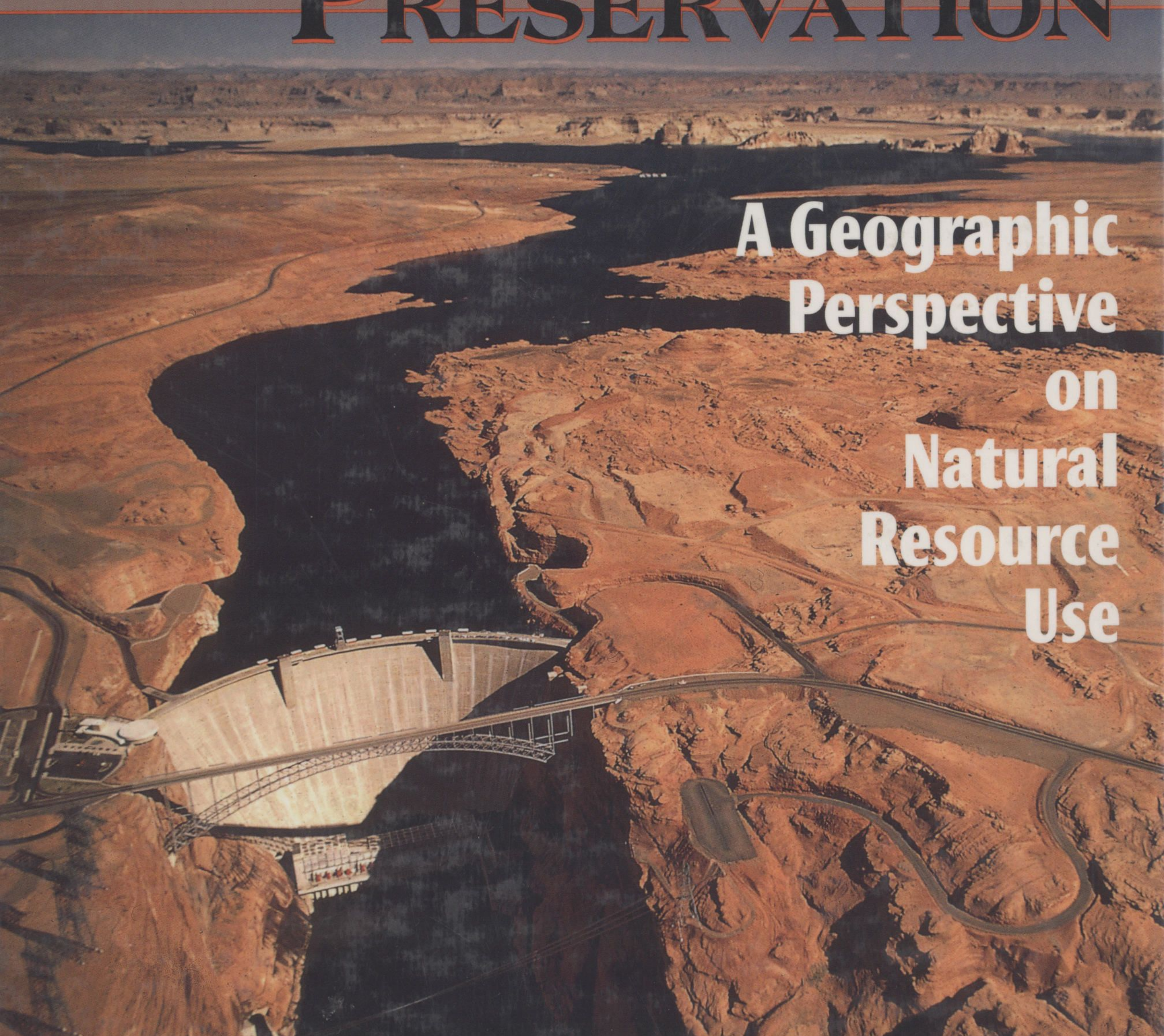
Susan L. Cutter • William H. Renwick

Exploitation Conservation Preservation



A Geographic Perspective on Natural Resource Use

Third Edition

*E*XPLORATION *C*ONSERVATION *P*RESERVATION

A Geographic Perspective on Natural Resource Use

THIRD EDITION

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Exploration Conservation Preservation

