Land Resource Management:

Economic Foundations and New Directions

Raleigh Barlowe, Soji Adelaja, and Paul Babladelis

Michigan State University

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Foreword

This book is a collaborative effort to provide a comprehensive look at the foundations of natural resource economics and to lay the foundation for accommodating changes that have occurred with the New Economy. Technological innovation has been one driver impacting these changes, but thinking about "the market" has expanded to incorporate additional factors and move toward a systemic view of value creation. It is essential for today's leaders and resource managers to have an understanding of the foundations, the ideas upon which the Old Economy was structured, and to become familiar with recent developments and changes that are on the horizon.

Eminent economist and scholar, Professor Raleigh Barlowe, Ph.D., wrote the foundations chapters of this work. His text, *Land Resource Economics: the Economics of Real Estate*, has been used in countless graduate level courses since the first edition was published in 1958 (At one time the text was in use at 78 colleges or universities). Copies of his fourth edition are still in use today and thousands of resource managers worldwide have planned, and continue to plan, using his methods. One of the most powerful concepts he conveys is that land is foundational to entrepreneurship, capital accumulation, and wealth formation; therefore, the long-run prosperity of society depends on how well we manage this resource whose use is not always reversible. Land, in this context, includes all the physical attributes of planet earth, surface soil and minerals, all that lies below the surface, water, the atmosphere, and the plants and animals that grow from the planet. It is a pivotal societal asset, the effective management of which is key to human prosperity and survival.

Professor Barlowe popularized the concept of the three-fold framework by which development projects are examined simultaneously through the lenses of: 1) physical and biological capability, 2) technological and economic feasibility, and 3) institutional acceptability, including laws, rules and regulations, as well as general public acceptability. This approach provided a systems view for the field of land resource economics and is a forerunner of the current triple bottom line analysis that considers development projects regarding benefits and/or costs for 1) people (social and physical well-being), 2) the planet (natural systems), and 3) profits (a variety of economic considerations).

This framework has been a prime driver in management of land resources for more than 50 years, yet the authors of this book note that even with advances in resource economics, its economic foundation does not allow a sufficient framework for addressing current land-based resource management issues. Advances in the study of ecology and institutions have created the need for a more holistic analytical framework for contemporary management strategies appropriate in the New Economy. However, the extensive presentation of production economics in this book regarding land resource use is vital to understanding factors that have contributed to the present situation and to understand a prime driver in resource use that still trumps all other factors in many cases.

The New Directions chapters of this book were written by Soji Adelaja, Ph.D., the John A. Hannah Distinguished Professor in Land Policy at Michigan State University, founder and former director of the Land Policy Institute. He is best known for his work in land use policy, agricultural and food policy at the urban fringe, asset-based economic development, economies of place and emerging issues in the New Economy. In his work he makes the point that production-centric frameworks for how the economy works are no longer valid. He further makes the point that traditional theories that treat land as an input to production, often at the cost of depletion, are no longer adequate to explaining the economies of places. This is especially true with the advent of the New Economy where natural resources, without alteration or consumption, are key attractors of critical factors that drive contemporary economic growth.

Dr. Adelaja, as well as other leading scholars, informs current literature with the understanding that natural resources are amenities that attract knowledge workers who have become the most critical drivers of economic transformation. In essence, conservation enhancement and leveraging of land assets can no longer be viewed as contradictory to current production and prosperity, or as costs to society, but must be viewed as critical assets to enhance in order to strengthen the economies of places in the New Economy. This book informs many of the most important developments in land use in the New Economy, including the emerging green economy, place science, and the economics of place performance.

As the Land Policy Institute's first director, Dr. Adelaja was responsible for much of the authoritative research used to chart new sustainable strategies for the future of Michigan and beyond. Examples of effective outreach include the People and Land (PAL) Program, the Michigan Citizen Planner Program, and the Michigan Prosperity Initiative. Dr. Adelaja is a respected consultant for government leaders at the state, national, and international levels. He is currently working internationally with significant impact on land policy in Africa, as well as the U.S.

Paul Babladelis, Ph.D., not only contributed critical pieces to this book, but also helped coordinate this project, and worked with other co-authors to develop the design and flow of the text. Dr. Babladelis, a specialist in international development from the Center for Advanced Studies in International Development at Michigan State University, has worked internationally to develop new models for economic and social management of natural areas that span national boundaries. His work seeks to create value through place and turn conservation and preservation costs into tangible benefits. Both Dr. Adelaja and Dr. Babladelis are proud to have worked closely with their teacher, mentor, and professional role model, Professor Raleigh Barlowe.

The book is presented in four parts. The first chapters of Parts One, Two, and Three provide the foundations of land resource economics. These three parts end with a chapter that discusses current developments, new directions, and possibilities for the future. Part Four draws upon both the foundations and new directions to examine current resource management issues that will provide critical challenges in the future.

This book touches on economics, ecology and ethics, social institutions, formal rules and regulations, not only of agriculture and rural areas, but with a consideration that rural and urban systems are connected, from the local to the global. An in-depth analysis of the institutional framework for land use and land policy, including planning, property rights, ownership structures, and the role of government, is provided with the recognition that these systems must evolve to meet emerging land management issues. These issues are also examined from the emerging lens of the New Economy; a model that is radically different from one in which land resources are simply inputs to production.

Land Resource Management: Economic Foundations and New Directions provides a comprehensive but user friendly treatise on environmental conservation and protection programs. It recognizes that environmental considerations must be integrated into planning for the future, and that the biological flow resources of the planet must be protected and nurtured rather than stressed to potential tipping points. The chapters on specific environmental problems touch on key issues, such as global warming, the protection of the ozone shield, and control of air and water-borne wastes. Also addressed are such issues as the use of fossil-based non-renewable energy sources, including nuclear power, coal, natural gas, as well as renewable energy alternatives, including biofuels, wind energy, solar power, geothermal, wave energy, and hydropower.

This book will provide subtle but important criticism of several academic disciplines, especially economics. While it provides a comprehensive and detailed analysis of production economics, it also calls for in-depth social analysis and a thorough understanding of development impacts on the natural world. It makes the point that academic disciplines have evolved into almost impermeable silos that have become limited in their ability to foster tangible real world discourse or effectively address practical problems of society. The authors argue that many current academic disciplines are increasingly losing sight of the fact that these disciplines exist to create knowledge that is relevant in today's society. The problems of the world demand that our approaches must now be integrative, interdisciplinary and eclectic.

Land Resource Management: Economic Foundations and New Directions provides an authoritative reflection on the planning theory and methodology that have brought us to the present. It suggests that a prosperous and sustainable future will be possible if ideas and institutions can adapt with the changing landscape.

A Note from Professor Raleigh Barlowe

With our worldwide concern about maintaining both the quantity and quality of the benefits we derive from use of our land-based and environmental resources, it is appropriate that emphasis be given to the wide array of economic and social considerations that affect their management. This need has not gone unnoticed. Numerous books have been written on the subject. Much of their emphasis, however, is limited in coverage and sometimes calls for more advanced levels of analysis than is appropriate for general readers.

My objective in partnering to write this book is simple. It is to provide readers and students at an introductory level with wide exposure to economics, and to a lesser extent, the social issues that affect the management of land resources, including the environment. My intent is to keep the analysis simple and leave formulation of concepts in algebraic and calculus terms, together with rigorous analysis of economic models, to others.

I am well aware of the fact that some readers will feel that various topics should be treated in more detail and sometimes with more sophisticated levels of analysis. I would like to remind them that entire volumes can be written on these topics and that our purpose is limited to providing readers with a broad overview of the economic and social issues involved in the management of land-based resources. Hopefully, the book will fill this need both for those who plan to pursue more advanced studies, as well as for readers who have little interest in more rigorous analyses.

Emphasis is given throughout to treating issues in a broad interdisciplinary manner and recognizes that economists do not have a monopoly in considering environmental management concerns. Valuable inputs also are needed from other fields, such as chemistry and physics; from earth sciences, such as geology, geography, and soil science; and from the biological sciences, and from law, political science, sociology, history, and the field of ethics.

Use of a multidisciplinary holistic approach is needed in the formulation of environmental management policies, because, while specialists from separate disciplines can provide valuable insights, amalgamation of relevant contributions from other disciplines is needed if truly workable answers are to be found. Viable answers are dictated as much by ecological, ethical, and political science considerations as by economics, and better decisions are made when one has knowledge of what has happened in the past. Tolerance and desire for cooperation are needed as people with different points of view examine alternatives in their quest for workable programs for action.

All of us are products of our individual backgrounds. This being the case, it is important that I indicate the nature of my philosophy concerning use of the environment together with my credentials for writing on the subject. I hold that as members of society, we all have vested interests in the uses made of the environment. These uses should contribute to our welfare as individuals and to the welfare of society at large; and emphasis should be given throughout to sustaining the flow of benefits that nature provides over time and for all living beings.

With an undergraduate degree in history, a master's degree in political science, and a doctorate in economics, I see myself as a political economist who has a strong leaning towards institutional economics. My professional career has been spent working as a land economist, a detail that explains much of the emphasis of my contributions to this book. My interest in this field was stirred when I took a course taught by Lewis C. Gray, author of the landmark article "The Economic Possibilities of Conservation" (1913). I later studied under George S. Wehrwein, the premier land economist of his day, at the University of Wisconsin. While there, I associated with Wehrwein's close friend and one-time office mate, Aldo Leopold, who had won comparable recognition as an ecologist. Some years later I had the pleasure of working for a while with Garrett Hardin who wrote "The Tragedy of the Commons" (1968).

I feel deeply grateful to these pioneers in scholarship and to the dozens of other teachers, colleagues, and students who have done much to shape my thinking. I am particularly grateful to Professor Soji Adelaja, whom I see as my replacement at Michigan State University to carry on the leadership of work in this important area of inquiry, and to my former student and friend, Dr. Paul Babladelis, the first recipient of the Jean and Raleigh Barlowe Endowed Graduate Fellowship in Natural Resource and Environmental Economics and Policy. I am grateful to them for joining me to ensure that I complete what will probably be my last book in this field. I am also grateful to Theo R. (Ted) Alter, and Scott G. Witter for the encouragement they have provided for this work, and to Professors Patricia E. Norris, John M. Kerr, Milton H. Steinmueller, and Mark A. Wyckoff for their generous assistance in reviewing earlier versions of our work. They provided noteworthy suggestions for its improvement. Credit also is due to the staff of the Land Policy Institute who provided valuable help with figures, graphics, and tables. These include Steve Stofflet, Charles McKeown, Ben Calnin, Katherine Baird, and Heidi Charron Macwan.

Raleigh Barlowe

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Chapter 1: Basic Concepts

"Ask not what your country can do for you,
ask what you can do for your country."

~John F. Kennedy (1961)

"Ask not what your country can do for you,
ask what you can do for yourself."

~Richard M. Nixon (1969)

Perceptions of the environment vary. For some, the term *environment* conjures up visions of fields of wild flowers, a walk in a forest, sailing on pristine waters, or perhaps a view of mountain majesty or of a gorgeous sunset. For others, it may revive memories of cherished vacation spots, places where we liked to hunt or fish, or sightings of rare endangered species in some far off wilderness. These are important aspects of the environment but they are only the exotic fringes of a larger concept that involves all of the natural resources of the earth with which we work every day.

Defined in a dictionary sense, the term environment refers to the conditions that affect the existence, development, and welfare of living organisms. It is a broad concept that can be and is used to describe a vast array of situations involving both human and non-human life. One may speak, for example, of one's household or neighborhood environment, the environment of the workplace, or of the environment affecting the growth of a culture in a laboratory.

Popular concerns about how we are using the vast resources of nature have brought a broad concept of global environment to the fore and made it what most people think of when they speak of "the environment.” It is with our economic and social management of this concept that we are here concerned.

It should be noted from the onset that this not a book on earth or environmental science. Earth science draws on physical sciences, such as chemistry, geology, physics, and soil science, and on the biological sciences for explanations of how our environment was formed, and why it is as it is. Findings from these sciences provide a necessary underpinning for discussions about the economic and social management of the environment. With our focus on this concern, however, we will draw upon the findings of earth and biological sciences and not seek to replicate or extend their research. Our emphasis is not on the nature of the environment but rather on the economic, legal, public policy, human society, and ethical considerations that affect our use of it. Sustainable use of these natural resources have biological constraints, and land resource managers must be aware of them, yet key to this equation is the concern of this book; how can human beings manage land resources in a way that yields the greatest benefits for most people living on the planet and without diminishing options for future generations?

Economics, Ecology, and Ethics

Economics, with its emphasis on the allocation of scarce resources, has an obvious concern with how environmental resources are used. Since its beginnings as a recognized discipline during the 1700s, it has tacitly assumed the operation of an ever expanding economy that comes as a growing labor force draws heavily on our environmental resource base for the inputs needed to provide a steadily increasing stock of capital goods. Somewhat in contrast, ecology, the science that deals with the mutual relations between organisms and their environment, operates with the assumption that all activities affecting the environment must take place within the fixed confines and constraints of the earth's ecosystem.

As the two disciplines matured in the two centuries following the mid-1700s some scholars foresaw a coming clash between their objectives. Rev. Thomas Malthus (*Essay on the Principles of Population*, 1798), for example, questioned the world's ability to provide enough food to sustain its burgeoning population while George Perkins Marsh (*Man and Nature*, 1864) noted the adverse effects acts of man could have on the environment. Yet while many others followed them in raising questions about the earth's ability to provide needed food supplies and about the impact of increasing population numbers on its supposed carrying capacity, economics and ecology continued to operate as independent disciplines that showed hardly more than a nodding acquaintance of each other until the late 1900s. Meanwhile, ethics, the philosophical view that one should do the right thing in working for the welfare of all, affected the attitudes and thinking of both the economists and the ecologists.

Two important developments have come front and center to change the situation. Among the ecologists, Rachel Carson proclaimed in *Silent Spring* that man has, *"acquired significant* *power to change the nature of his world"* (1962). Economists have realized that their vision of ever expanding growth has to take place within the confines of the ecologist's closed ecosystem. Like trying to grow plants in a bottle, only so much growth can be expected before lack of space will prevent further growth. Recognition of that fact led some economists, such as Herman Daly (*Toward a Steady-State Economy*, 1973) and E. F. Schumacher (*Small is Beautiful*, 1974) to endorse the concept of a steady state economy.

A second and equally important factor of ethical consequence came when mounting evidence that the economy's output of wastes was causing serious pollution of the world's air, water, and land. Bill McKibben (*The End of Nature*, 1989) presented a powerful case to document human impacts on the natural environment, including global warming.

Global warming can be seen as a great spoiler. It introduced what had been an unrecognized barrier to economic growth in that it highlighted a newly discovered limiting dimension to the size of the bottle within which economic growth can take place. It also carries with it a threat that failure to limit our contributions to its cause can lead to consequences that have the potential to change the nature of the ecosystem in which we live. While beliefs about global warming are varied and passionate, its reality is widely accepted when using empirical data. One current example can be found in the updated Plant Hardiness Zone Map published by the USDA that shows warmer temperatures in the U.S. based on the average annual extreme minimum temperature during a 30-year period in the past (USDA, 2012).

The job of management is often thought of as that of making parts work together efficiently, of cutting labor and materials costs and maximizing profits for the firm. Managing the environment calls for pursuit of these objectives but also for operating and making decisions in a broader framework. Managers of the environment have a moral and ethical responsibility to do what is right for society by working with nature rather than treating it simply as a resource to be used. They also have an implicit responsibility to work for the general welfare of society and to support sustainability of the environment by protecting nature's ability to generate a continuing flow of benefits that can be of use to living beings. With these goals, managers have an obligation to stretch the beneficial uses of fund and flow resources and at the same time minimize the adverse effects that arise with the disposal of wastes.

Environment as an Economic Concept

Much as we appreciate and value the more wondrous gifts of nature, the real environment that we must accept and work with is found in the vast array of natural resources that exist in the workaday world that surrounds us in our daily lives. It includes the air we breathe, the water we drink, the surface land we live on, and the minerals we draw from the earth.

For two hundred years, after economics emerged as a recognized discipline during the 1700s, economists treated land along with labor and capital as one of the three basic factors of production. Land was treated in this classification as a concept that embraced all of the physical and biological resources of the earth—its surface land, water, air, minerals, forests, and wildlife—in short as the God-given bounty of nature. This is the concept Henry George (*Progress and Poverty*, pp. 295–6, 1879) had in mind when he wrote:

> *". . . land is the habitation of man, the storehouse upon which he must draw for all of his needs, the materials to which his labor must be applied for the supply of his desires . . . On the land we are born, from it we live, to it we return again—children of the soil as is the blade of grass or the flower of the field. Take away from man all that belongs to land, and he is but a disembodied spirit."*

Viewed in this way, the terms <u>land</u>, <u>nature</u>, and <u>environment</u> all have comparable meanings each of which, for our purposes, can be treated as roughly synonymous with the others. While land once had a more narrow economic definition, an input to production, a new economic concept of land is emerging with the advent of the New Economy where land has development value by remaining in its natural state. This paradigm regarding new economic potentials of land will discussed in detail in later chapters. In the context of the New Economy, land, nature, and environment are closely linked.

Economic Objectives in Management

As human beings we are heavily dependent on our ability to draw on the resources of nature to provide sustenance for our lives. We need air, water, and food to sustain life, and once these essentials are met, we look to various uses of the earth's resources to satisfy a wide range of satisfactions. These satisfactions are both economic and non-economic in nature. In both cases, we expect managerial decisions to supply a surplus of wanted returns above their production costs.

