systems

Where do natural resources and the environment fit in this diagram? **Natural resources**, including minerals, water, fossil fuels, forests, fisheries, and farmland, generally fall under the inclusive category of "land." The two other major factors of production, labor and capital, continually regenerate through the economic circular flow process, but by what processes do natural resources regenerate for future economic use? Environmental economists recognize that it is necessary to address the limitations of the standard circular flow model in this respect. But ecological economists place a particular emphasis on a broader circular flow model that takes into account ecosystem processes as well as economic activity (Figure 1.2).

Taking this broader view, we notice that the standard circular flow diagram also omits the effects of wastes and pollution generated in the production process. These wastes from both firms and households must flow back into the ecosystem somewhere, either being recycled, through disposal, or as air and water pollution.

In addition to the simple processes of extracting resources from the ecosystem and returning wastes to it, economic activities also affect broader natural systems in subtler and more pervasive ways not illustrated in Figure 1.2. For example, modern intensive agriculture changes the composition and ecology of soil and water systems, as well as affecting nitrogen and carbon cycles in the environment.

Figure 1.2 Expanded Circular Flow Model

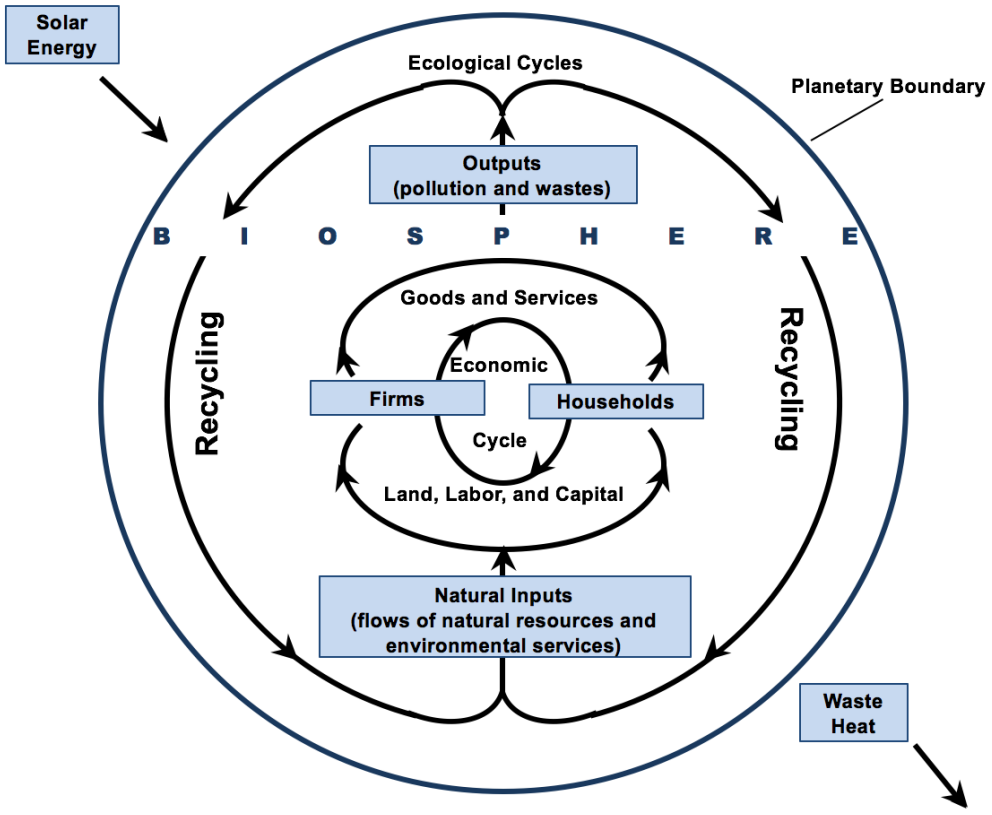


Figure 1.2, provides a broader framework for placing the economic system in its ecological context. Natural resources include both renewable and nonrenewable resources. **Renewable resources** are those that are regenerated over time through ecological processes, such as forests and fisheries. Renewable resources can be managed sustainably if extraction rates don't exceed natural regeneration rates. However, if renewable resources are over-exploited they can be depleted, such as species that go extinct through over-harvesting. **Nonrenewable resources** are those that do not regenerate through ecological processes, at least on a human time scale. Nonrenewable resources such as oil, coal, and mineral ores are ultimately available in a fixed supply, although new resources can be discovered to expand the known available supply. The other input into the economic system is solar energy, which as we will see later in the text provides a limited but incredibly abundant source of continual energy.