A Geographic Perspective on Natural Resource Use

THIRD EDITION

PREFACE

Natural resource conservation has been an important college-level course for several decades, and many good texts have been written on the subject. Moreover, in the nearly 30 years since the first Earth Day, students' interest in environmental issues has remained high. The textbooks most often used since the early 1970s have reflected the ideals of the recent environmental movement, with its concern for natural environmental processes, pollution control, the population explosion, and depletion of mineral and other resources.

The environmental movement of the 1960s and 1970s was one of idealism. Throughout the 1970s and 1980s those ideals became incorporated into many aspects of government policy, business practice, and the everyday concerns of the general population. Since the late 1980s, we have seen both a renewal of environmental concerns with a global focus and a maturation of our understanding of the interdependence of economic processes and environmental protection. Today natural resource issues have great emotional and political significance, and form one of the most central elements of our economic and social lives. As we near the next century we are obliged to examine the diverse facets of these issues.

In this book, we integrate physical, economic, social, and political considerations into our examination of the major natural resource issues facing the world today. We take the view that none of these four factors alone determines the suitability of a resource for any particular use at any time. Rather, a dynamic interplay between these factors causes continuing changes in methods and rates of resource exploitation. The title *Exploitation, Conservation, Preservation* includes three value-laden and politically charged words that have been at the heart of the natural resources debate over the last century. The subtitle, *A Geographic Perspective on Natural Resource Use*, reflects the traditional use of geography, which integrates studies of physical and human phenomena to understand human use of the earth.

Although the authors share this approach to the subject, we have contrasting scientific and philosophical views. With the exception of the epilogue we have avoided, as much as possible, taking any one point of view. Instead, we have attempted in most cases to include a wide range of opinions and interpretations of natural resource issues, in the hope that this will provide both a balanced review and a basis for discussion. At the same time, no commentary on natural resources can be free of political content, and we recognize that this book must inevitably be influenced by its authors' personal views. We hope that students reading this book will learn to recognize and understand the political content of our discussions as well as others' presentations and arguments on these issues.

In this edition we have made use of several global environmental databases that are now available. These are invaluable instructional tools that have the potential to transform a course in environmental conservation from one that helps students to understand the issues to one in which they learn how to analyze and quantitatively evaluate the significance of resource patterns and trends. We have used a small fraction of these data to illustrate some of the more important topics covered in this text, but we encourage students and instructors using the book to exploit these data more fully, and especially to be aware of changing conditions over time. Fortunately, the Internet and those who have made their data available on it have made this much easier than it was just a few years ago.

In this regard, we are establishing a new web-based resource for users of this book. It will consist of updates on important topics (equivalent to new or updated issue boxes) and links to other web sites with useful data related to this text. The URL for this is **www.wiley.com/college/cutter**

Those familiar with the previous editions will recognize many changes, most significantly the consolidation of agriculture and rangeland into a single chapter on food, consolidation of the water quantity and quality chapters, and an entirely new chapter on sustainability. These changes were made primarily to highlight the interconnectedness of these resource issues. As before, a glossary has been included for students' use.

In producing the third edition we have benefited not only from those who worked on previous editions, but also from several people who contributed specifically to this one. In particular, we would like to thank Jerry Mitchell, Rick Collins, Tracy Fehl, and Bill Lace at South Carolina, and Andrea Kuyper and Mark Petrie at Miami who helped with bibliographic and statistical research. Many reviewers offered useful critiques including Kirstin Dow (University of South Carolina), Leslie Duram (Southern Illinois University), Tom Orton (Concordia Lutheran University, Austin), John Hayes (Salem State College), Melissa Savage (UCLA), Roger Balm (Rutgers University), Neil Salisbury (University of Oklahoma), Paul Knuth (Edinboro University of Pennsylvania), Chris Steele (State University of New York, Binghamton), Clarence Head (University of Central Florida), Marvin Baker (University of Oklahoma), Solomon Isiorho (Indiana Purdue University), Norman Stewart (University of Wisconsin) and Marshall Parks (Indiana State University).