Economics deals with the allocation of scarce resources. As such, it is concerned with creation of wealth and the process whereby one can secure a surplus of economic returns above their production cost. While non-economic considerations have their impacts on managerial decisions, emphasis is given in economic thinking to a narrowing of emphasis to strictly economic considerations. With the economist's concept of the economic man, one asks pertinent questions about how managers should use their resources to maximize their net returns, or under adverse circumstances, minimize their losses.

Attainment of economic objectives in resource management calls for application of several economic concepts. Important among them are the maximization of economic returns, the use of discount rates, the treatment of externalities, and securing the highest and best economic uses of resources.

Maximization of Economic Returns

The economic man is not content with just securing some economic net benefit. He is engineered to seek the maximum benefits possible above his costs of operation. This means that he must carefully identify the limiting and strategic factors he uses in production and allocate his other inputs around them to the point at which his last inputs of variable factors just pay for their use in the production process. Similarly, in his marketing transactions, he will seek profit maximization by supplying units of products for exchange to the point at which the last marginal units supplied can be sold at prices buyers are willing to pay. Calculation of these managerial objectives calls for input-output analysis, a topic that will be addressed in a later chapter.

The maximization principle lies at the heart of economic thinking. In our commercial society, the demonstrated ability of managers to generate surpluses of economic returns is one of the principal standards used to evaluate the quality of management.

Discounting Future Returns

Economic-minded operators prefer receiving their incomes now. They may be willing to accept promises of income to be secured at predicted future dates. In accepting them, however, they think in terms of the present value of the predicted future income. This present value can be thought of as the current sum, which if capitalized at a given interest rate over the length of the waiting period, would equal the value of the expected future income. The process of using the capitalization process in reverse is called discounting.

How much a future income is worth today depends on the period one must wait to get it and the discount rate applied. An income of $10,000 10 years from now is worth $6,139.13 today when discounted at a five percent interest rate but only worth $3,855.43 if discounted at 10 percent. Should the waiting period be extended to 50 years, the current values would be $823.67 when discounted at five percent and $71.65 if discounted at 10 percent.

As these examples suggest, discounting at high rates tends to discourage the holding of investments that cannot be harvested until distant years in the future. Promises of periodic receipts of income make enterprises more economically attractive, but in every case operator decisions are likely to be affected by their considerations of levels of expected income, discount rates, and the time periods they must wait before expected incomes can be received.

Positive and Negative Externalities

Resource developments often bring significant side benefits or costs to communities and residents of adjacent areas. These benefits and costs can be described as externalities. They occur whenever an operator's actions affect another's well-being and the associated benefits or costs are not affected by market prices. Positive externalities can be created when a shopping center or an amusement park is developed in what was once an open space area if its development brings the provision of streets, sewers, and other utilities, and also the prospect of hundreds of potential customers to areas that did not have them before. Negative externalities arise when developments bring problems, such as unwanted noise, air pollution, or traffic congestion that can reduce the attractiveness and value of adjacent properties.

New developments often bring higher land values and expanded opportunities for the owners of neighboring sites to use their properties for purposes that will yield higher profits than they have previously received. Where possible, it is to the developer's interest to try to capture or internalize as many of these benefits to their firms as possible. Railroad builders often used this approach during the 1800s when they insisted that local towns pay portions of their construction costs or be by-passed in favor of other towns. Disney World acted in a similar manner when it acquired a large adjacent area, the development of which it could control, when it picked the site of its operations in Florida.

Just as some developments create positive benefits for their neighbors, many others have negative effects, such as the stench from uncollected garbage or the smoke from a backyard fire. Familiar cases on a wider basis occur when firms discharge untreated wastes into the atmosphere, flush them into public waters, dump them on land, or when they cause unwanted traffic congestion or noise. Operators in these cases often have a financial interest in ignoring the ill effects their operations have on others and for avoiding responsibility for their creation of the negative externalities.

Highest and Best Use

Succession in land use is another economic concept that affects the management of environmental resources. Except for the small area used for his hut, primitive man was surrounded by a vast expanse of wild land. As he shifted from hunting and gathering to an agricultural economy, portions of the earlier wild land area shifted into meadows and agricultural fields. With the rise of towns and cities, pressures rose to shift portions of the farm and grazing areas into residential and trading centers. With the rise of industry, some residential areas, along with tracts of farm and grazing land, shifted to industrial and commercial uses, while more wild land was brought into agricultural use and more farmland into residential use.

This process of land areas shifting to those uses that can bid higher prices for their use brought a hierarchy of land uses. Industrial and commercial uses usually have the greatest capacity to bid for needed areas. Ranked below them in economic pecking order are residential uses, then agricultural and grazing uses, leaving wild lands in the lowest category. Figure 1–1 below illustrates the economic concept of highest and best use.

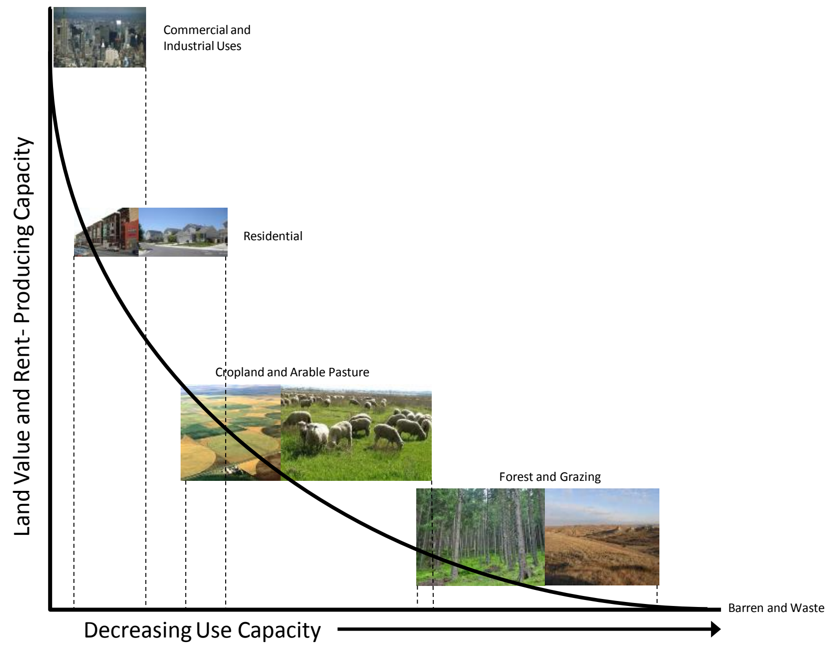


Figure 1–1. Economic Concept of Highest and Best Use

It must be noted that the concept of highest and best use is tied closely to the concept of value, and an appropriate question might be, “valuable to whom, and in what ways?” While wild lands historically did not command the highest sale price, their value is very high from an ecosystem perspective and continues to grow as humankind understands their importance in sustaining basic planetary functions. Healthy natural ecosystems have great economic value when they are considered as drivers in the creation of prosperous places favored by mobile and talented entrepreneurs in the New Economy. The historical concept of highest and best use does not capture the value of ecosystem services, but rather relies on a price per acre signal to indicate value.

Population and commercial pressures have done much to foster demands for shifting land areas to higher economic uses. It must be recognized, however, that this process does not always operate with mathematical precision. Location of land areas relative to the demand for their use always affects the succession process. Rigidities, such as unawareness of one's economic opportunities, conflicting ownership objectives, lack of financing for making changes, and considerations of supersession costs, may keep properties in their present use even when shifts seem overdue. Without public policy restraints that call for protection of the social values attributable to their uses, or a change in public attitude regarding relative value, the overall succession process can be expected to continue to operate in the future as it has in the past. However, as the chapters on the New Economy suggest, public values and attitudes may be changing, thereby altering the traditional categorization of “highest and best” use.

Countervailing Considerations

Managers of the environment must always give appropriate attention to the economic principles that guide the workings of the marketplace. No manager can expect to succeed while ignoring them. At the same time, they should recognize that the economic man's self-centered drive to maximize his own interests makes him an unrepentant Ebenezer Scrooge. However, all people have important objectives and interests in life besides making the last possible dollar. Professional economists, like the rest of us, are enamored by the joys of family life, by pursuit of non-economic goals, and by willingness to indulge in the pleasure of taking time to engage in favorite hobbies

Ugly as the concept of the economic man may be, it has definite value in that it identifies and highlights the basic principles that guide the decisions of commercial-minded operators. As a model for managerial decision-making, however, it can well be balanced with a parallel concept of the altruistic woman. Unlike the economic man, our Lady Altrua is primarily concerned with promoting the well-being of the people who populate her community. And, as with her counterpart, the attainment of her goals calls for recognition of a set of important considerations.

With two conflicting sets of considerations, managers can be expected to cluster more around one pole than the other. Money-minded operators may, thus, lean toward following the lead of the economic man while more community-minded operators are influenced by altruistic goals. Neither position is completely right or wrong. This is not an area in which we can speak of absolutes. Management of the environment calls for balanced consideration of the pulls from both poles.

Among the countervailing constraints that affect management of the environment, special attention should be given to maximizing social benefits, recognizing the ecological imperative, attaining continuity of benefit flows, dealing with limits to growth, and securing highest and best social uses of environmental resources.

Maximizing Social Benefits

While the goal of operators striving to maximize their self-interests provides motivation for the operation of Adam Smith's invisible hand in guiding the economy, it does not stand without criticism. It may indeed provide a worthy goal for the decisions made by honest businessman, but for those who operate outside the law, it can equally well be the objective of a bank robber or a stock swindler. As John J. Piderit (*The Ethical Foundation of Economics,* 1993) has observed, what appears as a maximizing of returns to one party "may appear as greed or thievery to others." As a goal for public action, it should be broadened to include maximization of the welfare interests of the entire community. Welfare economics has been generated as a subfield of economics to deal with this problem, and has brought with it recognition of the need for accepting maximization of social benefits and welfare as an objective that should guide the decisions of those who manage the environment.

The social benefits managers seek take several forms. They start, of course, with successful operation of whatever enterprise one is managing. Going beyond that common goal, they call for special efforts to assure a continuing flow of the benefits of nature. They may involve objectives as small as helping a person in need or as broad as preventing epidemics or avoiding wartime slaughter. They call for doing what people consider as the right thing from an ethical standpoint.

Many important social benefits, such as the peace of mind one enjoys in feeling secure, while living in one's neighborhood or the desire most people have to avoid the perils of war do not lend themselves to economic evaluations. Consideration of the public goods nature of many intangible social benefits and their possible negative impacts vastly complicate the problems managers face in trying to secure an appropriate balance between economic and social objectives in their investment decisions.

There are no easy guidelines managers can follow in securing optimum balance between economic and social benefits. Insofar as possible, attempts should be made to maximize both and neither should be downgraded at the expense of the other.

The Ecological Imperative

Managers of the environment should always remember that they are not dealing with isolated supplies of lifeless material. They work instead with ecosystems that involve the interrelations of the living (biotic) and non-living components of the biosphere that provide us with our home in space. Mankind does not stand alone or apart from the biosphere. We are part of it and our decisions concerning our use and abuse of its ecosystems should always be premised on the assumption that it is our responsibility as representatives of its highest living species to act as guardians for the others in providing protection for their survival.

While there are few questions about our moral duty to protect the ecosystems that surround us, legitimate arguments may be advanced concerning how far society must go in protecting individual species. Some ecologists argue persuasively for the protection of every species and lament the disappearance of even the least significant species. Others have displayed little concern for their actions and may be actively engaged in efforts to eradicate species they regard as threats to their welfare. Others question the need to save all 15 of the separate species of finches Charles Darwin identified on his visit to Galapagos as long as examples survive of the pairs from which they evolved.

The essence of the ecological imperative was stated by Aldo Leopold when he wrote in his *Sand County Almanac* (1949):

> *"We abuse land, because we regard it as a commodity belonging to us. When we see land as a commodity to which we belong, we may begin to use it with love and respect . . . That land is a commodity is a basic concept of ecology, but that land is to be loved and respected is an extension of ethics . . . The land ethic simply enlarges the boundaries of the community to include soils, water, plants, and animals, or collectively the land . . . [It] changes the role of* Homo sapiens *from conqueror of the land-community to plain member and citizen of it."*

Leopold's land ethic and his insistence that mankind see itself as part of the environment's ecological base can be attributed, in part, to Biblical teachings and similar frameworks exist in many other world religions. It involves an intermixture of ethics with ecology and provides a moral dimension for decisions regarding uses of the environment.

Acceptance of Leopold's concept of man as a part of nature does not mean that we should refrain from use of its fruits. It means that in our use of nature's flow of benefits that we must take care to maintain its integrity and productivity. Our ethical responsibility for wise use of the bounty of nature is also expressed in the widely accepted stewardship of the land philosophy. Proponents of this view hold that mankind has a moral and sacred responsibility to use the resources of the earth in such a manner that they can be passed on to future generations in as good, or better, condition than they were received.

Continuity of Benefit Flows

All of us expect the sun to rise each morning, warm summer days to follow winter's chill, and rivers to keep flowing. With them we have a renewable resource base from which we can expect to receive a continuing predictable flow of benefits over time. At an opposite extreme we also make extensive use of a group of resources, such as oil, natural gas, and coal, which are non-renewable in the sense that they lose their value once they are used. Between these two classes is a large grouping of biological resources, including plants and animals, cropland, forests, and fisheries that have both renewable and non-renewable characteristics. Used on a sustained yield basis, they can provide a continuing flow of benefits over time; misused, their productive values can be destroyed.

Measures are needed to optimize the uses made of non-renewable resources and maintain, if not increase, the benefits we can expect from our use of biological resources. This is an uppermost objective, a paramount responsibility, of environmental management policy. Attainment of this goal is complicated by our attitudes and performance with respect to the discounting of values of expected future benefits.

Most of us accept aspects of the discounting principle in our daily activities with market decisions that promise incomes within the next 10 to 20 years. Should we win a lottery, our impatience with waiting might lead us to request immediate payments of its present discounted value rather than wait for annual payments over a 30 year period. At the same time, however, we seek continuance of the full flow of nature's benefits for ourselves and our children. Proponents of a stewardship model recommend that people save for a rainy day and deplore the “eat, drink, and be merry” philosophy that goes with the discounting principle.

Application of the discounting principle has serious implications for the economic management of the environment. Obvious questions can be raised about how and when it should be applied and whether it should be applied with society's long-term investments. These issues will be discussed more in later chapters. Meanwhile, it may be noted that some operators dismiss the discounting idea as being totally irrelevant in light of stewardship as an imperative.

Limits to Growth

Producers typically operate with the assumption that an adequate supply of needed basic resources is available for their use. As users approach the margins of resource availability, it is not unusual to find that the cutoff or scarcity of needed resources imposes a limit to further growth. Individuals may find themselves in this situation if their mining operations must cease, because their mineral deposits are mined out or if they have cultivated their last acre of arable cropland. Speculations about worldwide limits to growth have led some thinkers to question the world’s ability to feed its burgeoning population. Similar questions can be raised about the limits that may be imposed by global warming.

Limits to growth can have somewhat more confining impacts on the activities of individual operators than of the world at large but can usually be dealt with alternative planning. Worldwide shortages of key resources can be dealt with further explorations and substitutions. Another limit to growth problem exists with the competition between users for use of scarce resources when the carrying capacity of a resource base has been utilized to its self-sustaining limit. At this point attempts to broaden its limits can lead to deterioration or destruction of its productive value. Examples of this nature have occurred with commercial fishing in favored fishing grounds, the pumping of water from ground water aquifers, and the overgrazing of public lands. Appropriate action for protecting the productive value of the resource in each of these cases, and for making it less a limit to growth, calls for identification and assignment of use rights for designated uses and users. With appropriate regulations in force, registered permit holders can engage in rational sharing programs that advance their economic advantage without destroying it.

Garrett Hardin's essay on "The Tragedy of the Commons" (*Science*, 162, 1968) highlights this issue as a factor of major significance in managing the environment. In illustrating his thesis, Hardin used the example of a limited grassland commons on which operators are free to graze as many cattle as they wish. As long as the number of operators is small and the number of animals limited, few problems arise in their sharing of grazing rights. As more operators avail themselves of the opportunity to graze their animals and as individual operators see it to their advantage to increase the size of their herds, problems of overuse arise. With all operators trying to maximize their returns, no one finds it to their advantage to cut back on their grazing activities, because the beneficial effects of such action would only accrue to others. If no action is taken to limit the rights of individual operators, overgrazing can destroy the grazing value of the commons for all operators.

The situation he described is exactly what happened with uncontrolled public grazing on America's unsold public domain during the 1920s and '30s prior to the passage of the Taylor Grazing Act of 1934, and what is happening with the over-pumping of ground waters from some of the nation's aquifers and the overfishing of many ocean waters. A comparable problem is taking place in some less developed nations where land-hungry peasants are pushing farming operations up mountain sides that could better be left covered with forests that hold back the rapid runoff from rainstorms that causes downstream flooding. Jared Diamond's book *Collapse* (2005) details several cases in which population pressures and the overuse of local resources have brought the demise of local civilizations.

Several economists have identified Hardin's problem as being that of having open access to resource use. They recommend acceptance of rules and regulations to limit the volume of their use and in some cases privatization of ownership rights as answers. These recommendations have merit, but in a way, they sidestep the point of Hardin's thesis, which is: the whole world with the full range of its environmental resources can be viewed as a commons, that we face the prospect of overuse of some of its vital sectors, and that collective action is needed to limit population growth and keep the number of new users in line with the earth's carrying capacity.