renewable resources resources that are regenerated over time through ecological processes, such as forests and fisheries.
nonrenewable resources resources that do not regenerate through ecological processes, at least on a human time scale, such as oil, coal, and mineral ores.

What does this expanded circular flow model imply for economic theory? There are at least three major implications:

1. The recognition that natural resources and solar energy provide the essential input into economic processes implies that human well-being is ultimately dependent on these resources. Measuring well-being using standard economic metrics, such as gross domestic product, understates the importance of natural resources. This suggests a need for alternative indicators of well-being, which we will discuss in Chapter 10.
2. As shown in Figure 1.2, the ecological system has its own circular flow, which is determined by physical and biological rather than economic laws. This broader flow has only one net "input"—solar energy—and only one net "output"—waste heat. Everything else must somehow be recycled or contained within the planetary ecosystem.
3. In the standard circular flow model, the economic system is unbounded and can theoretically grow indefinitely. But in the expanded model, economic activity is limited by both the availability of natural resources and the ability of the environment to assimilate wastes and pollution. Thus the overall scale of the economy relative to the available natural resources must be considered.

As with some of the other questions we have discussed, there can be significant overlap between environmental and ecological economics perspectives on these issues. In terms of the double circular flow shown in Figure 1.2, a standard environmental economics perspective starts from the inner, economic, circle and tries to understand broader ecological issues in economic terms. Ecological economists place greater emphasis on the outer circle, with its biophysical laws and limitations, but are also aware of the importance of the way resources and environment are taken into account in economic analysis.

Defining Sustainability

As mentioned in Box 1.1, sustainable development was first defined in 1987 by the United Nations' Brundtland Commission. Headed by the former Prime Minister of Norway, Gro

Harlem Brundtland, the Commission published "Our Common Future," a nearly 400-page report on the environment and economic development. The report is generally recognized as coining the term **sustainable development**, and defining it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

sustainable development defined by the Brundtland Commission as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
anthropocentric worldview a perspective that places humans at the center of analysis
ecocentric worldview a perspective that places the natural world at the center of analysis
pluralism the perspective that a full understanding of an issue can only come from a variety of viewpoints, disciplines, and approaches.

While sustainable development has become a popular buzzword, and nearly everyone agrees that it is a worthy goal, it is difficult to define precisely. Note that the Brundtland Commission defines sustainability based on the criterion of meeting human needs across time. However, this definition does not explicitly say anything about maintaining natural resources or ecological functions. This definition of sustainable development is consistent with standard environmental economics, which implies that at least some degradation of the environment can be acceptable as long as it doesn't interfere with meeting human needs.

An alternative, more ecologically-oriented, approach would define sustainability on the basis on maintaining appropriate levels of natural resources and ecological functions. In fact, some ecological economists believe that sustainability should be defined solely based on ecological, rather than human, factors. We will further discuss the different definitions of sustainability in Chapter 9.

Another way to characterize this distinction is that environmental economics tends to align with an **anthropocentric worldview**, meaning it places humans at the center of analysis. Thus the value of nature arises because humans assign it value. Ecological economics ascribes more to an **ecocentric worldview**, one that places the natural world at the center of analysis. An ecocentric viewpoint places value on nature independent of any human concerns.