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We also thank our families: Langdon, Nathaniel, Megan, Debra, Sarah, Levi, Peg, and Oliver who continue to be understanding of the time pressures we face. The authors accept all responsibility for any errors, and we share credit with everyone who helped us for any praise this book may receive.

Susan L. Cutter
William H. Renwick

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CHAPTER 1

NATURAL RESOURCES: THOUGHTS, WORDS, AND DEEDS

WHAT IS A NATURAL RESOURCE?

Have you ever wondered what went into the manufacture of the pencil you are now using? A seed germinated and consumed soil nutrients, sprouted and was warmed by the sun, breathed the air, was watered by the rain, and grew into a beautiful straight tree. The tree was cut down. Perhaps it rode a river's current, was stacked in a lumberyard, and was sawn into small pieces. This wood was transported to a factory, where it was dried, polished, cut, drilled, inserted with graphite (which is made from coal), and painted. Then consider how the pencil made its way to you. It has been packaged attractively with appealing letters painted down its side, shipped via truck, and stored in a warehouse. Your pencil's active life will not end with you, for it may be used by other hands and minds if you lose or discard it.

Where are the natural resources in that description? *Resources* are things that have utility. *Natural resources* are resources that are derived from the Earth and biosphere or atmosphere and that exist independently of human activity. The seed, tree, soil, air, water, sun, and river are all natural resources. They are out there, regardless of whether or not human beings choose to use them. They are the *"neutral stuff"* that makes up the world, but they become resources when we find utility in them (Hunker 1964).

Now, consider the role of human effort in the creation, sale, and use of that pencil. First, in addition to natural resources, nonnatural resources are needed, such as saws, labor, and the intelligence to create the pencil. But what motivates people to select and use some portions of the neutral stuff so that they become resources while other things are neglected? It is here that we are able to isolate the subject matter of this book: the interactions between human beings and the environment or the neutral stuff. When geographers focus on natural resources, we are asking: What portions of the Earth's whole have people found of value? Why? How do these values arise? How do conflicts arise, and how are they resolved? Neutral stuff may exist outside of our use, but it becomes resources only within the context of politics, culture, and economics. Let us begin, then, to try to understand how and why resources emerge, are used, and fought over.

Resource Cognition and Value

A resource does not exist without someone to use it. Resources are by their very nature human-centered. To complicate the picture, different groups of people value resources differently. Let's look at the role of environmental cognition in the emergence of resource use.

Environmental cognition is the mental process of making sense out of the environment that surrounds us. To cognize, or think, about the environment leads to the formation of images and attitudes about the environment and its parts. Because we constantly think and react to the environment, our cognition of it is constantly changing on some level. Nonetheless, certain elements of environmental cognition will remain stable throughout our lives. Many factors influence our cognition of resources and thus how they will be used. These factors can be grouped into five broad categories: (1) cultural background; (2) view of nature; (3) social conditions; (4) scarcity; and (5) technological and economic factors (see Fig. 1.1).

With regard to the first category, there are many different cultures in the world, and each has a different system of values. What has value and meaning in one culture may be regarded as a nuisance in another. More to the point, the value and meaning assigned in one culture may be the complete opposite of the meaning and value of that resource in a different culture. Whaling provides a classic example. Native Americans, especially the Inuit, historically used whales as a source of food and the whale's fat as fuel. Later, the Inuit used whale bones in their arts and crafts, a usage that continues to the present. Today, most Americans appreciate the majesty and beauty of these marine mammals and value them, not as a consumable resource (food and fuel), but as an aesthetic one. Whale watching in California and New England draws thousands of people to view these migratory mammals in their natural habitat. Harvesting whales for food produces high seas protests against commercial whaling vessels, actions that garner world headlines and public sympathy (Fig. 1.2).