He warned:

> *"Earth's common resources will continue to be used at unsustainable rates as long as the decision-making structures regarding their management are based solely on individuals making decisions for their own gain."*

Highest and Best Social Use

As environmental resources shift in the land use succession process from lower to higher uses (recognizing that these categories change over time), conflicts often arise between what seems best for individuals as compared with what is best for society at large. Operators, who are seeking personal gains, might logically seek developments that will take highly productive farmland out of agricultural uses and, thereby, reduce the area of socially desired open space around a city. Similarly, the opening of an open pit mining operation in a scenic wonderland area may deprive thousands of people of opportunities to enjoy a valued recreational experience.

When a potential for conflict exists between the interests of private developers and community interests, it is the responsibility of the affected parties, community planners and officials, and public agencies to act in the public interest. They can raise questions about development plans, insist on their review and possible modification, and even reject them. Developers, in turn, have the option of arguing their cases, using court action to authorize proceeding with their plans, or unfortunately if they have sufficient political clout, proceed with their development plans in defiance of community opposition.

Situations of this order are not limited to proposals for private developments. They can also involve locally unwanted land uses (LULUs), in which proposed developments, such as a municipal water tower or a sewage disposal plant, must be located somewhere in the community. It is not unnatural for neighborhood groups to display “not in my backyard” (NIMBY) determinism in their opposition to such proposals. The uses are legitimate and necessary and must be located somewhere. Final decisions about their location should not be reached without a careful weighing of the cases for their location at possible alternative sites.

The Three-Fold Framework

Public and private decisions relative to the management and use of the earth's resources are conditioned at every turn by the workings of a three-fold framework. Recognition must first be given to the nature of one's resource base. Decision makers must make sure that their plans and policies are both physically and biologically possible. Dreamers may spin plans for fanciful projects. Practical operators, however, know that they cannot proceed without first making certain that they have or are working with the physical and biological resources needed for their projects.

A second phase of the framework calls for recognition of the impact economic and engineering considerations have on the success of their operations. Operators soon learn that it is not wise to invest in projects that are not economically feasible; projects that cannot produce returns in excess of their costs. Technological feasibility is an equally important requirement, because regardless of the great contributions new technologies have provided in the past and may be expected in the future, it is the state of technological knowledge at any given moment that provides the feasibility limit on what can be accomplished.

A third requirement for successful management calls for recognition and acceptance of the rules and regulations of society. The institutional milieu within which individuals must operate plays an often determining role in both facilitating and inhibiting what they can do. On one side, the rules of society can liberate and expand the opportunities of operators to do things. On other occasions, they establish the limits on what is considered as acceptable behavior.

Need for institutional acceptability is apparent when developers identify appropriate sites for their operations, have work forces and the financial backing needed to proceed, but cannot act until they acquire the legal rights to use the land on which they want to build or until they secure public agency approval for their projects. Institutional factors involving customs, laws, religious beliefs, and accepted practices of society play significant roles in telling us what we can and cannot do in using the earth's resources.

The requirement for physical and biological possibility, economic and technological feasibility, and institutional acceptability provides a dynamic framework for analysis of the issues and problems that affect our use of the earth's resources. This framework provides a pattern for the four groupings of chapters that follow. Part One deals with the physical and biological nature of our environmental resource base. Part Two explores the economic aspects of environmental resource development with a comprehensive presentation of the tools and practices that were at the foundation of the Old Economy. Part Three focuses on social institutions, both governmental and societal, which place constraints or provide impetus for development decisions. Part Four draws upon these first three sections to examine land management through the multiple lenses of the three-fold framework and looks at ways in which the New Economy will continue to profoundly change the way we see through those lenses.

Figure 1–2 illustrates the three-fold framework used in land resource management.

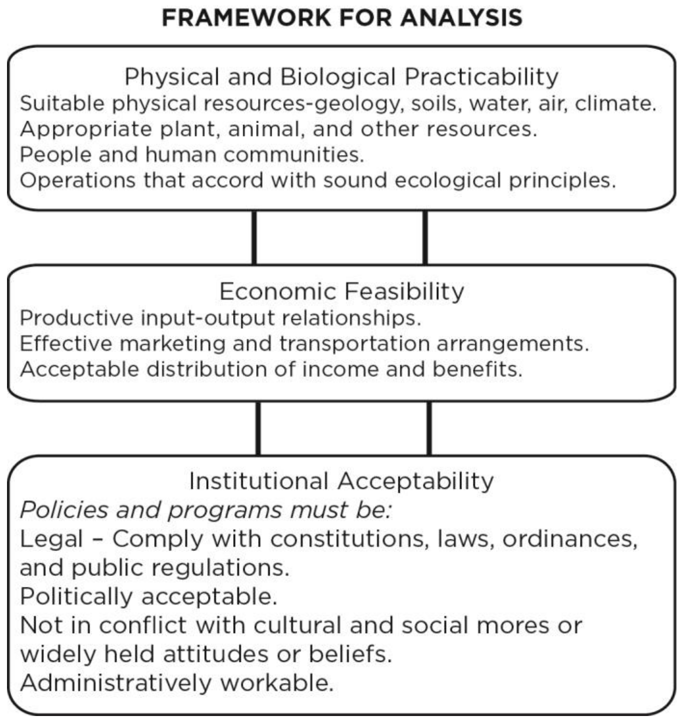


Figure 1–2. Three-Fold Framework for Decision-Making

Chapter 2: Our Environmental Resource Base

"There is enough for all. The earth is a generous mother, she will provide in plentiful abundance food for all her children if they will cultivate her soil in justice and in peace."

~Bourke Cockran

Viewed from outer space, Mother Earth looks like the outer crust of a blue and white marble, almost 8,000 miles in diameter, spinning around its axis at a speed of slightly more than1,000 miles an hour at the equator, and swinging though space in a 365 1/4 day orbit around the sun. It is composed of more than 100 different elements. Only a third of its surface appears as land, the rest being covered by oceans, seas, and polar ice caps. Its position relative to the sun gives it a climate that is conducive to the support of life and its air has just the right mixture of nitrogen and oxygen needed by mankind and the many other species of flora and fauna that inhabit its surface.

The earth provides us with a heritage of tremendous use potential, but it is not an inert storehouse of resources awaiting exploitation. It is an amazing and dynamic ecosystem that has the ability to generate a continuing flow of benefits. Properly used and respected, it can serve us for centuries to come. We must, however, accept the fact that as a living biosphere there are standards in usage that must be respected. Blind disrespect for them can plant the seeds for what could be our demise.

Our resource base has not always been as we now see it. Conditions affecting both its physical nature and the plants and animals on it have evolved over time. Scientists date the creation of the universe several billions of years in the past, and remarkable changes have come on earth during recent thousands of years.

Geological evidence indicates that portions of the earth's surface have risen and fallen, continents have drifted apart, dinosaurs once lived here in a tropical environment, and ice ages at other times have buried large portions of our two hemispheres. The lesson to be learned from these observations is that we are living in a world of physical change. Global climate change may be as much a manifestation of a process of natural change over which we have no control as it is a phenomenon caused by acts of man.

Examination of the nature of our resource base calls for cataloguing its major categories, classifying their use potential, and considering their value for human use. As a logical first step, we should note that the use values we attribute to the earth's resource base are highly dependent on the continuing flow of energy it receives from the sun. Except for the flow of energy we get from the sun, and the earth's reflection of light and heat into space, we live in a closed biosystem.

Laws of Thermodynamics

Living within a closed system means that our use of the earth's resources is governed by the operation of two physical laws of thermodynamics. The first of these relates to the conservation of energy and matter. It states that these resources can neither be created nor destroyed but that they can be transformed by use.

The second law, the law of entropy, holds that the transforming of energy resources from one form to another always involves a down-grading of their use value. When no use is made of the energy from sunlight or flowing water as it comes, its value is lost forever. With mineral fuels, such as coal, use of the resources leaves an end product of heat, gases, and ashes, all of less economic value than the coal. Entropy has a similar down grading effect with some minerals, such as molybdenum and zinc, because their reformulation as they are processed into market goods makes later recycling economically infeasible.

Appreciation of the significance of these two laws of physics should remind us of the unintended impacts our actions can have on our environmental resource base. With our heavy dependence on fossil fuels as a source of energy, some pessimists argue that entropy is leading us to disaster. Much of the problem they fear can be avoided if we can shift this dependence from use of fund resources to greater use of flow resources.

Physical and Biological Capability

Meeting the physical and biological capability requirement of the three-fold framework of analysis calls for first establishing that we have the resource base we need. A quick look indicates that we have a bountiful resource base but that nature has not scattered its resources evenly across the face of the planet. We learned long ago that we do not live in a Garden of Eden and that human ingenuity in combination with time and effort are needed to find the particular resources we need and put them to work.

The resources that are of value to us are found in different areas and vary widely in their availability, in their characteristics, and in their use capacities. One of our primary concerns has always been centered on food production. The areas available for this purpose are closely affected by 1) sunlight and temperature; 2) access to water; 3) soil conditions, including fertility and drainage; and 4) physical location with respect to markets and transportation facilities. Other classes of resources are dependent in varying degrees on the same factors together with special requirements associated with their needs.

Resource Base for Agriculture

Almost all of the earth's surface enjoys enough access to sunlight during its growing season to permit some type of crop, forest, or grazing use. Short growing seasons, however, make a fourth of the surface area unsuitable for growing wheat. While unsuited for this use, much of the area of northern Canada, Europe, and Russia can be and is used for forestry and summer grazing by cattle and wildlife. Global warming may make more of this area available for more commercial use and at the same time bring a thawing out of icy expanses in the Arctic and Antarctic regions.

The supply of water available for plant and animal use poses a greater restriction on agricultural land use than access to sunshine. Frank A. Pearson and Floyd A. Harper (*The World's Hunger*, 1945) found that only 34 percent of the world's surface had sufficient rainfall for crop production. Thirteen million square miles were found to be too wet and 17 million square miles too dry for cropping. Some of the wet area, however, was suitable for rice culture while the use of irrigation and summer fallowing practices has permitted cropland use of some dry lands.

Approximately a third of the area that is climatically suited for crop production is too mountainous or rough to be considered adequate for this use. Terracing is used in many rough areas, most particularly in the densely populated countries of eastern Asia, to provide additional cropland. This practice calls for huge investments of time and effort and is practicable only where the supply of potential cropland relative to population pressure is scarce. Problems have arisen in several areas where peasants in their quest for farming opportunities have pushed their operations up the sides of mountainous areas and in the process, by removing needed forest cover, have caused soil erosion problems, floods in lower areas following rains, and dry streams during later seasons.

Pearson and Harper concluded that only about 46 percent of the earth's surface is covered with "good soils" suitable for crop use. This figure can be taken as a general measure of the adequacy of our potential supply of land for agricultural use. Questions, of course, can be raised about what is good soil; but regardless of definitions, consideration must always be given to measures needed to maintain and protect the quality of soils for crop production, because it is the thin layer of soil on the earth's land surface that spells the difference between survival and starvation for most of the world's inhabitants.

From the standpoint of quality, soils vary considerably in color, structure, texture, physical constitution, chemical composition, and fertility. They range from heavy clay to sand and gravel, from light-colored soil to black earth, from shallow deposits to deep formations, from soils of high acidity to those that are alkaline, and from soils that provide plants with little more than space and foundation to productive soils that are well-endowed with nutrients and organic matter. Crops differ somewhat in their soil requirements, but most of them respond to fertile and productive soils. The same situation is true with forestry and grazing. These uses, however, are usually relegated to the less fertile lands and to areas that are too rough or dry for cropland use.

Non-agricultural Land Uses

Residential housing, urban commercial centers, and most industries are not dependent for their location on sunlight, temperature, and rainfall in the same sense that agricultural uses are. Indeed, many activities associated with these uses are now conducted with artificial light, the provision of air conditioning and heating, and the piping in of water supplies. All of them, however, benefit from access to the resources needed by agriculture. Some of the areas that are too rough or arid for crop production purposes fortunately have values for certain urban and recreational uses.

Industrial uses, such as mining, call for locations at sites where quantities of the minerals sought are found. Many early industries located near mill ponds that could provide them with a source of water power. Electricity and the development of steam power and internal combustion engines has freed industries from this early requirement and developments in communication now make it possible for them to outsource some of their service needs to places half a world away. They are still dependent though on locations at sites that offer them access to raw materials and favorable transportation facilities.

Cities with their commercial centers have tended to locate near industries and in the midst of hinterland areas they can serve. Urban residential developments are found at sites near industries and commercial centers that offer employment for their residents. In an earlier day most urban workers lived within walking distance of their jobs. With improvements in transportation, many now live in suburban and even in rural communities.

Among the other uses of land, reservoirs call both for flowing streams, and for topography that permit the building of dams for storing water; cemeteries call for well-drained sites; and highways for ribbons of land that provide ready access for moving people and products between travel points. Parks and recreation areas call for sites that offer opportunities for a wide variety of activities, such as outdoor sports, swimming, fishing, boating, camping, enjoyment of scenic views, and embracement with nature.

Air and Water Resources

Air and water, along with food, are necessary for our survival. Mention of their significance is often ignored in listings of our resources for the simple reason that they are ubiquitous and assumed to be abundant and available. Both have important features, however, that call for their examination as features of our environmental resource base.

The air we breathe is part of an atmosphere composed mostly of nitrogen and oxygen that hugs the earth's surface. Gravity holds it to the surface and calls for denser concentrations at low elevations and ratification at higher altitudes. Unlike land resources, the chemical content of air is remarkably similar all over the globe and there is no discernible difference in its ability to support life as long as plants and animals have ready access to it. One of its more significant features is its free movement with winds. Air that is in the atmosphere above an ocean one day can be hundreds of miles away the next.

Water resembles air in its ability to flow from one place to another. When it occurs as vapor, it can be borne about by wind. But in its usual heavier-than-air form, it is bound to the earth's surface and always flows downhill. Water covers almost two-thirds of the earth's surface. Most of it is salty and is found in oceans and seas. Large amounts of fresh water, however, are found in lakes, ponds, and flowing streams. Tremendous additional deposits are locked up in glaciers and ice caps, in wetlands, and in underground aquifers.

One of the most distinguishing features of water resources is their continuing flow through the hydrologic cycle. As shown in Figure 2–1, water evaporates from the oceans and locations on land. It moves as vapor in the atmosphere until it is precipitated as rain or snow. The water precipitated on land can seep into the land surface, evaporate again, or run off as drainage into brooks and rivers that carry it to lakes or to the sea. Once it falls as rain or snow, it can evaporate again as it continues its repetitive flow through the hydrologic cycle.

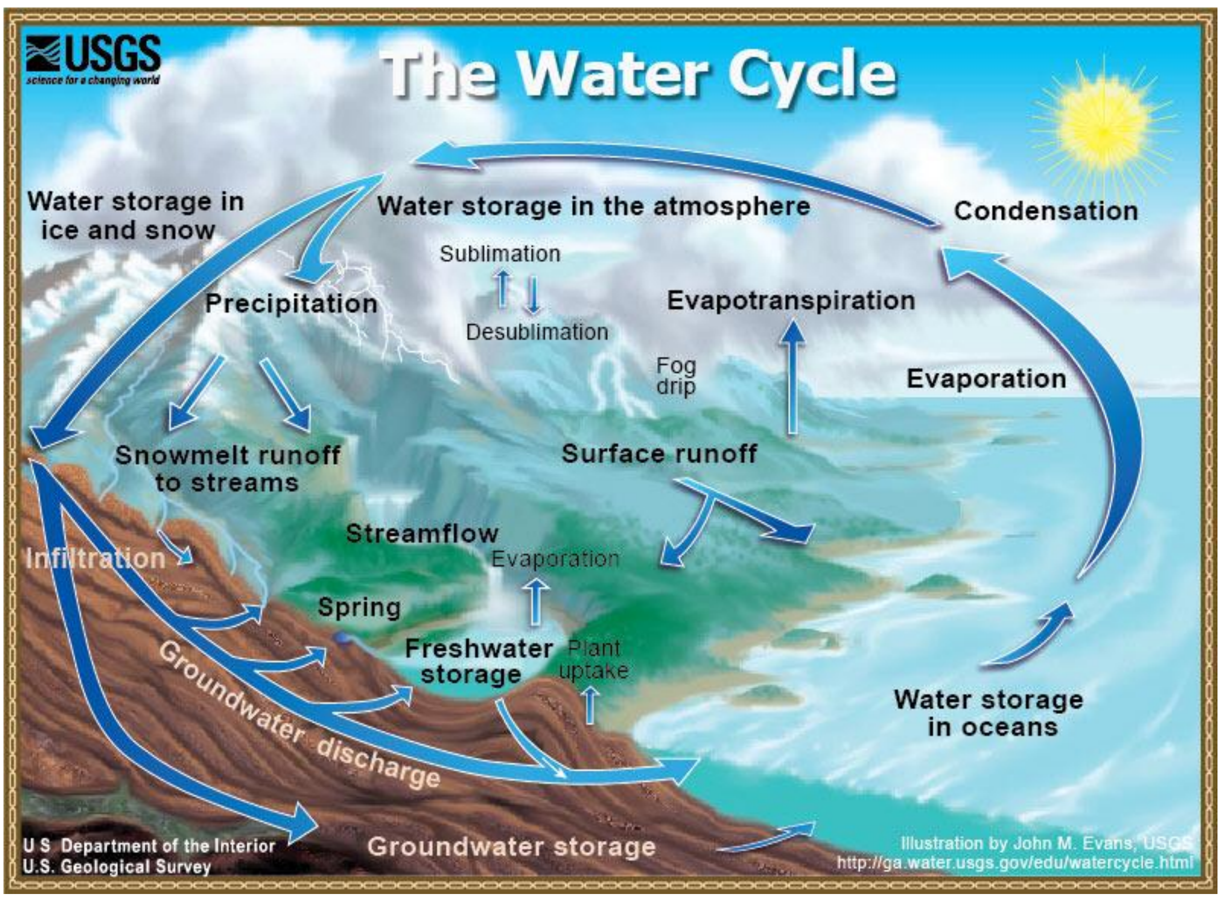


Figure 2–1. The Water Cycle

Operation of the hydrologic cycle provides the earth's surface with tremendous supplies of freshwater. For most practical purposes, this would seem to be enough. Unfortunately though, the supplies are not evenly distributed. While many areas receive adequate supplies of moisture at the times it is needed for cropland use, some areas get excessive amounts of rain while many desert areas do not get enough. Mankind has met this problem in many arid regions by storing water where it is available in reservoirs behind huge dams from which it is conveyed by canals to thirsty acres where it can be used for irrigation and other purposes.