A Pluralistic Approach

The final core concept in ecological economics is the promotion of a pluralistic approach to studying the relationship between the economy and the environment. By **pluralism** we mean the perspective that a full understanding of an issue, such as environmental problems, can only come from a variety of viewpoints, disciplines, and approaches. By promoting pluralism, many ecological economists distinguish themselves from more traditional environmental economists. The main academic journal for ecological economics, titled as you might expect *Ecological Economics*, notes that its:

> unique and distinctive identity rests on its role in promoting a diversity of views and cross-disciplinary perspectives. [*Ecological Economics*] is based on the premise that understanding and managing the interplay between economic and ecological systems requires an interdisciplinary approach. [*Ecological Economics*] should therefore be a "big tent," not a narrow domain characterized by an exclusive or dominant viewpoint.[11]

One obvious implication of pluralism, as mentioned previously, is that many people who call themselves ecological economists were not primarily trained in economics. Even those who were primarily trained as economists are likely to have exposure to other disciplines such as political science, engineering, and ecology in addition to economics.

Embracing pluralism also means that ecological economists may disagree among themselves. As mentioned earlier, ecological and environmental economics have grown closer over time – not all ecological economists see this as a positive development. A 2013 article distinguishes between "shallow" and "deep" ecological economics. "Shallow" ecological economics is seen as closer to environmental economics, but deep ecological economics seeks:

> to make ethical conduct central and to place the social, ecological and economic discourses on an equal footing. … Deep ecological economics requires challenging both personal and social pre-conceptions, while taking a campaigning sprit to change public policy and the institutions blocking the necessary transition to [alternative economic systems].[12]

This text will adopt a pluralistic approach to studying environmental issues, encompassing environmental economics, ecological economics, and other academic disciplines. The goal is to provide students with varied analytical approaches, allowing the reader to judge which approach or technique, or combination of approaches and techniques, is most useful in understanding a particular environmental issue, and in seeking policy solutions.

Other Differences between Environmental and Ecological Economics

As we saw earlier, environmental economists tend to favor attempts to place monetary values on environmental goods and services. In mainstream economics, something has **economic value** only if people are willing to pay for it. But if no one is willing to pay for a particular environmental good or service, then according to traditional environmental economics, it does not have economic value. For example, if no one is willing to pay to preserve an endangered insect in the Amazon forest, then there would be no loss of economic value if the species were to go extinct.

Analysts taking an ecological economics perspective are more likely to argue that environmental goods and services may have value separate from economic value, consistent with an ecocentric worldview. Specifically, ecological economists are more likely to acknowledge the **inherent value** of nature. Inherent value derives from ethics, rights, and justice, rather than human willingness to pay. Thus an insect species in the Amazon would have inherent value and a right to exist, and thus be worthy of preserving even if it does not have economic value. For a famous example advocating for the inherent value of the natural world, see Box 1.2.

economic value the value of something derived from people's willingness to pay for it.
inherent value the value of something separate from economic value, based on ethics, rights, and justice.
market-based solutions policies that create economic incentives for behavioral changes, such as taxes and subsidies, without specific control of firm or individual decisions.

Box 1.2 Should Nature Have Legal Rights?

In the late 1960s the United States Forest Service granted a permit to the Disney Corporation to develop a large ski resort in the remote, undeveloped Mineral King Valley, adjacent to Sequoia National Park in California. The Sierra Club, an environmental organization, filed suit in federal court to block the development. The Forest Service and Disney responded that the Sierra Club did not have legal "standing" in the case – only a party that can demonstrate it will be sufficiently harmed by an action can initiate a lawsuit to prevent the action.

The question of whether the Sierra Club had legal standing in the case went all the way to the U.S. Supreme Court. While the Sierra Club technically lost the case, it is best known for the dissenting opinion written by Justice William Douglas. Douglas asserted that the real question wasn't whether the Sierra Club had legal standing, but that Mineral King Valley itself should have legal standing to sue for its own protection. Below is an excerpt from Douglas' opinion in the case:

> Inanimate objects are sometimes parties in litigation. A ship has a legal personality, a fiction found useful for maritime purposes. The corporation is an acceptable adversary and large fortunes ride on its cases. So it should be as respects valleys, alpine meadows, rivers, lakes, estuaries, beaches, ridges, groves of trees, swampland, or even air that feels the destructive pressures of modern technology and modern life.
>
> The voice of the inanimate object, therefore, should not be stilled. [B]efore these priceless bits of Americana (such as a valley, an alpine meadow, a river, or a lake) are forever lost or are so transformed as to be reduced to the eventual rubble of our urban environment, the voice of the existing beneficiaries of these environmental wonders should be heard.
>
> Those who hike the Appalachian Trail into Sunfish Pond, New Jersey, and camp or sleep there, or run the Allagash in Maine, or climb the Guadalupes in West Texas, or who canoe and portage the Quetico Superior in Minnesota, certainly should have standing to defend those natural wonders before courts or agencies, though they live 3,000 miles away. Then there will be assurances that all of the forms of life which it represents will stand before the court - the pileated woodpecker as well as the coyote and bear, the lemmings as well as the trout in the streams. Those inarticulate members of the ecological group cannot speak. But those people who have so frequented the place as to know its values and wonders will be able to speak for the entire ecological community.

Although the Sierra Club lost the case, public pressure forced the Disney Corporation to withdraw its development plans. In 1978 Mineral King Valley was added to Sequoia National Park and in 2009 it was designated as a wilderness area by the U.S. Congress, permanently protecting it from development.

Sources: EarthJustice, "Mineral King: Breaking Down the Courthouse Door" http://earthjustice.org/features/mineral-king-breaking-down-the-courthouse-door; full opinions on Mineral King case http://caselaw.findlaw.com/us-supreme-court/405/727.html

Both environmental and ecological economists recognize that policy recommendations

should consider future costs and benefits. While we'll discuss this issue in more detail in Chapters 6 and 7, for now we can note that ecological economists are likely to place more weight on impacts that occur in the future, particularly those that occur more than a few decades in the future. Environmental economists favor weights that value impacts across time derived from market activity, while ecological economists often develop weights based on ethical considerations including the rights of future generations.

When market failures occur, environmental economists tend to advocate **market-based solutions** – policies that create economic incentives for behavioral changes, such as taxes and subsidies, without dictating what a firm or person can or cannot do. We will discuss market-based solutions in Chapter 8. While ecological economists aren't necessarily opposed to market-based solutions, at least in some situations, they emphasize that market-based solutions applied at a micro level fail to address macro-level issues about the overall scale of market activity. We will discuss this issue in more detail in Chapter 9.

A final, related, point concerns whether further economic growth is possible, or even desirable. Mainstream perspectives support the idea that continued economic growth is feasible and generally desirable, although it should tempered by greater application of market-based solutions for environmental externalities. Ecological economists are more likely to advocate for an eventual leveling-off of economic growth, or even "de-growth." We'll discuss this topic more in later chapters. Table 1.1 summarizes the main differences between environmental and ecological economics. The viewpoints of individuals who consider themselves one or the other may not exactly align with all these designations, but the table gives a sense of the contrasting perspectives that we will encounter as we explore environmental topics.

Table 1.1 Main Differences between Environmental and Ecological Economics

Question	Viewpoint of Environmental Economics	Viewpoint of Ecological Economics
How is the value of the environment determined?	Using economic value, based on people's willingness to pay	Economic value may be useful, but also recognize inherent values
How are values measured?	Convert all values to monetary terms if possible	Some values, particularly inherent value, cannot be expressed in monetary terms
Advocate market-based solutions to market failures?	Yes, in the majority of cases	Perhaps, but micro-level market solutions may fail to address macro-level issues.
Consideration given to future generations?	Some, with weights inferred from market activity	More weight given to future generations based on ethical considerations
Is value neutrality desirable?	Economics aims to be value neutral (objective)	Values are acceptable in a pluralistic framework
What is sustainable development?	Maintaining the well-being of humans across time	Maintaining ecological functions across time
Are there ultimate limits to economic growth?	Perhaps not, at least in the foreseeable future	Very likely, based on the limited availability of natural resources

1.4 A Look Ahead

How can we best use these two approaches to economic analysis of environmental issues? In the following chapters, we apply the tools and methods of each to specific environmental issues. But first, Chapter 2 provides an overview of the relationship between economic development and the environment, looking at trends in developed and developing countries as well as envisioning sustainable development in both types of countries. The core theory and methods from environmental economics are explored in detail in Chapters 3–8. Chapters 9 and 10 further explore the concepts of ecological economics and environmental accounting.