The mesquite, a deep-rooted drylands shrub, is another example of cultural differences. Ranchers in West Texas feel the need to fight the thirsty mesquite because they perceive that it dictates what will flourish and what will wither and die in the semiarid environment. Range grasses are shallow rooted and do not compete well with mesquite, which thus deprives range animals of a source of food. As one popular magazine reported, "the rancher enjoys with his mesquite the same relationship that Wile E. Coyote maintains with the Roadrunner in the children's cartoon; the rancher will try anything short of nuclear weapons to conquer mesquite" (*Time*, March 1, 1982). Yet, not too long ago, the Indians of the American Southwest lived quite harmoniously with the now pesky mesquite. The mesquite was used for fuel and shade, while the bush's annual crop of highly nutritious beans was a staple resource. Even diapers were fashioned from the bark. Today mesquite is popular as a fuel for gourmet barbecues.

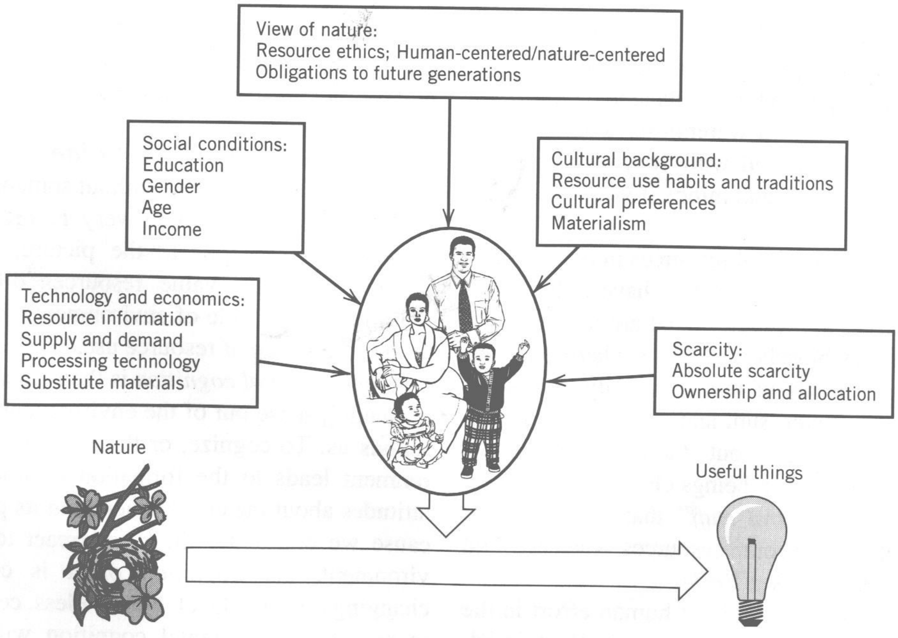

Figure 1.1 Factors involved in resource-use cognition include cultural evaluation, view of nature, social change, economic and technological factors, and resource scarcity.

Figure 1.2 Society's view of nature. Nature can be viewed as a commodity or as a scenic wonder in need of preservation. These Greenpeace activists believe that killing whales is immoral, and use dramatic actions such as this to call attention to their beliefs. In Norway, whales have been eaten for years and many regard this as morally no different from eating any other animal.

A society's view of itself relative to its natural environment is a second indicator of how it will ultimately use natural resources. On an idealized spectrum, different worldviews range from human domination and control of nature (technocentrism) to living in harmony with it (ecocentrism) (Pepper 1996). Of course, there is variation within any one group; not all members will agree on their view of nature. These underlying philosophical ideas form the basis for many of the modern environmental movements (Chapter 3).

Social conditions the third category, influences the value and use of resources. The composition of societies is constantly changing. People grow older, richer, and poorer, and the cultural makeup of societies changes. All of these factors, particularly ethnicity, gender, education, and income, influence how societies cognize and use resources. For example, higher-income households in the United States use more energy than do lower-income households. In colonial New England, lobsters were fed to indentured servants as a cheap food resource. It was not until the late nineteenth century and the influx of southern European immigrants, who regarded the lobster highly, that it became a valuable culinary delicacy.