The precipitation that falls as rain and the air that carries it can occur as clean resources. Both can be downgraded in quality when they are used to absorb and carry away waste products. Wind can carry dust, the smoke from fires or smoldering volcanoes, and chemical wastes exhausted from industrial plants. Water too can be polluted by farmland wastes, the flow of city sewers, and the unwanted by-products of industry.

Air and water were long accepted as a natural sink for the disposal of waste products. Little was done to change that situation until medical science discovered the relationship between contaminated water and the spread of diseases like cholera and typhoid fever. This discovery prompted demands for the provision of water treatment and sewerage disposal facilities. It was not until the last half of the 1900s that awareness of the serious nature of air and water pollution in the world's more developed nations brought demands for public policies for their control.

Possible Hazards

Our resource base provides wonderful opportunities for future use; however, it may be noted that these prospects can be clouded. Much of the progress mankind has enjoyed during the last three centuries has come, because we have lived during an era of favorable climatic conditions. We know that much of our two hemispheres were covered with ice a mere 10,000 years ago and that the earth has experienced periods of rising and falling temperatures since. Present observations about the impacts of climate change and global warming indicate that this process is still at work.

As resource managers we must accept the fact that there are possible hazards we must face. Life on earth would be impossible without the energy we receive from the sun. Fortunately, scientists assure us that we can count on a stream of sunlight for several millions of years. The prospect of the earth being hit by a large meteor from outer space, although possible, still seems remote. Far more immediate problems can occur with a reoccurrence of a tsunami like the one that took 264,000 lives in Southeast Asia in December 2004, the earthquake that took 87,000 lives in Pakistan in August 2005, the earthquake and tsunami that took over 10,000 lives in Japan and triggered a nuclear disaster in 2011, or volcanic eruptions, such as the one that buried Pompeii in 70 A.D.

These seem like catastrophes that take place only a half a world away. With global warming, however, we face the prospect that hurricanes may strike America's Gulf and East Coast with the fury of another Katrina or Sandy on a more frequent basis, that destructive cyclones may strike more often and that heavy rainfall may cause more flooding in some areas while lack of rain creates drought conditions in others. In another gloomy scenario, the near simultaneous eruption of a string of volcanoes along the Pacific Rim could befoul the atmosphere with enough smoke to darken the skies and cut short the growing seasons needed for crop production all over the earth.

These are natural hazards we hope never to encounter. Meanwhile, environmental problems exist about which we have the power to do something. Examples include the avoidance of air and water pollution, control of soil erosion, protection of wetlands, and avoidance of costly developments in flood prone areas. If global warming is induced at least partly by human beings then human beings have the power to mitigate this threat.

Other Classifications of Resources

Our environmental resource base is composed of the air, water and land resources provided by nature. Land resources are often classified by type of use as cropland, grazing, forestry, residential, industrial, commercial or other. They may also be classified on the basis of their renewability. Other classifications are based on how they are viewed in an economic feasibility sense or an institutional capability context.

Renewal and Regenerative Ability

Natural resources can be classified into three groups on the basis of renewability. The first of these involves resources, such as energy from the sun, rainfall, ocean tides, wind, and changing climate, which come in predictable flows over time. They are self-renewing and must be used as they come, because of the difficulty if not impossibility of storing them for future use. This group is called flow resources.

A second class, known as fund resources, occurs in nature as finite resources that are fixed in supply. Although they can often be recycled for further use, they are not replenishable. There are two subclasses of fund resources. Mineral fuels, such as oil, natural gas, and coal, can be consumed through use. A second subclass is made up of metals, such as iron, tin, copper, lead, and zinc, together with some non-metals, such as sand, gravel, salt, and sulfur, which are not normally destroyed though use.

A third group can be described as composite resources in that they have characteristics of both flow and fund resources. Examples include crops and other flora, all animal life, including human beings, and water that may be stored in a reservoir or underground aquifer. These resources can come as a continuous or reoccurring flow over time as long as care is taken to protect the necessary seed stock. At any given time though, they can be viewed as a fund resource the complete taking of which would end with their total extinction. Most biological species fight for survival. Some, such as rats, pests, weeds, and many strains of bacteria, strongly resist attempts to destroy them. Some others are more vulnerable to extinction, a problem that lends justification for programs to protect endangered species.

Concepts of Supply, Demand, and Resources

The terms supply and demand frequently appear in discussions of the adequacy of natural resources. Like some other terms used by economists, they do double duty in the sense that they have more than a single meaning. As used in economic theory, the term supply refers to a schedule of the amounts of a good or service sellers will offer at different prices during a given time period, all other factors being equal. Similarly, demand refers to a schedule of the amounts of a commodity buyers are willing to purchase at all possible prices during a given time period, other factors being equal.

These refined concepts have their place in economic thinking. It may be noted though that they exert a limiting effect on the amounts of resources people usually think of when they speak of supply or demand. Since they are limited to the amounts offered in the market, the economic supply of environmental resources amounts to something less than the total amounts that exist and may be available in a physical sense.

The terms supply and demand will be used loosely throughout much of the discussion that follows. On those occasions when more specific meanings are needed, we will speak of physical supply when concern is with the physical existence of particular classes of resources, such as mineral fuels, water resources, or forests. References to the economic supply will involve only that portion of total physical supplies that people want and use. Economists also apply a restricted meaning to the term resource. For them, land, water, and minerals do not become a resource until people begin to use them, compete with others for their use and control, place values on them, or indicate willingness to undertake the costs associated with their use.

The concept of demand parallels that of supply. As a physical concept it is associated with our desires, needs, and wants. The broad term resource requirements can be used to describe the amounts of food, water and housing needed to provide everyone a given level of sustenance. This concept can be and is often used as a guide to what we would like to have but it has limited value as a tool of economic analysis. It is economic effective demand, the willingness and ability of people to buy the goods and services they want; not the existence of unsatisfied needs or desires for products and services that determine the prices at which commodities sell and move in the market.

Derived demand is another economic concept that has particular significance. Our demand for air and water are directly associated with first hand contacts with these resources. With land and minerals, however, our demand is more apt to be for the quart of milk, the pound of meat or rice, gallon of gasoline, or new automobile than for the basic resource itself. Our effective demand for environmental resources involves a combination of direct and derived demands. We seek quality in air, water and scenic attractions and at the same time we make extensive use of products that have been processed from natural resources.

Technological and Institutional Adjustments

Just as application of the economic concepts of supply and resources can have a narrowing effect on our view of environmental resources, technological developments and modifications in institutional arrangements can exert a broadening effect. Primitive man had no conception of the worth of iron, coal, or oil and accordingly placed no economic value on them. It took the technological revolution that came with the opening of the gates of science to make us realize the potential use value of many gifts of nature that had gone unnoticed and unappreciated until then.

Hundreds of examples can be cited of the significance of new technologies. The development of steam power revolutionized both industry and transportation. An avalanche of new opportunities was made possible by the harnessing of electricity, only to be spurred further along by developments with microchip technology. Simple developments, such as the invention of the cotton gin, enhanced opportunities for spreading cotton culture to new areas; substitution of steel girders for masonry construction made construction of skyscrapers and suspension bridges possible. Air conditioning added to comfort and made Sunbelt locations attractive sites for commercial expansion.

Technology has met the problem of scarcity by providing substitute products, substitutes that are often superior to the items replaced. Power secured from burning coal or using electricity has freed industry from the need to locate along millponds that could provide water power. The synthetic dye industry has replaced the two million acres once needed to produce indigo and madder. Automobiles and farm tractors have freed the 80 million acres once needed in the United States to provide feed and fodder for the horses and mules that provided motive power.

Possibilities for expanding the use value of our resource base have also done much to make the three-fold framework for resource use analysis a vibrant dynamic concept. Many of these changes have come with adjustments in institutional arrangements. Examples come when governments open up new areas for land settlement, for mineral exploitation, or for scientific inquiry. Similar expansion can come as an outgrowth of programs to expand educational opportunities. Public policies can also narrow opportunities for expanding knowledge if they deny permission and funding for research in areas, such as stem cell research.

Fixed Location Factor

Air, water, wildlife, and many products produced on land are mobile in the sense that they are free to move or be moved around. This characteristic is not shared by the surface land sites with which most environmental resources are associated. These resources are earthbound and have an immobile fixed location characteristic that distinguishes them from other resources. As Alfred Marshall (*Principles of Economics*, 8th ed., 1938) observed:

> *". . . The fundamental attribute of land is its extension. The area of the earth is fixed: its geographic relations in which any particular part of it stands to other parts is fixed. Man has no control over them; they are wholly unaffected by demand; they have no cost of production; there is no supply price at which they can be produced."*

The fixed location of land means that it must be used were it is. Property owners cannot use their holdings for purposes for which they are not adapted. Climatic conditions dictate that farmers in Minnesota not raise cotton or bananas. Land for housing may be in short supply around Los Angeles and owners in northern Michigan may have thousands of acres available for this use but they have no option for making their land available in California. At the same time, they must accept weather conditions as they come; they must live with the neighbors they have; they are subject to the jurisdiction of their local governments; and if they want to sell their properties, they must expect to sell them to buyers who are interested in owning land in their localities.

The tying of land to fixed locations has important impacts on property values. Owners of land located near the commercial centers of cities or along expanding corridors of commercial value can cash in on opportunities for rising land values that owners at more distant sites can only dream about. Economic location advantages stem from location at choice sites relative to transportation of people and products, in places of commercial activity, and in the case of housing, at locations that provide attractive amenities for their residents.

Fixed locations make it possible for governments to define the legal boundaries of properties in very specific terms for the registration of land titles. Two principal systems of land measurement are used in the United States. Properties originally settled along the Atlantic seaboard are measured in terms of metes and bounds with their various boundaries described by their location with respect to local landmarks and natural objects, such as streams, rock formations, or trees.

A second system known as the rectangular survey system was introduced in 1785 with the opening of the public domain for settlement and is in use in the 30 public domain states and parts of other states. This system calls for official surveys of the land, its division into six-mile square townships composed of 36 sections, each of which is approximately one mile square. Individual sections can be described by section number and township location relative to their principal meridian. Holdings within each section can be described in detail as would be the case with a tract of 80 acres described as the West 1/2 of Southeast 1/4 of section I7 of Township two North Range three West of the sixth principal meridian.

While all properties in the United States are legally described by one of these systems with additional descriptions noted by lot and subdivision plat numbers in the case of urban properties, neither system is based on a truly global system that can provide the exactness needed for computerized mass analysis. A highly refined measurement system that calls for descriptions in terms of latitude and longitude, state plane coordinates, and Universal Transverse Mercator ticks has been developed for this purpose.

Adequacy of the Resource Base

It is natural that each of us has an interest in our survival and in the world's ability to support our style of living. National and worldwide concern about these matters has stimulated the writing of dozens of dissertations on the topic. Some of them paint glowing pictures of an abundant future while some others have made predictions that had they come true would have had us all dead or dying from starvation by now instead of hearing complaints about problems of obesity.

More attention will be given in later chapters to the adequacy of our resource base. At this point, however, it can be noted that the world faces no imminent threat to its ability to care for the basic needs of its residents. Great progress has been realized in increasing the supply of food and other benefits we have received from the bounty of nature during the last 300 years. Continued progress can be expected. Realism tells us, however, that problems of various natures can be expected and that those who manage the environment will be called upon to deal with them. Even though it may be possible to feed most of the people of the planet, many will still go hungry without significant changes in the way natural resources are managed.

Thomas R. Malthus opened the subject of resource adequacy when he advanced a theory of population growth in 1798 that asserted that while food supplies were increasing at an arithmetic rate (2 + 1 + 1 + 1), population had a potential for increasing at a geometric rate (2 + 4 + 8 + 16). He recognized that factors, such as war, epidemics, and local famines, had kept population numbers in check in the past and indicated that circumstances, such as the high birth rates reported in the American colonies, could bring population numbers up to a balance level at which further population increase could not be supported.

Malthus and the other economists of his day had no reason to anticipate the tremendous impact changing technology would have in increasing food supplies. Working with the knowledge they had, they assumed the operation of a secular law of diminishing returns. As stated by Alfred Marshall, this law proclaims that:

> *". . . Whatever may be the future development of the arts of agriculture, a continued increase in the application of capital and labor to land must ultimately result in a diminution of the extra produce, which can be obtained by a given amount of capital and labor."*

As the diagrammatic presentation of this concept in Figure 2–2 indicates, over the long run, without substantial changes in the nature of their inputs, users of land resources must expect to eventually reach a point of diminishing returns. The diagram also shows that the volume of production associated with the successive input of composite units of capital and labor involves three phases. Production per input unit rises at an increasing rate in Phase I. It continues to increase at a decreasing rate in Phase II to a point of overall diminishing returns at which the return per each additional input unit becomes zero. The area beyond this point in Phase III is one of negative returns.

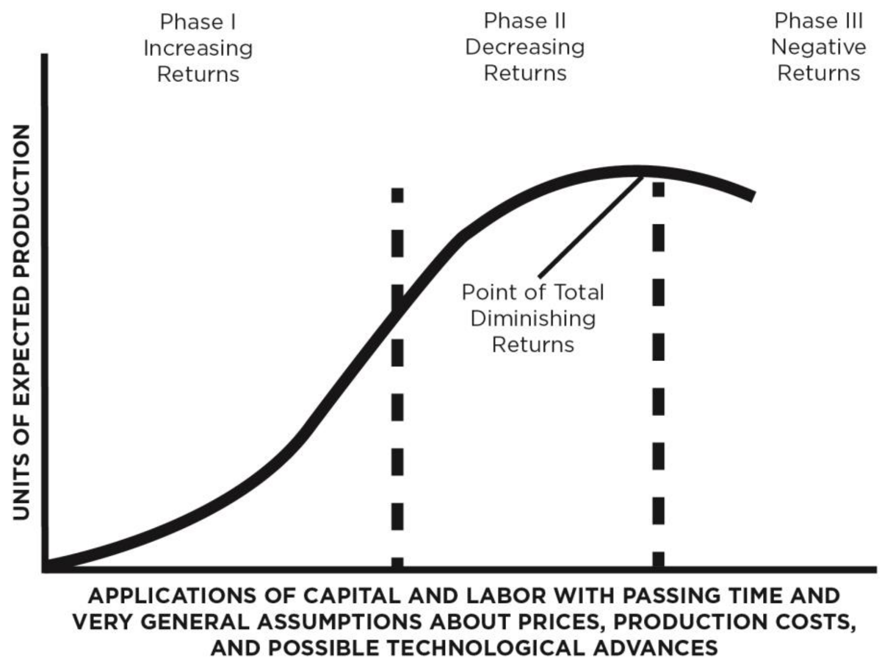


Figure 2–2. Relationship of Units of Production and Returns

Technological advances can postpone the day of reckoning with diminishing returns and make it possible for operators to expand production capacity far beyond its earlier potentials. Workers in the more developed nations have been able during recent years to enjoy the rising standards of life that come with operations under conditions of increasing returns. Present prospects indicate that important new advances in technology are probable, and that these may enhance the opportunities the world's people have to enjoy higher levels of living. But no one knows how long this progress will continue. Prophecies of doom, such as those advanced by Barry Commoner (*The Closing Circle*, 1971) and Donnella and Denis Meadows (*The Limits of Growth*, 1972), have been unduly pessimistic in assuming that we were much higher on the production curve than we in fact were. Recognition of this detail suggests that with continued increasing pressure against our resource base that we must eventually face the prospect of diminishing returns.

While the concept of secular diminishing returns seems to be logically consistent, some economists argue that it will not apply in our time, because the prospects for new technology and new input-output combinations of resources for production provide almost infinite opportunities for increased productivity. Julian Simon (*The Ultimate Resource II*, 1996) has championed the idea that an increasing population is needed to advance the prospects for technological progress.

Harold J. Barnett and Chandler Morse (*Scarcity and Growth: the Economics of Natural Resource Availability*, 1963) indicated: a strong case can be made for the view that the accumulation of knowledge and technical progress is automatic and self-reproductive in modern economics, and obeys a law of increasing returns. Every cost-reducing innovation opens up possibilities of application in so many new directions that the stock of knowledge, so far from being depleted by new developments, may even expand geometrically.

Whether the rosy horizon forecast by the optimists will be as bright 100 years from now remains to be seen. It is obvious, however, that pessimists from Malthus on to the present day have been wrong, not because their logic was wrong, but because their expectations placed us at higher points on the long-term return curve than circumstances show we were. The optimists may be equally wrong in assuming that the increasing returns to scale phase of the curve at which we are now positioned will continue without change.

Present Land Use Situation

Almost all of the earth's surface land area has been explored, and most of its visible resources have been appropriated by individuals or governments for some type of use. The uses found in different areas range over a wide spectrum from densely populated centers to wilderness and barren regions. For an overall view of how our surface land is used, we will start with the world situation and then turn to the situation reported for the United States.