In Chapters 11–20, we apply techniques of environmental and ecological economics to the major environmental issues of the 21st century: population, food supply, energy use, natural resource management, pollution control, and climate change. Chapters 21 and 22 bring together many of these topics to focus on questions of trade, economic development, and key institutions as they relate to the environment.

Summary

National and global environmental issues are major challenges in the twenty-first century. Responding to these challenges requires understanding the economics of the environment. Policies aimed at environmental protection have economic costs and benefits, and this economic dimension is often crucial in determining which policies we adopt. Some cases may require tradeoffs between economic and environmental goals; in other cases these goals may prove compatible and mutually reinforcing.

Two different approaches address economic analysis of environmental issues. The standard approach applies economic theory to the environment using the concepts of money valuation and economic equilibrium. This approach aims to achieve efficient management of natural resources and the proper valuation of waste and pollution. The ecological economic approach views the economic system as a whole as a subset of a broader biophysical system. This approach emphasizes the need for economic activity that conforms to physical and biological limits.

Much of the analysis drawn from the standard approach is microeconomic, based on the workings of markets. Variations of standard market analysis can be applied to cases in which economic activity has damaging environmental effects or uses up scarce resources. Other economic analyses provide insight into the use of common property resources and public goods.

Ecological economics takes a macro perspective, emphasizing the relationship between economic production and the major natural cycles of the planet. In many cases, significant conflicts arise between the operations of the economic system and these natural systems, creating regional and global problems such as global climate change from excess carbon dioxide accumulation. This broader approach requires new ways to measure economic activity, as well as analysis of how the scale of economic activity affects environmental systems.

This text outlines both analytical perspectives and draws on both to help clarify the major issues of population, food supply, energy use, natural resource management, and pollution. The combination of these analyses can help to formulate policies that can address specific environmental problems as well as promote a broader vision of environmentally sustainable development.

KEY TERMS AND CONCEPTS

anthropocentric worldview
common property resources
ecocentric worldview
ecological economics
economic value
environmental economics
externalities
inherent value
market-based solutions
market failure
natural resources
nonrenewable resources
pluralism
public goods
renewable resources
standard circular flow model
sustainable development

DISCUSSION QUESTIONS

1. Do economic growth and sound environmental policy necessarily conflict? Identify some areas where a choice must be made between economic growth and environmental preservation and others where the two are compatible.
2. Is it possible to put a money price on environmental resources? How? Are there cases in which this impossible? Identify specific instances of valuing the environment with which you are familiar or that you have read about.
3. In what ways do the principles of ecological circular flow resemble those of the economic circular flow? How do they differ? Give some specific examples in the areas of agriculture, water, and energy systems.

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WEB SITES

1. **www.worldwatch.org.** The homepage for the Worldwatch Institute, an organization that conducts a broad range of research on environmental issues. The Worldwatch annual "State of the World" report presents detailed analyses of current environmental issues.
2. **www.ncseonline.org.** Web site for the National Council for Science and the Environment, with links to various sites with state, national, and international data on environmental quality.
3. **www.unep.org/geo/.** Web site for the Global Environment Outlook, a United Nations publication. The report is an extensive analysis of the global environmental situation.

NOTES

[1] See http://www.uncsd2012.org/content/documents/814UNCSD%20REPORT%20final%20revs.pdf.
[2] UNEP, 2012, pages 5 and 23.
[3] IPCC, 2014, page 8.
[4] United Nations, 2015.
[5] Often the term "environmental and natural resource economics" is used instead of just "environmental economics" (as evident by the title of this book). Natural resource economics focuses on issues related to the allocation of natural resources, while environmental economics focuses on issues such as pollution, public goods, and the value of ecosystem services. For simplicity we use the term environmental economics here, but this is inclusive of natural resource economics as well.
[6] See Sandmo, 2015.
[7] Howarth, 2008.
[8] Plumecocq, 2014.
[9] For example, see Hoepner, et al., 2012.
[10] Baumgärtner and Quaas, 2010, p. 449. See also, Remig, 2015.
[11] Howarth, 2008, p. 469.
[12] Spash, 2013, p. 359, 361. See also, Söderbaüm, 2015.