Cognition of future resources is colored by historical and current use; cognitions also change over time. As a result, planning for future uses of natural resources must take account of these changes. Economists, politicians, and industrialists find it difficult to make accurate forecasts of future resource uses. We may overlook today a resource that will become invaluable in 20 years. Specifically, the solid waste we produce and discard today may be a source of raw materials in the future, and we may see mining reclamation projects in old landfills.

The fourth factor influencing natural resource cognition and use is resource scarcity. As a natural resource becomes scarce or is cognized as becoming scarce, its value may increase. This scarcity may be of two different types. *Absolute scarcity* occurs when the supplies of that resource are insufficient to meet present and future demand. The exhaustibility of all supplies and known reserves of some resources is possible, if improbable. The dwindling supply of certain land resources such as wilderness could conceivably lead to an absolute scarcity. *Relative scarcity* occurs when there are imbalances in the distribution of a resource rather than the insufficiency of the total supply. This imbalance can be either short or long term. Climatic fluctuations resulting in floods, droughts, or frost routinely cause relative shortages of fresh produce. Open space was not considered a resource until it became relatively scarce in urban areas. Then it became something to be valued, protected, and incorporated into urban redevelopment plans. Relative scarcity also results when one group is able to control the ownership or distribution of resources at the expense of another group. In the energy crises of the early and mid-1970s, Americans were told by both environmental and industry experts that the supply of oil and gas was dwindling—and that it would be impossible to meet future demand because of the absolute scarcity of the resource. Yet, in the 1990s, we see lower prices and a more than adequate supply, suggesting that relative scarcity was in fact the cause of the energy crisis.

Finally, the fifth set of factors that influence resource cognition and use are technological and economic, both of which are basic to understanding the role of scarcity. Technological factors relate to our knowledge and skills in exploiting resources. Groundwater is not a resource until it is made available by drilling a well and installing pumps or other means to bring it to the surface. Desert lands have little agricultural value unless we possess the technical capability to collect and distribute irrigation water, at which time they may become very valuable. Deuterium in the oceans is not at present a resource, except for its use in weapons. However, if we learn how to control the fusion reaction for energy production in the future, it may become a resource.

Economic factors combine technology and cognition, as reflected in our pricing system. That is, the value or price of a good is determined by its physical characteristics as well as our ability and desire to exploit those characteristics. In a capitalist economy, a commodity will not be exploited unless it can be done at a profit. Therefore, as prices change, things become (or cease to be) resources. A deposit of iron ore in a remote location may be too expensive to exploit today, but if prices rise substantially it may become profitable to exploit and sell that ore; at that time it becomes a resource.

Rarely is the status of a resource determined by technological, cognitive, or economic factors alone; usually it is a combination of all three. The nuclear power industry is a good example. The development of fission reactors and related technology was necessary for uranium to become a valuable energy resource. But rapid expansion of nuclear-generating capacity depends on this energy source being economically competitive with other sources, such as coal and oil. Coal has become costly to use, in part because of concerns about the negative environmental effects of global warming, air pollution, and mining. These concerns helped make nuclear power competitive. But the belief that nuclear power is unsafe necessitated modifications in plants that drove up the cost of nuclear power to the point where it is no longer economically attractive. In addition, many people, citing environmental and health fears, reject nuclear energy at any price. The interplay of these forces will continue to affect the choice of nuclear power relative to other energy sources for some time.

Kinds of Resources

There are various ways to classify resources. We can ask how renewable they are and who benefits from them. *Perpetual resources* (Fig. 1.3) are resources that will always exist in relatively constant supply regardless of how or whether we exploit them. Solar energy is a good example of a perpetual resource; it will continue to arrive at the Earth at a reasonably constant rate for the foreseeable future. In the past, the atmosphere and precipitation were regarded as perpetual resources. Recently, however, their quality and the absolute supply of rainfall in some locations have been questioned.

Resources that can be depleted in the short run but that replace themselves in the long run are called *renewable* or *flow resources*. Forests, most groundwater, and fisheries are good examples. Although they can be depleted by harvesting in excess of the replacement rate, if given sufficient time and the right conditions, natural processes will replace them. The key to maintaining the availability of renewable resources is keeping our rate of use at or below the rate of natural replacement.