World Land Use Picture

Altogether, the world has a total surface area of approximately 197 million square miles, of which 55 million square miles, or 35.7 billion acres, are land surface. When a deduction is made for the ice-covered extent of the two Polar Regions, it appears that the six major continents have a total surface area of almost 33.2 billion acres. Approximately 3.8 billion acres, or 11.7 percent of this total area, was reported by the Food and Agriculture Organization (FAO) of the United Nations in 2002 as being arable cropland. A more detailed report issued by FAO in 1995, reported in Table 2–1, indicates that 11.1 percent of the earth's surface was used as cropland, 26 percent as pasture and grazing land, and 31.7 percent as forestland, leaving 31.2 percent, a small portion of which was built upon, as other land.

Table 2–1, Major Land Uses by World Regions and Selected Regions, 1994

	Total Area (million ha.)	Percentage Distribution			
		Cropland	Pasture	Forests	Other
World	13,045	11.1	26	31.7	31.2
Africa	2,964	6.3	29.8	24.3	39.6
Asia	2,679	17.6	29.6	20	32.8
Europe	473	28.6	16.8	33.6	21
N. America	2,137	12.7	16.9	40.5	29.9
S. America	1,753	6	28.3	48.3	17.4
Oceania	85	6.2	50.7	23.7	19.4
Australia	764	6.2	54.2	19	20.6
Brazil	846	6	21.9	57.7	14.4
Canada	922	4.9	3.0	53.6	38.5
China	933	10.3	42.9	13.9	32.9
Egypt	100	3.5		0.1	96.4
France	55	35.4	19.3	27.3	18
India	297	57.1	3.8	23	18
Italy	29	37.8	15.4	23	23.8
Japan	38	11.7	1.8	66.4	20.1
Mexico	191	13	39	25.5	22.5
Nigeria	91	35.9	43.9	12	8.2
Sweden	41	6.8	1.4	68	23.8
U.K.	24	24.8	45.9	10.4	18.9
U.S.A.	916	20.5	26.1	32.3	21.1

Source: Food and Agriculture Organization. FAO Production Yearbook, 1995.

Land-use distribution patterns vary considerably by world regions and individual countries. As Table 2–1 indicates, Europe, with 28.6 percent of its area as cropland, has almost three times the world average percentage of area available for planting crops while Africa, South America and Oceania have less than average amounts. Oceania has almost double the world average of pasture and range land, while South America has twice the amount of the average proportion of forestland.

Greater differences exist between countries. India, Italy, France, and Nigeria enjoy significantly larger than average proportions of cropland; Australia, the United Kingdom, Nigeria, China, and Mexico have above average amounts of pasture and grazing land; Sweden, Japan, Brazil, and Canada have large forested areas; and Egypt, Canada, and China have large expanses of barren and wastelands.

Many reasons can be given for the wide differences between continents and countries. Relatively favorable climate, topographic, and soil conditions favor the use of land for crops in Western Europe and the United States. In contrast, the use of land for crops is regimented by arid climates in Egypt and Australia, by a short growing season in northern Canada, by mountainous topography in parts of South America and by tropical jungles in Brazil. Population pressure has also had an effect in India, Italy, and Japan in favoring the terracing and reclamation of areas that might pass as wasteland in other countries.

Land Use in the United States

The United States has a total area of 3,723,033 square miles of which 181,587 square miles are in lakes and 3,541,447 square miles or 2,271.3 million acres are surface land area. A total of 671.8 million acres, 29.6 percent of the total surface area, was held in federal ownership in 2003. Relatively small portions of this total are held in the Eastern States. Federal ownership is extremely important in the West, however, where it accounted for 66.7 percent of Alaska, 50.2 percent of Arizona, 46.9 percent of California, 66.4 percent of Idaho, 91.9 percent of Nevada, 49.1 percent of Oregon, 66.5 percent of Utah, and 50.6 percent of Wyoming.

Some of the area held in federal ownership is used intensively for purposes, such as federal buildings and military installations. An area of 192.3 million acres is reserved for national forests and another 79.0 million acres is administered by the National Park Service. The remaining federally owned area is located mostly in the western states where much of it is held in organized grazing districts, and a substantial residual area of wilderness, barren and wild lands remains.

In addition to the lands held in federal ownership, approximately 200 million acres, about nine percent of the total surface area, is held by the various state and local governmental units. These lands are used mostly for forests, parks and recreation areas, wildlife refuges, and public transportation. Indian reservations account for two percent of the nation's area, while the remaining 60 percent is privately owned.

The 2000 Census for the United States reported that 18.1 percent of the nation's land area was urban, 3.9 percent entirely urban, and 14.2 percent partly urban. A more precise counting by the National Resources Inventory conducted by the U.S. Department of Agriculture and updated to 2002 found that 106.3 million acres (5.5 percent) of the 1,937.7 million acres in the United States, Alaska and the District of Columbia excluded, have been developed for non-rural uses. This classification involves small areas in predominantly rural states, such as Montana, but accounts for all of the District of Columbia, more than a third of New Jersey and about 28 percent of Massachusetts and Connecticut.

The remaining 94.5 percent included 50.4 million acres covered by water, 401.9 million acres of federally owned land, and a residual 1,378.1 million acres of rural lands. Of this residual rural area, 368.4 million acres, or 26.7 percent were used as cropland, 117.3 million acres (8.5 percent) were used as pasture, 405.3 million acres (29.4 percent) were range lands, 404.9 million acres (29.3 percent) were forestland, and 88.2 million acres (six percent) were other rural lands.

Rural land use patterns vary a great deal between states and regions. High proportions of the land area in the Corn Belt are used as cropland, while low proportions are used for this purpose in Alaska and the Mountain States. Large areas in the Mountain States and the Southern Plains are used for pasture and range purposes as compared with much lower proportions in other regions. Privately owned forests account for major portions of the area in the Northeast, the Southeast, and Appalachia as compared with very small areas in the Northern Plains region. Wide differences are also found between communities with nearly all of the land being used for a single purpose in some communities while mixed-uses prevail in others.

Important changes affecting how rural lands are used have taken place over the last two centuries. With the tide of western settlement, thousands of acres of public domain were converted into farms. The total number of farms counted by the Census increased from 536,000 in 1880 to 2,313,000 in 1970 and 2,129,000 in 2002. A total of 938 million acres were counted as in farms in 2002. Only 46 percent of the farms, however, were classified as commercial operations in the sense that they had farm sales of more than $10,000 during the previous year, while 39 percent reported sales of less than $2,500.

It was common practice along the western frontier, as land was being settled, for people to graze their animals and cut timber on the adjacent unsold public lands. This practice continued as settlement moved to the drier lands of the west. Ranching became an established industry with ranchers grazing their herds on private lands plus often larger areas of unsold federal lands. Open access for grazing on the unsold public domain continued until the 1930s when a large portion of the grazed area was converted into federal grazing districts that leased grazing rights to ranchers.

Comparable competition between timber operators led to private acquisition of large areas of forest land, which shifted to farmland use once the timber was harvested. Several million acres of cutover land, however, were unattractive for agricultural use and have since shifted back into long-term forest management enterprises. The area used for this purpose has been augmented by the planting of large areas for ongoing timberland management.

One of the most significant recent changes in land use has occurred with a rapid shifting of once rural lands to urban and suburban uses. This shift brought a four-fold increase in urbanized areas between 1950 and 2001. Transportation improvements have made it possible for urban workers to move to suburban and rural non-farm places of residence. Commercial establishments and industries often followed in their wake. Rising incomes have also generated a demand for second homes in high amenity areas often located at considerable distance from their owners' place of legal residence. The increasing independence enjoyed by senior citizens has made it possible for thousands of them to move to favored retirement sites. The result has brought a shifting of large areas from rural to urban-oriented uses. This situation provides opportunities for real estate developers but poses a problem for those who fear that the nation is losing its farmlands. Data assembled by the American Farmland Trust indicate that the nation was losing 3,000 acres of farm and ranch land every day for this purpose in 2005.

No inventory has been made of the uses made of the 5.5 percent of the nation's land area that is considered as developed for residential, urban, and suburban uses. Widely different patterns of use are found in cities and towns. The two uses they have in common are the provision of areas for residential housing, and for streets and parking areas. Large cities typically have significant additional areas used for industrial purposes, such as factories, railroad yards, port facilities, and warehouses. Land in their commercial districts is used for financial centers, office buildings, and for retail stores. Shopping centers, new and used car lots, and similar space consuming uses are often located around their outskirts. Areas also are needed for public buildings, schools, churches, parks, and playgrounds. Bedroom communities, in contrast, often have small areas used for commercial purposes, while most of their area is used for residential housing and the provision of public services.

The growing affluence of American society has brought increasing emphasis on sports and recreational activities and the need to provide sites with appropriate quality and use characteristics for these uses. The types of areas needed cover a wide range stretching from sandy beaches to winter ski slopes, from urban playgrounds to forested camp sites, from crowded zoos to primeval hunting and fishing sites. Some activities involve very intensive uses of land as when 100,000 fans fill a stadium on an October afternoon. Others call for traipsing alone along a wilderness trail. No specific enumeration has been made of the extent of these areas. It is known, however, that the federal, state, and local governments have provided millions of acres for these purposes. Large additional privately operated areas are available in the form of golf courses, resort facilities, and other privately owned recreation and sports facilities.

While some land uses are incompatible, recreational use and strip mining for example, the potential exists for multiple compatible uses. Markets are now beginning to include dimensions like carbon sequestration, a biological function that produces oxygen, while simultaneously removing carbon from the atmosphere and, at the same time, provide a recreational use that adds value and has positive impacts on urban areas near green zones. Categorization of land use is multifaceted and includes uses currently captured by economic markets and uses that are externalities, not captured by a market, yet observable and potentially important.

Chapter 3: Demand Pressures for the Use of Resources

"The power of population is indefinitely greater than the power of the earth to produce subsistence for man."

~Thomas Robert Malthus

Examination of the nature of the world's resource base tells us much about its physical and biological capability to supply the ongoing needs of mankind. The picture it supplies, however, is incomplete if consideration is not also given to the demand pressures on the use of these resources. The amount and nature of these pressures obviously comes from the number of people whose wants and needs must be served. More is needed than just a count of numbers, though this is the logical point at which to start.

People have different wants and desires. Up to a point, all of us have a primary concern and a physical need for provision of the basic materials needed to sustain life. Beyond that, what we want and can demand depends upon our knowledge of how resources might be used, our cultural and educational backgrounds, our incomes and spending power, and our personal tastes and preferences. These considerations have a defining impact on our demand for environmental goods; it is numbers of people times average individual demands that tells us how much is needed.

The World's Population

Widely different ideas are held about increasing population and the question of what, if anything should be done about it. Since the beginning of time, parents have wanted children, because they cherish the contribution they can make to happy family life, as well as to perpetuation of the species. In earlier periods, large families were often favored, because children added to the family work force, while they were young; and because with high child mortality rates, children grown to maturity were needed to provide old age security for the parents. These economic and social reasons for having large families have largely disappeared. A shift to smaller families comes when prospective parents weigh the advantages of having children against the amenities they could enjoy without having them. The values parents associate with having children, however, carry considerable weight in this balancing process as do other factors, such as religious beliefs and the time-old desire in some cultures to have sons.

Several societies in the past have accepted population control measures, such as observance of sex taboos, delayed marriages, birth control, infanticide, and senicide. Moral constraints now prevent popular endorsement of control measures that may involve the taking of human life; but concerns about burgeoning population numbers have brought strong support for practices and policies that use family planning and other techniques to limit population growth.

A second key consideration is the standard of living associated with population growth. If population increases are also associated with greater use of resources the impacts on carrying capacity of the planet change. If people drive cars, use air conditioning, and live in a society with many disposable items, their drain on the resource base is substantially greater than those living in huts.

Regardless of the position one takes on the question of population control, it must be recognized that increasing population impacts the demand for environmental resources. Understanding the nature of this impact calls for consideration of global population trends.

Growth Trends

Population reports for the pre-modern era are fragmentary. Demographers generally agree that the world's population probably did not exceed 500 million until about 500 years ago. World population numbers were characterized in earlier time periods by high birth rates balanced by equally high mortality rates and relatively short life spans.

Naturally there were periods of population growth during the pre-modern years. Yet every increase in numbers resulting from high birth rates was counterbalanced by the doleful consequences of famines, plagues, and wars. More than 600 famines occurred in parts of Europe during the first 18 centuries of the Christian era; three times that many were experienced in China. Plagues, such as the Black Death of 14^{th} century Europe, wiped out two-thirds of the population of some communities and probably killed more than a fifth of Europe's people. Wars were a common and devastating phenomenon; between a third and half of the people in Bohemia and the German states, for example, died as a result of the Thirty Years War.

The importance of the role disease played in controlling population numbers is illustrated by changes in life expectancies. The average child born in the United States in 2005 could expect to live for 75 years. This is double that of children born in the decade following the American Revolution and three times that of children born in Europe during the Middle Ages. An average of 2.1 children per family is now sufficient to maintain the population of the United States. This figure compares with the 10 to 11 children needed for family replacement during the years of the Black Death.

With the onset of the agricultural revolution in Western Europe around 1700, the population situation began to change. Increases in food production provided more sustenance for human life and paved the way for an upward surge in population numbers. This trend was accelerated by the industrial and sanitary-medical revolutions of the next two centuries. Increasing trade and commerce, the settlement of new land areas, the trend toward industrialization and higher productivity per worker, and the success with which medical developments lowered mortality rates all opened the way for further increases in total population numbers.

As the data on world population trends reported in Table 3–1 indicate, the world's population increased rapidly after 1600. World totals rose from 580 million in 1600 to 1,613 million in 1900, to 6,095 million in 2000, and to an estimated 7,255 million in 2015. Total numbers increased almost three-fold between 1600 and 1900 and will rise about four and a half times from 1900 to 2015.

Table 3–1. World Population Growth, 1600–2015 (in Millions)

Area/Year	1600	1700	1800	1900	1950	1980	2000	2015 (Expected)
Africa	114	106	101	118	228	479	807	1,154
North America	3	2	5	90	166	252	313	358
Latin America	10	10	19	75	165	361	520	623
Asia	339	436	646	902	1,438	2,644	3,694	4,347
Europe	111	125	195	422	547	695	730	736
Oceania	3	3	2	6	12	23	30	37
World (Totals Vary Due to Rounding)	580	682	968	1,613	2,557	4,453	6,095	7,255

Source: Estimates for 1600 through 1900 from, *6*, Caselli, Wunsch, Vallin, 2005. Estimates from 1950 through 2015 from the U.S. Census Bureau, International Data Base, 2011. *Including ex-USSR.

Table 3–1 indicates that in the year 2015, approximately 60 percent of the world's people will live in Asia, only 10 percent in Europe, nine percent in Latin America, and only five percent in North America. While this large scale regional analysis is useful, it is possible to develop a much more detailed picture by examining individual nations or groups of nations that share common characteristics. It is possible to look at population trends by religious group, energy consumption, longevity, or a wide variety of targeted traits.

Table 3–2 provides a comparison of the population numbers for the world and projects population trends over time, by region, and by development category to the year 2050. It must be noted that the division of regions by more developed and less developed is a very general way of categorization. The World Bank, the World Trade Organization, the International Monetary Fund, and the United Nations all have slightly different ways of designating nations as to development status. The designations used in the following tables are from the United Nations Department of Economic and Social Affairs and are useful for the general sorts of comparisons that will be made regarding population, age, and gender.

Table 3–2. Expected Increases in World Population Numbers, 2000–2050

Area	2000	2010	2050 Assuming Different Rates of Increase			
			Low	Medium	High	Constant
World Total	6,123	6,896	8,112	9,306	10,614	10,943
More Developed Regions	1,189	1,236	1,158	1,312	1,478	1,252
Less Developed Regions	4,934	5,660	6,955	7,994	9,136	9,691
Africa	811	1,022	1,932	2,192	2,470	2,997
Asia	3,719	4,164	4,458	5,142	5,898	5,908
Europe	727	738	632	719	814	672
Latin America	521	590	646	751	869	863
North America	313	345	396	447	501	444
Oceania	31	37	49	55	62	60

Source: United Nations, Department of Economic and Social Affairs, Population Division, 2011.

Distribution Relative to Land Resources

All of the world's people have access to air yet significant differences occur when consideration is given to surface land resources. Some parts of the earth's surface are far better endowed than others with the ability to supply food, water, and other environmental resources to meet human needs. The near deserts of Africa and Australia and the colder regions of the far north are ill equipped to serve the needs of large populations. This situation has led to an uneven distribution of population around the globe as people have settled in greater densities in areas with abundant resource bases than in areas less well-endowed.

Table 3–3 provides a range of information on population numbers, densities per square kilometer, average life expectancies at birth, current fertility rates, and some measures of per capita average rates of resource consumption for a list of 20 selected nations; selected, in part, to illustrate the wide variations now found in various parts of the world. Average densities range from lows of three people per square kilometer in Australia and Canada to highs of 386 in the Netherlands and 336 in Japan (approximately nine per square mile in Australia and Canada and 1,000 and 870, respectively, in the Netherlands and Japan).

Table 3–3. Population Densities, Life Expectancies, Fertility Rates, and Per Capita Measures of Food Consumption, Energy Use, and Incomes (20 Selected Countries, 2000)

Nation	Population Recent Year (Millions)	Density per Sq. Km.	Average Life Expectancies	Average Fertility Rates	Average Annual incomes	Per Capita Daily Consumption		
						Calories Units	Protein Grams	Energy Units
Austria	8.1	97	78.5	1.3	$23,388	3,782	111.1	3,283
Australia	17.9	3	79.2	1.7	$19,046	3,110	106	6,008
Brazil	169.7	20	68.3	2.2	$2,925	3,002	79.8	771
Canada	30	3	79.3	1.5	$22,385	3,177	103.3	8,012
China	1,242.6	130	71.1	1.8	$4,310	2,972	84.5	599
Egypt	59.3	68	68.9	3.3	$1,390	3,366	95.5	714
France	58.2	107	79	1.9	$22,168	3,603	117.3	4,223
Haiti	5.1	293	49.5	4	$447	2,041	45.1	264
India	1,027	310	63.9	3	$467	2,492	58.5	309
Japan	126.9	336	81.5	1.3	$32,809	2,753	90.7	4,732
Kenya	28.7	49	44.6	4	$367	2,044	53.2	2,965
Malawi	9.9	94	37.5	6.1	$169	2,164	54.1	302
Mexico	97.5	52	73.4	2.5	$6,144	3,152	88.9	1,331
Netherlands	7.4	386	77.9	1.7	$24,029	3,394	107	5,267
Pakistan	130.6	179	61.1	5.1	$441	2,458	62.6	291
Peru	20	20	71.3	2.9	$2,053	2,602	41.6	410
Russia	145.5	8	67	1.1	$2,139	2,944	87.2	4,194
Thailand	60.6	117	69.4	1.9	$1,065	2,466	55.5	1,067
U. K.	58.8	246	78.2	1.6	$24,281	3,343	104.4	3,829
U. S. A.	281.4	30	77.1	2.1	$34,788	3,769	114.8	7,798

Source: United Nations, Demographic Yearbook, 2001, Tables 1, 11, 19, and 31.

Examination of the comparative data in Table 3–3 also shows that average life expectancies at birth ranged from 81.5 in Japan and 79.3 in Canada to lows of 37.5 in Malawi, and 44.6 in Kenya. Average fertility rates, which are indicative of probable future population growth, range from highs of 6.19 in Malawi, and 5.1 in Pakistan, to lows of 1.1 in Russia and 1.3 in Austria and Japan. Average per capita consumption of food calories and proteins is high in the United States, Austria, and France, while it is low in Haiti and Kenya. Average per capita consumption of energy is far higher in the United States and Canada than the low rates reported for Haiti and Pakistan. Average per capita shares of gross national products showed significantly higher average per capita income levels in the more developed nations than in less developed areas.

Differences in Rates of Growth

Tables 3–1 and 3–2, indicate wide differences among regions in their reported rates of population growth. If this analysis is broken down further, it can be seen that such nations as Mexico and Thailand have experienced spectacular growth since 1950. Others, such as France and Germany, experienced their growth in earlier time periods and are now barely replacing their population levels. Explanation of why these trends are taking place calls for examination of the dynamics of population change.

Increases in population numbers come from new births and the immigration of people from other areas. Losses come with deaths and the out migration of people. Birth rates provide a measure of the numbers being born, while mortality rates measure their demise. Fertility rates, measured in terms of numbers of children under the age of five born to women of child-bearing age (usually all women between the age of 15 and 44) provide another predictive tool for demographic forecasts of future populations.

Until comparatively recent times, a Malthusian balance in population was retained with high birth rates matched by high mortality rates. A change in this situation started to take place about two centuries ago when increases in food supplies and revolutionary developments in the practice of medicine brought a downward shift in mortality rates and a gradual rise in life expectancies. This trend had its first impacts in what are now the more developed nations and led to rapid rates of population increase. Once mortality rates declined, it became obvious that large families were no longer as necessary as they had once been for family survival. Changes in cultural attitudes emerged as more and more parents began to weigh the advantages of having additional children versus not having them.

The decline in mortality rates was matched by gradual acceptance of lower birth rates. But in every case a decline in mortality rates preceded the drop in birth rates. This situation, which has taken place or is still taking place in almost every nation, involves five stages of population growth (see Figure 3–1).

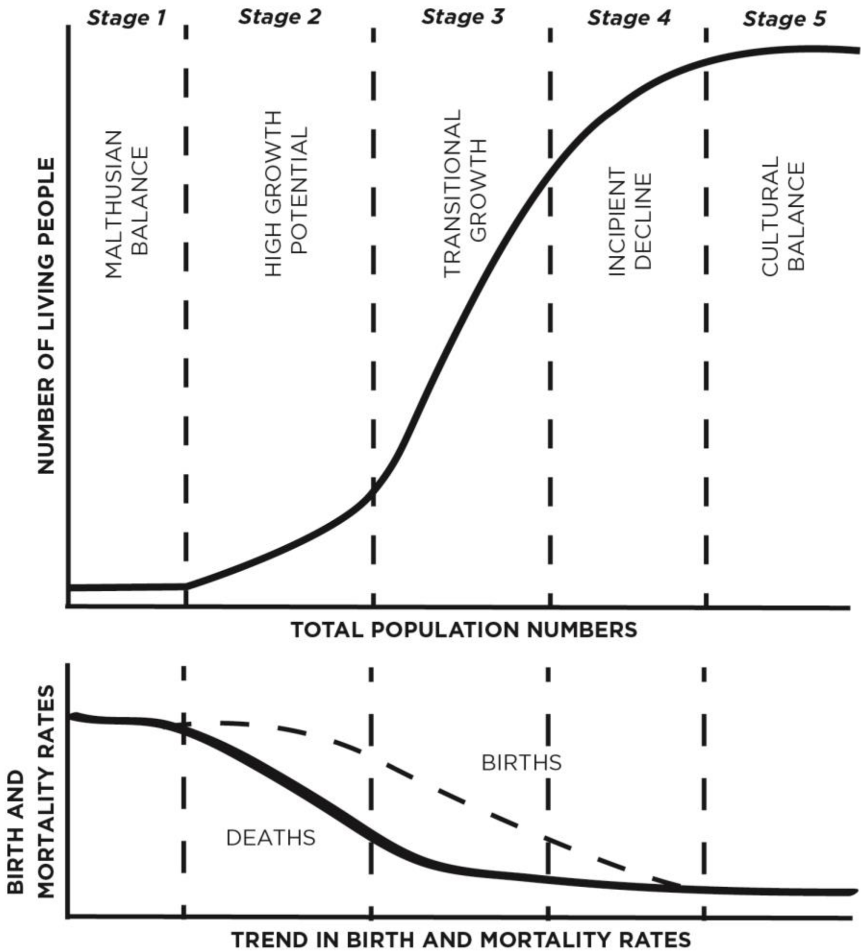


Figure 3–1. The Five Stages of Population Growth

Stage I represents a time of Malthusian balance with high birth rates matched with high mortality rates. With more food and better medical practices, mortality rates start to drop and nations move into Stage II, which is an interval of high growth potential as there is an excess of births above deaths. With mortality rates dropping to a lower level and birth rates beginning to fall, a nation enters Stage III, a period of high transitional growth in which population numbers show their greatest increase. Stage IV follows with mortality rates now at a low level and birth rates declining to balance with them. This is a period of incipient decline. When birth rates have dropped along with mortality rates to a new cultural level, a nation reaches Stage V. This is the objective most nations strive for when they seek a balanced population.

Data are presented in Table 3–4 that compare the reported statistics on birth rates, mortality rates, and population growth rates at three recent time periods for a selected group of nations. Examination of these data shows that Austria, Sweden, and the United Kingdom were already incipient decline (Stage IV) countries in the 1950s and have since shifted to areas of near cultural balance (Stage V). Mexico, Peru, and Turkey were shifting from a Malthusian balance (Stage I) to the high-growth-potential class in 1950–55 and have since shifted to the incipient decline grouping. Afghanistan, Mali, and Nigeria also were shifting from Stage I to II in 1950–55 but still represent areas of high population growth potential. Treated as a group, the more developed nations have shifted from Stage III to very near Stage V, while the less developed nations have lagged behind but have mostly moved from Stage II toward Stage IV. Canada and the United States were both areas of high growth potential in 1950–55. Canada has since shifted to the near Stage V category, while the United States remains an area of incipient decline.

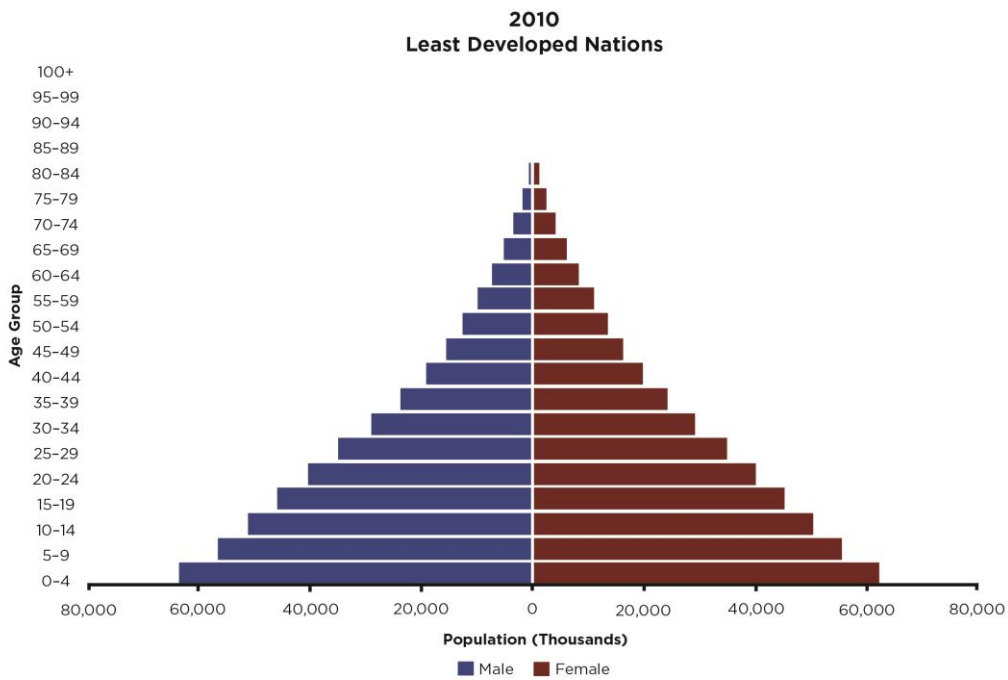
Table 3–4. Crude Birth Rates, Mortality Rates, and Growth Rates for Selected Countries

Area	1950–55			1975–80			2000–05		
	Births	Deaths	Growth	Births	Deaths	Growth	Births	Deaths	Growth
World	37.5	19.5	1.81	28.1	10.8	1.94	21.1	9	1.21
Developed Nations	22.4	10.3	1.20	15	9.5	0.66	11	10.2	0.3
Less Developed Nations	44.6	28.1	2.09	32.5	11.3	2.09	23.5	8.7	1.43
Austria	15	12.3	0.66	11.9	12.4	-0.08	10.3	9.6	0.25
Sweden	15.5	9.8	0.70	11.7	10.9	1.09	10.6	10.4	0.37
U.K.	15.9	11.7	0.23	12.4	11.9	0.04	11.4	10.3	3.34
Canada	27.8	8.7	2.72	15.2	7	0.65	10.5	7.2	0.41
U.S.A.	24.3	9.5	1.61	15.1	8.6	0.95	14	8.4	0.97
Mexico	45.3	17	2.69	37.9	7.7	2.76	21.7	4.5	1.34
Peru	47.1	21.6	2.55	38	10.9	2.78	23.3	6.1	1.5
Turkey	50.8	23.5	2.72	34.1	10.2	2.34	21.4	6.6	1.4
Afghanistan	52.1	33	1.92	50.1	22.9	1.21	49.3	19.8	4.59
Mali	54.1	32.9	2.15	53.7	25.2	2.32	49.7	17.8	2.98
Nigeria	49.3	27.7	2.17	47.3	20.2	2.56	42	19.4	2.24

Source: United Nations Demographic Yearbook. Tables A15, A23, and A27.

Age-sex pyramids, such as those shown in Figure 3–2 below, can be used to illustrate the age distributions of populations. They show the relative proportions of the total population, males on the left side and females on the right, represented by successive age cohort groupings. Diagrams for nations at the Group I Malthusian balance level have a near perfect pyramidal shape as the largest proportions are found with the early age brackets (such as a 0–5 or 0–10 years-of-age bracket) with each successive older bracket shrinking in the size of its proportion of the total as mortality takes its toll. As nations move with lower mortality and birth rates toward the cultural balance of Group V, the proportions of the total represented by the successive cohort groupings remain about the same in size for the age brackets under 50 years of age. For those over 50, a pyramidal form can be expected to continue.

(The following three pyramids comprise a single figure.)



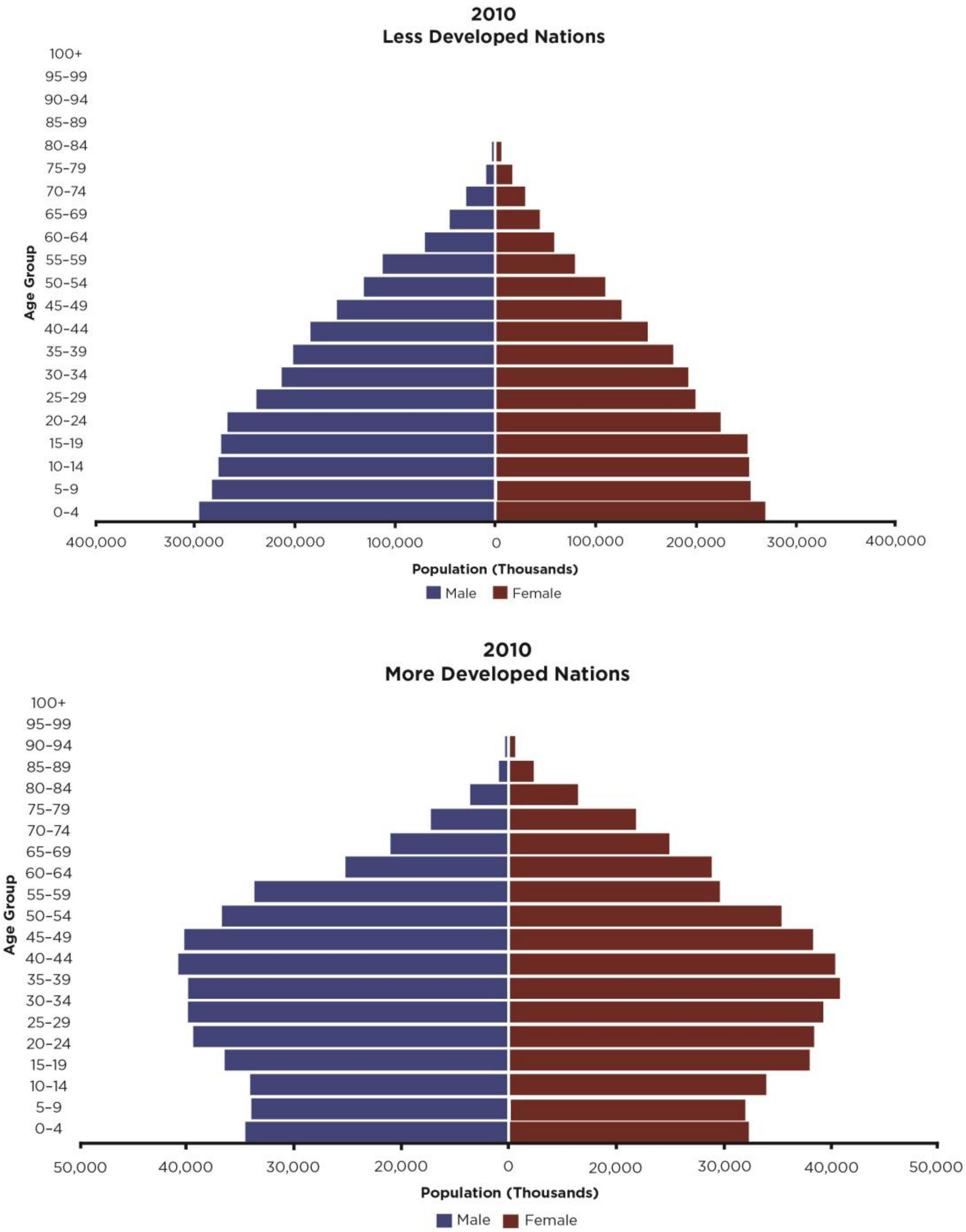
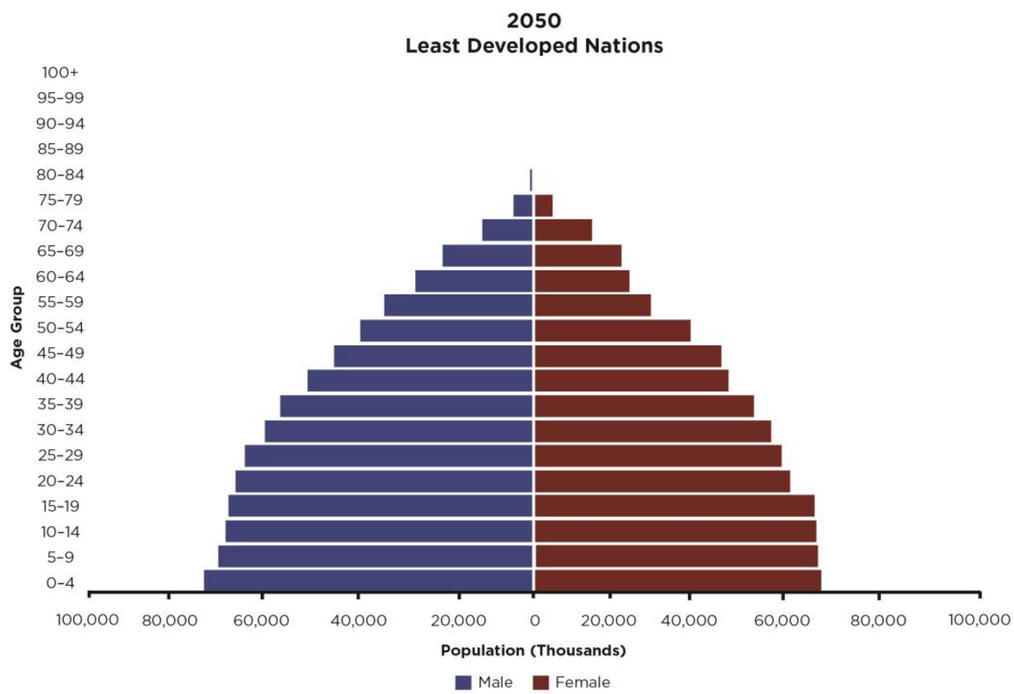


Figure 3–2 Population Pyramids by Development Status, 2010

Figure 3–2 indicates that the less developed nations had a broad-based population pyramid in 2000 and that downward adjustments in birth and mortality rates are expected to bring a definite narrowing of the proportions represented by the younger age brackets during the next few decades. Quite in contrast, the diagram for the developed nations in 2000 shows that a true pyramidal form existed only for the age cohort groupings born before 1930. The number of births declined during the 1930s and the World War II period. A baby boom (indicated by the width of the 35 to 55 age cohorts) followed during the postwar period until about 1965 after which the size of the younger age cohorts declined.