Nonrenewable or *stock resources* exist in finite supply and are not being generated at a significant rate in comparison to our use of them. Once they are used up that is the end of them. Most geologic resources, such as fossil fuels and mineral ores, are of this type, as is wilderness.

Finally, *potential resources* are not resources at present, but may become resources in the future depending on cognitive, technological, and economic developments. Their potential depends in part on decisions made about them today. Should we make decisions that eliminate them from consideration (such as allowing a plant or animal species to become extinct), then there is no chance of our discovering a resource value in them. Some contemporary examples of potential resources that have recently come into use are

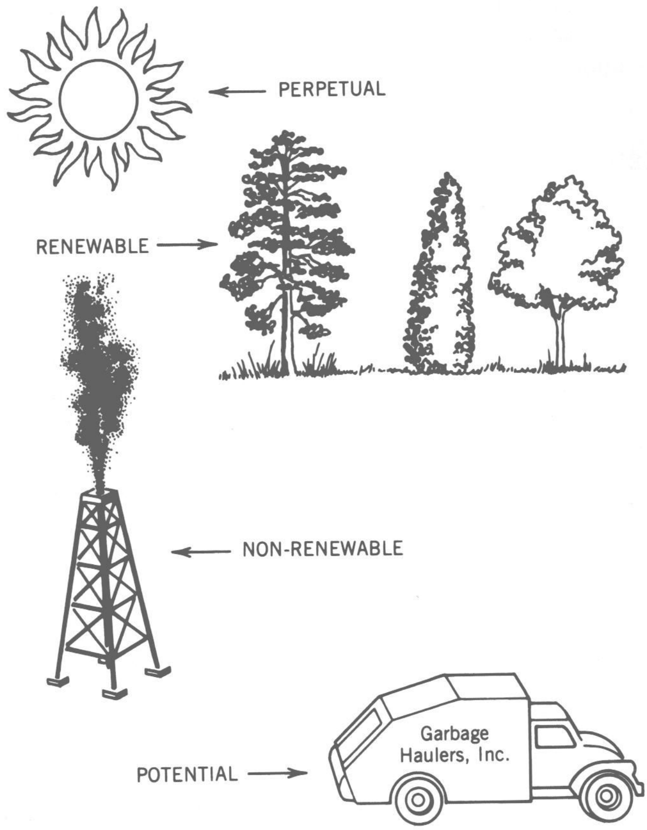

Figure 1.3 The four traditional resource classifications. In reality, a resource can shift from one category to another.

solid waste as an alternative fuel or material source and wastewater that might be treated and used in irrigation or other purposes.

Limits to Resource Classification

Although these definitions are relatively clear, to a large extent the status of any resource as perpetual, renewable, or nonrenewable depends on the time scale in which we view it and on how we manage the resource. Even though rainfall on the global level is reasonably constant from year to year, in many areas the quality of that water has been changed by industrial and auto emissions that produce acid rain. On a longer time scale, there is evidence that we may be causing global climatic changes, resulting in increases or decreases in rainfall at the regional level, if not worldwide. Soil, generally regarded as a renewable resource, will recover some degree of its natural fertility if left fallow for a few years. But if accelerated erosion removes a substantial portion of the soil profile, the ability of that soil to support plants that restore nutrients and organic matter may be impaired. It may be centuries before the soil is again productive. That time period is probably too long to consider the soil renewable in human terms.

Similarly, groundwater is generally considered a renewable resource, but in many areas, particularly desert areas where it is so important, the natural rate of recharge is very low, and in some cases there is presently little or no recharge. In these cases the groundwater is effectively a stock resource; once it is used it is lost forever. For these reasons, the traditional definitions of resources tell us little about the true nature of particular resources. In fact, they may be harmful, leading us to think that a renewable resource *will* always be available regardless of how we exploit it. These classifications illustrate, however, that not all resources are equal to the demands put on them. They also indicate the im-