Figure 3–3 below shows how these population pyramids are expected to change by 2050. The projections for 2050 indicate that the cultural balance attained with youngest age groups in 2000 is expected to continue, while the bulge in population growth represented by today's senior citizen groups works its way through the system.

(The following three pyramids comprise a single figure.)



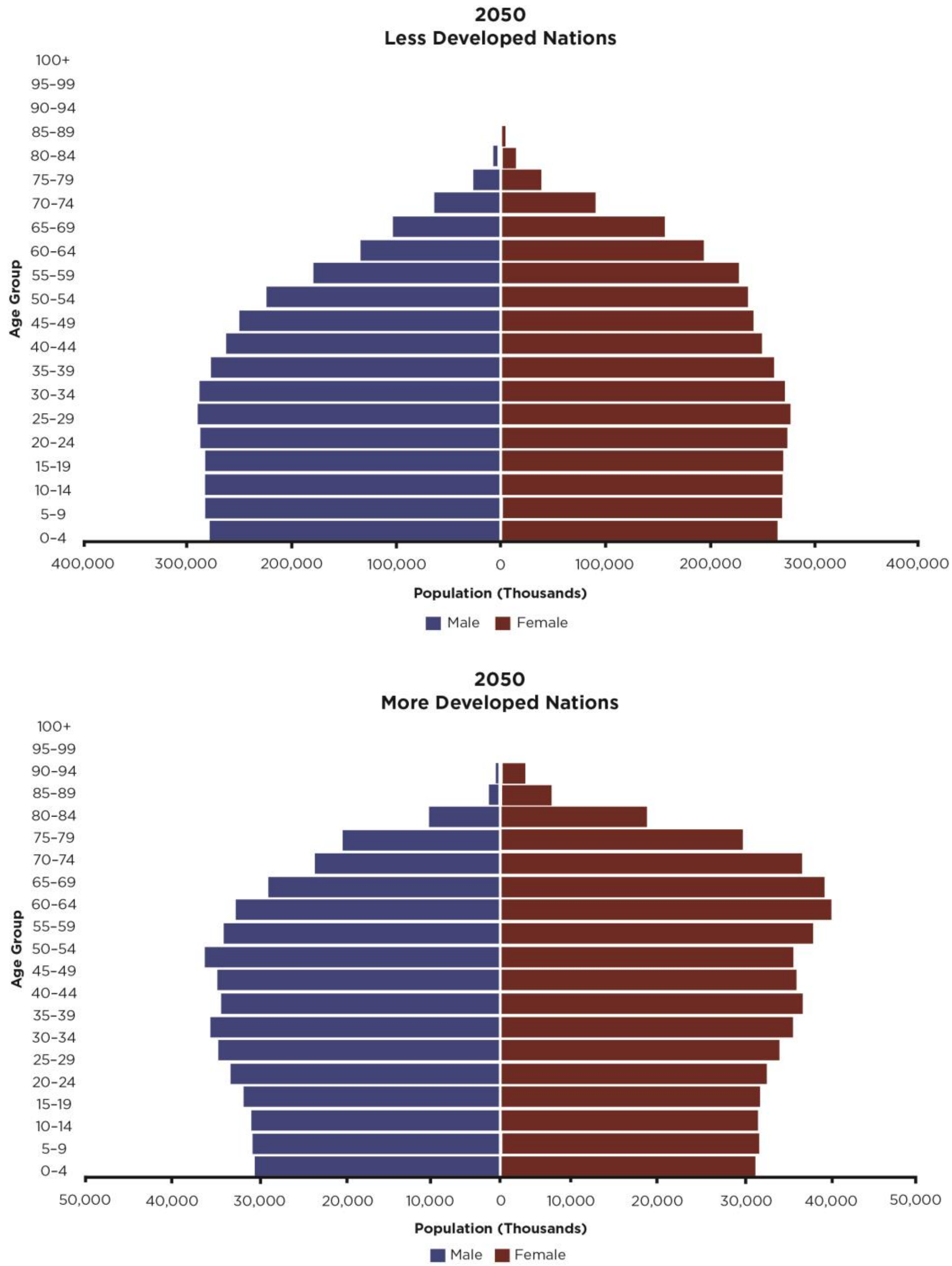


Figure 3–3. Projected Population Pyramids by Development Status, 2050

The two sets of diagrams (Figure 3–2 and 3–3) have important implications for management of the environment. Those for the developed nations suggest that a cultural balance in population growth is at hand. The situation for the less developed nations is one of transition. While movement toward a balancing of population growth for these nations is projected, it must be remembered that the sheer numbers within this group can be seen in the labels of the *x*-axis of

Figures 3–2 and 3–3 that are approximately eight times greater for less developed nations than for developed nations. With huge concentrations of the population in the younger age brackets, less developed nations face the prospect of tremendous added growth in total population numbers before a cultural balance can be reached. Associated with this increase are the problems they must face in educating, feeding, and finding remunerative employment for their growing numbers.

Population Growth in the United States

Few nations have experienced faster rates of growth during the last two centuries than the United States. Most of this increase has come from a surplus of births over deaths. Unlike most other nations, however, much of its growth can be attributed to large-scale immigration. In 1800, it had a population of 5.3 million. Between then and 1850, it experienced a four-fold increase to 23.3 million. This number tripled during the next half century to 76.3 million in 1900, doubled again to 151.3 million in 1950, and almost doubled again to 281.4 million in 2000. Immigration of settlers from Europe accounted for much of its early increases, and from 1830 (the first census year immigrants were separately counted) to 2000, 65.6 million immigrants were officially counted as entering the country. A total of 9.1 million people were counted as legal immigrants during the 1990s, while an estimated total of almost this number came without official sanction.

Table 3–5 indicates that population increases of 23–26 percent were realized during every decade from 1790–1890. This rate then declined to a low of 7.3 percent in the 1930s when adverse economic conditions brought a decline in marriage, birth, and immigration rates. A population explosion, following World War II, brought a rise in birth and immigration rates that led to higher rates of population increase until the 1960s when the small baby crop of the 1930s came into its child bearing years. The nation's population continued to grow after that at rates ranging from 9.8–13.3 percent per decade.

Table 3–5. Population Trends in the United States, 1790–2000

Year	Population (Millions)	Increase Percent	Immigration for Decade	Percent White	Percent Rural	Percent Urban
1790	3.9			80.7%	94.1%	5.9%
1800	5.4	35.1%		81.1%	93.9%	6.1%
1810	7.2	36.4%		81%	92.7%	7.3%
1820	9.6	33.1%		81.6%	92.8%	7.2%
1830	12.9	33.5%	152,000	81.9%	91.2%	8.8%
1840	17.1	32.7%	559	83.2%	89.2%	10.8%
1850	23.2	35.9%	1,713	83.3%	84.6%	15.4%
1860	31.4	35.6%	2,598	85.6%	80.2%	19.8%
1870	38.6	22.6%	2,315	86.6%	74.3%	25.7%
1880	50.2	30.2%	2,812	87.1%	71.8%	28.2%
1890	62.9	25.5%	5,427	87.5%	64.9%	35.1%
1900	76.2	21%	3,688	87.9%	60.4%	39.6%
1910	92.2	21%	8,795	88.9%	54.4%	45.6%
1920	106	15%	5,736	89.7%	48.2%	51.8%
1930	123.2	16.2%	4,107	89.8%	43.9%	56.1%
1940	132.2	7.3%	528	89.8%	43.5%	56.5%
1950	151.3	14.5%	1,035	89.5%	36%	64%
1960	179.3	18.5%	2,515	88.6%	30.1%	66.9%
1970	203.2	13.3%	3,322	87.7%	26.4%	73.6%
1980	226.5	11.5%	3,962	83.2%	26.3%	73.7%
1990	248.7	9.8%	7,338	80.3%	24.8%	75.2%*
2000	281.4	13.1%	9,095	80.3%	21%	79%

Source: U.S. Census 2000 datasets. *Seventy-eight percent using new Census definition.

Changing Characteristics of the Population

While population numbers provide a significant index of the demand for environmental resources, the nature of the demand for specific types of resources reflects both the makeup of the population and changes from one period to another in population characteristics. The nature of these changes is amply illustrated in the case of the United States. The nation's resource base now supports a larger and more urban population than it has in the past. Households are more numerous and smaller in size. People are more urban-oriented in their work and thinking; a higher proportion of the women work outside their homes. Most adults have more years of education, are more skilled in their training, and until recently have enjoyed higher real incomes, and are more mobile and communication-minded. The average person is taller, heavier, healthier, and has a longer life expectancy. A significantly larger proportion of the population is in the 65-years-old and older age group; and the population mix that was dominated by individuals with white, Anglo-Saxon, and Protestant backgrounds until the 1900s, now contains increasing proportions of people with Hispanic, African, Eastern and South European, and Asian roots. The U.S. 2010 Census noted that for the first time in U.S. history non-Hispanic white births comprise a minority when compared to all other births.

Urbanization

Important changes in the characteristics of the nation's population have come with the shift toward urbanization. In 1790, only one person in 20 in the newly constituted United States lived in an urban community (see Table 3–5). By 2000, this proportion had changed to 79 percent of the total. What was once a nation of small farmers had become an urban world in which only about two percent of the citizenry lived and worked on farms. This shift from rural to urban living represented more than a new geographic distribution of population; it created a shift in lifestyle and attitudes.

Urbanization has divorced the interests of most city folks from intimate use or concern for agricultural land resources. As consumers, they are interested in food, fibers, fuels, building materials, and the prices they must pay for these products in their retailed form. They tend to associate milk with the sanitary container in which it is purchased or fresh vegetables with the well-lit greens department of the local supermarket rather than with the cow or garden from which they came. So long as there is no threat to their supply of food and other products of the land, they are often apt to value agricultural land as much for the open space and environmental values it provides as for its food production potential. Their direct interests in land are more often expressed in their demand for housing, commercial and industrial sites, for highways, streets and parking spaces, and recreational areas.

The urbanization trend has also brought important changes in how we look at cities. Cities grew in size and number during the 1800s and early 1900s as expanding industries provided employment opportunities for millions of rural and foreign migrants. Then with the advent of automobiles, millions of urban residents used the same highways and expressways that had been built to bring people and products into the cities to move to outlying areas where they could make more luxuriant uses of living space. Commercial and industrial developments followed and what were once well-defined cities became metropolitan centers surrounded by suburban communities, many of which became satellite cities that competed with the central cities in providing services for area residents. With this outward sprawl, large areas of once rural land were appropriated for urban and suburban uses. The older concept of cities with well-defined boundaries lost much of its significance for other than governmental administration purposes.

With the suburbanization trend, businessmen and professional workers with above-average incomes were often leaders in the flight to the suburbs. They retained their commercial and financial interests in the central cities but left the aging housing and infrastructure of the cities behind them. Families with lower incomes and minority groups often became the dominant residents of the remaining city residential neighborhoods, a situation that often led to urban blight and decay.

Number and Size of Households

Table 3–6 shows that the number of households has increased at a significantly faster rate in the United States than total population since 1890. The number of households more than doubled between 1900 and 1940 and almost tripled between then and 2000. The average size of households dropped from 4.9 people per household in 1890 to 3.8 in 1940 and to 2.6 in 2000. This trend has had an important impact on the demand for land resources, because each new household unit brings with it an independent demand for additional living quarters, furnishings, and other products. A sevenfold increase in the number of non-family households between 1950 and 2000 (from 4.7 to 32.7 million as compared with the 38.8 to 72.0 million for family households) also signaled increasing demands for new types of household facilities.

Table 3–6. Trend in Number and Size of Households, Median Age of Population, and Proportion of Population Under the Age of 15 and 65-Years-Old and Older, United States, 1890–2000

Year	Number of Households	Average Size of Households	Median Age of Population	Percentage	
				Under 15	65 and Older
1890	12.7	4.9	22	33.8	3.9
1900	16	4.8	22.9	34.4	4.1
1910	20.3	4.5	24.1	32.1	4.3
1920	24.4	4.3	25.3	31.8	4.7
1930	29.9	4.1	26.4	29.4	5.4
1940	34.9	3.8	29	25	6.8
1950	42.9	3.4	30.2	26.9	8.1
1960	52.8	3.3	29.5	31.1	9.2
1970	63.4	3.1	28	28.5	9.9
1980	80.8	2.8	30	22.6	11.3
1990	93.3	2.6	32.8	21.7	12.5
2000	104.7	2.6	35.3	21.1	12.4

Source: Statistical Abstract of the United States, 1975 and 2006.
Proportions of population under the age of 15 and 65-years-old and older from Historical Statistics of the United States from Colonial Times to 1970.

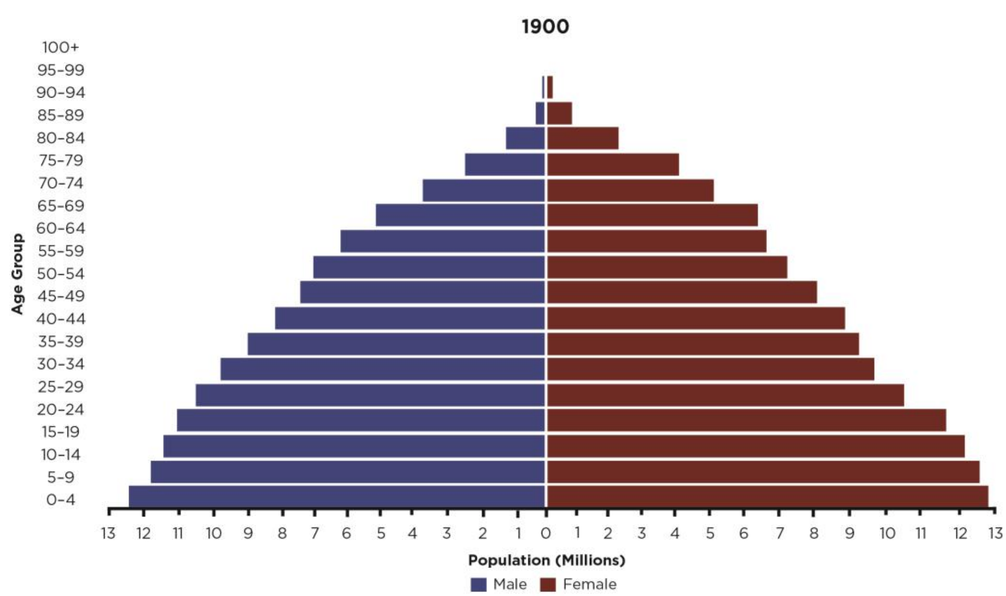
Changing Age Distribution

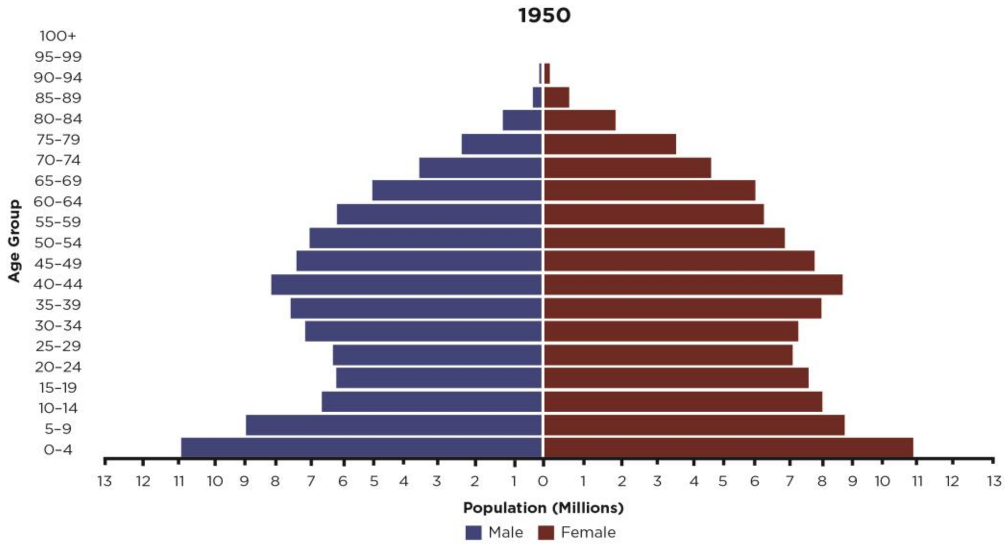
More of the nation's people are living to adulthood and to old age than at any previous period. Average life expectancies at birth increased from 59.1 for males in 1920 to 74.1 years in 2000, and from 54.6 to 79.5 for females. Reductions in the mortality rate made these gains possible and explain the fact that far larger proportions of the people born in the United States now live through infancy and childhood to become productive workers than was once the case. From an economic and social point of view, this factor has greatly enhanced the returns the nation can expect from its investment in the nurture and training of the young. It means that almost every baby born now will consume and use environmental products as a child and as a youth, then as a working adult and parent, and probably later as a retiree. The economic collapse of 2008 in the U.S. partly contributed to chronic unemployment that has disturbed the once abundant cycle of plentiful work at reasonable pay and the demand for goods and services that these worker purchase.

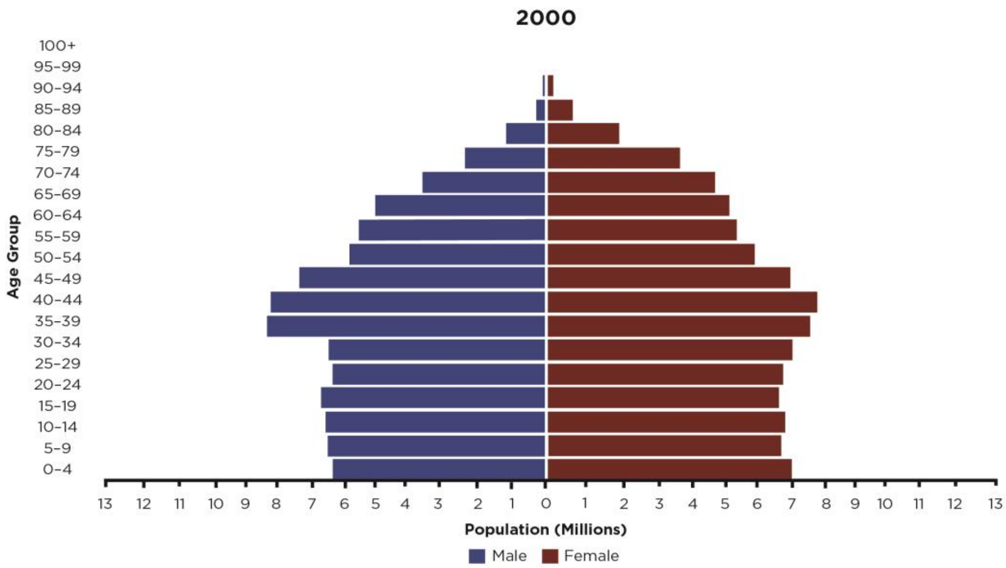
The median age rose from 16.7 in 1820 to 30.2 in 1950 and then dropped temporarily with the upsurge of new births before climbing to 35.6 in 2001. Meanwhile, the proportion of the population age 65 and older increased from 4.1 percent in 1900 to 12.4 percent in 2000. This aging of the population has called for new programs to deal with the health, housing, and recreation, as well as the economic security of older citizens. Retirement benefit programs also have made it possible for larger numbers of retirees to relocate at places where they want to be without regard for employment opportunities.

Age-sex pyramids, such as those shown in Figure 3–4 below, illustrate the change in age distribution that has taken placed since 1900. The distribution shown for males and females in 1900 provided an almost perfect pyramid profile. By 1950 this profile existed only for the cohort age brackets of people who were 25-years-old or older. The adverse economic conditions of the 1930s together with the effects of World War II caused considerable shrinkage in the proportions of the population born between 1930 and 1945. The effect of the post war baby boom shown by the width of the 0–5 year bracket in 1950 continued for a few years thereafter as is indicated by the bulge for people in the 35- to 49-year-old age brackets in the pyramid for 2000. The 2000 pyramid also shows the increasing tendency of people, most particularly females, to live into the older age brackets.

(The following four pyramids comprise a single figure.)




1950
Age Group
100+
95–99
90–94
85–89
80–84
75–79
70–74
65–69
60–64
55–59
50–54
45–49
40–44
35–39
30–34
25–29
20–24
15–19
10–14
5–9
0–4
13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13
Population (Millions)
Male
Female


2000
Age Group
100+
95–99
90–94
85–89
80–84
75–79
70–74
65–69
60–64
55–59
50–54
45–49
40–44
35–39
30–34
25–29
20–24
15–19
10–14
5–9
0–4
13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13
Population (Millions)
Male
Female

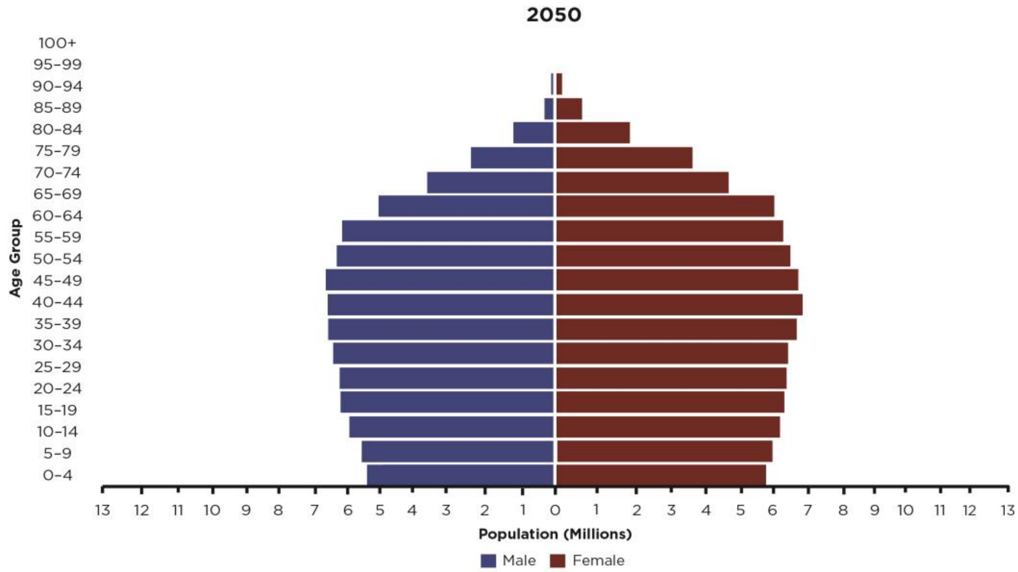


Figure 3–4. Population Pyramids, United States, 1900, 1950, and 2000 with a Projection to 2050

The medium rate projections for 2050 indicate that the three five-year cohort age brackets between 30 and 44 years of age, all people who will be born between 2005 and 2020, will have the largest proportions of the 2050 population. The younger groups will be slightly smaller and the older age groups will taper off proportionally once they are 65-years-old and older. Overall, the diagram shows little resemblance to a true pyramid until people reach age 65- to 69-years-old.

The four pyramids are indicative of the progress the nation is making in its shift from a Malthusian state to a cultural balance between births and deaths. Attainment of this balance can ease many of the problems associated with management of the environment. At the same time, it heralds a different set of problems as the nation must cope with the prospect of having a smaller work force together with the responsibility for providing economic and social security for an enlarged population of older citizens.

Education and Income Levels

Prior to 1920, most young Americans ended their formal education on completion of elementary schooling. Emphasis is now given to higher levels of educational attainment, and more than half of the nation's adult population have been high school graduates since 1966. In 2000, 84.1 percent of the population in the age 25 through 29 bracket had four years of high school, while 25.6 percent were college graduates, as compared with 38.1 and 5.9 percent in these age brackets in 1940. Approximately the same proportion of people now graduate from college programs as graduated from high school in 1940.

The trend toward securing more education has delayed the entry of large numbers of potential workers into the labor market. It has extended the time periods during which parents have cared for the needs of their children and at the same time greatly increased the production potential of the stream of new workers entering the labor market. Education has made higher productivity and higher incomes possible, and together they have opened new horizons in awaking desires for enjoyment of the material and amenity values of modern life. Many average workers now enjoy living levels that were not available even for royalty in the past. Our new-fold wants also have had significant impacts on the environment in that our effective demand covers a wider array of "essential" consumer goods together with more expenditures on vacations, sports equipment, and the other amenity items that many associate with good living.

An upgrading of worker skills has brought significant increases in average per capita disposable personal incomes. United States Bureau of Economic Analysis calculations indicate that average disposable incomes rose from $676 per person in 1929 and $362 in 1933 to $8,848 in 1980 and $30,466 in 2005. Measured in constant valued 2005 dollars, this represents an increase in disposable incomes from approximately $2,147 in 1929 and $1,150 in 1933 to $27,370 in 2005.

This increase was associated with a reduction in the average work week from 60.2 hours per week to 49.7 hours in 1920 to approximately 40 hours per week in 1950. Paid vacations along with provisions for health care and retirement benefits have become a common phenomenon with many employment agreements. The combination of these advances has made it possible for large numbers of workers to use surplus income above what they need for subsistence to secure better housing, enjoy household luxuries, own a second car and sometimes a second home, indulge in vacation travel, finance college educations for their children, and set aside funds for investments and savings. The demands associated with these expenditures have had major direct and indirect impacts on how we have used our environmental resource base.

The positive picture suggested by these trends has not affected all segments of the population alike. Census Bureau calculations indicate that U.S. households had a total income of

$4.3 trillion in 2005 of which 20.58 percent went to the top 2.67 percent of the households that had incomes of $200,000 or more. Only 0.27 percent of the income went to the bottom 6.37 percent of the households.

Average household incomes have increased rapidly since 1980 for the wealthier segment of the population. They have increased at a much slower rate for the middle class; and for millions of lower-income workers, the one-time upward trend has seemingly stalled and lost ground. The average work week has experienced little reduction since 1950. The inflation adjusted median income for male workers has declined. Personal savings have declined and family debts have risen to uncomfortable levels. And there has been a many fold increase in the number of married women who have entered the job market to provide a second breadwinner for household support.

Arthur B. Kennickell (*A Rolling Tide: Changes in the Distribution of Wealth in the U.S.*, 2003) reported that 32.7 percent of the nation's wealth was held by the top one percent of its families in 2001, 68.9 percent by the top 10 percent, and only 2.8 percent by the bottom 50 percent. With this maldistribution of wealth, it is not surprising that the Census Bureau found that 12.3 percent of the nation's families and 24.3 million of its people lived below the poverty line in 2006, and regrettably that 17.5 percent of the nation's children under the age of 18 were in families that lived below the poverty line.

Changes in Mobility

Relaxation of the transportation constraints that once bound the nation to a horse and buggy economy has had tremendous consequences that impact on the demand for environmental resources. Commercial developments were seldom found more than a few miles inland from coastal ports that offered water transportation advantages until the early 1800s. An internal improvements program that brought the construction of highways and canals, and which was followed by a period of railroad expansion, opened the middle of the nation for settlement. Still later in the 1900s, the rise of automobiles, development of a national highway system, and growth of air travel made it possible for people to travel distances in a few hours that had earlier taken weeks and months.

Workers in our early towns and cities had to locate within walking distance of their places of employment. With railroads, automobiles, urban mass transit systems, and air travel, many workers now live miles away from their jobs. Telecommuting, or working electronically from home, has taken this concept to the point that a virtual office can connect a team from around the world without anyone having to physically travel. Farm products that once had to be grown within a few miles of market can now be shipped to local markets from sites half a world away. Computer and communication developments also have also had a globalization effect in making it both possible and profitable for businesses to outsource important service activities to distant locations. These developments have provided profitable opportunities for some businessmen and have had desirable effects in providing market supplies of numerous goods, at lower costs. At the same time, they have wiped out the comparative advantages once enjoyed by many local producers and have afflicted their employees with the prospect of having to compete for employment with lower paid workers who live far away in distant lands.

Like other aspects of our daily lives, our ability to move faster and further has opened up vast new opportunities for personal enjoyment and use of environmental resources; but it has also created problems. It has aggravated land use issues associated with urban and suburban sprawl. Its dependence on the burning of mineral fuels to provide the energy needed to facilitate travel has magnified our problems with air pollution and global warming. It has contributed to health problems in some cases as when people have substituted their increased mobility for needed physical exercise. Longer trips to and from work have brought hours of time lost in traffic, as well as increased pollution.

Immigration

A total of 9.1 million people were legally admitted to the United States as immigrants during the decade of the 1990s. This total accounted for 27.8 percent of the nation's population growth during the decade. Of this total, 1.3 million came from Europe, 2.9 million from various parts of Asia, and 4.9 million from the Hispanic areas of North and South America (2.25 million from Mexico). An additional unknown total (estimated as 12 million persons in 2006) entered the nation as undocumented migrants.

The volume of this immigration has generated considerable controversy concerning future immigration policy. Like Canada and Australia, the United States has been a nation of immigrants yet there is widespread debate as to whether its doors should remain open for all who wish to come. Migrants who come with skills and financial resources are generally welcome.

The great majority of those who come from south of the border, however, are poor and lacking in skills needed to secure a high paying job. Prospective employers welcome their arrival as a source of cheap labor. Low income workers in the country, on the other hand, have reasons to oppose their admission, because the sheer volume of their numbers has a depressing effect on domestic wage rates.

Large scale immigration has a direct bearing on management of the environment in that it adds to the pressure placed on a nation's natural resource base and also to domestic demand for the use of environmental resources. The matter of whether public policy should be used to curtail immigration has two sides. Proponents of liberal immigration policies argue that we have a moral duty to accept immigrants and even suggest that everyone has or should have a right to relocate anywhere they wish to go. International law, however, recognizes the right of nations to protect their cultural and economic interests by controlling entry across their borders.

Immigration policy poses a challenging problem for every developed nation that has moved toward stabilizing its population numbers and that wants to preserve its perceived cultural values together with the levels of living enjoyed by its citizens. With free uncontrolled immigration, many developed nations could face the prospect of being swamped by an influx of migrants from less developed nations. Liberal immigration policies can be a boon to the migrants and to the economic groups that benefit from their employment. They are not necessarily beneficial, however, for the interests of nations at large.

Other Demand Factors

Every new birth means a new mouth to feed, a new body to clothe and house, and a new person whose health and happiness calls for use of environmental resources associated with the earth's bounteous flow of benefits. It is little wonder that we think first of population numbers when we consider the overall demand for natural resources. But the extent of individual demands varies widely from person to person. A native living at a subsistence level in a tropical jungle may ask for very little from the earth as compared with a young American who expects to eat well, live in a nicely furnished house, own an automobile and a full array of new electronic and recreational gear, travel widely, enjoy an active social life, and engage in a lifestyle that draws heavily on use of the earth's resource base. In both cases total demand depends upon population numbers multiplied by the average individual's level of demand. This average level reflects one's buying power or affluence, consumption and buying habits, access to technology and the availability of products in the market that one has the ability to buy.

Food Requirements

"Give us this day our daily bread," the first request in the Christian's Lord's Prayer, is indicative of the age-old concern people have had about the availability of food supplies. Uses of agricultural land for farming purposes, grazing lands for the production of livestock, and fishing are the primary sources for our food supplies. How much we need of these resources is affected by their productivity and by the nutritional standards we are trying to meet. Decreasing productivity can force nations to tighten their belts and go on half rations much as soldiers and sailors have often done when they found themselves short of needed supplies. Increasing productivity, on the other hand, has made it possible for nations to provide growing populations with more products per capita without requiring increases in the areas used in production.

Data reported by the Food and Agriculture Organization of the United Nations indicate, that while there have been cases of famines associated usually with local unrest in Africa, worldwide food production has kept ahead of population demand. During the decade of the 1990s, for example, significant increases were reported in the total production of cereals, oil crops, vegetables and fruit, beef, pork, poultry, and fish. Moreover, the prospects for further increases in production are promising as farming practices are adopted that increase yields.

How much food is needed depends on consumption levels and the nutritional standards that are being met. Consumption needs per capita vary by age, sex, body size, types of activity, and differences in working climates. A man who weighs 200 pounds and works with a logging crew in a cool northern climate naturally has as greater need for food calories than a petite secretary working at a sedentary job in a warm environment.

Average per capita data on the availability of food calories and proteins provide a general measure of the adequacy of these supplies in different nations. As the data reported in Table 3-3 indicates, vast differences exist between nations. Differences in the availability of food calories ranged from a low average of 2,041 calories per day in Haiti to a high of 3,769 in the United States. Availability of proteins ranged from a low of 41.6 grams per day in Peru to 117.3 in France. All of the more developed nations provided their people with 3,000 or more food calories per day while calorie intake was lower in the less developed nations.

Average per capita consumption of food calories in the United States rose from 3,200 calories during the 1970–79 period to 3,800 calories in 1999. This increase involved increases of from 387 to 500 grams of carbohydrates, 95 to 111 grams of protein, and 149 to 164 grams of fat. Comparable data for 1999 indicate that 56.5 percent of the population is overweight and 21.1 percent are classified as obese. Data from the National Health and Nutrition Examination Survey, 2009–2010, indicates that by 2010 more than one-third of U.S. adults (35.7%) were classified as obese.

Dietary tastes and nutritional differences have a considerable effect on the amounts of land needed for food production. Some types of food provide large outputs of food nutrients from relatively small areas. Others call for the extensive- and sometimes luxurious-use of considerably larger areas. The sugar produced on a sixth of an acre planted to sugar beets can provide more than enough calories to meet the energy equivalent needs of a moderately active man for a year. This same energy equivalent can be met by slightly less than an acre used to produce apples, beans or wheat, while larger acreages are required with livestock products. It takes around 7.5 acres for feed crops plus 2.3 acres of pasture to produce enough dressed beef to provide the annual food-energy equivalents requirements of a moderately active man. This makes beef one of the most expensive foods from the standpoint of land requirements. Among the cereals, wheat is most expensive, a factor that helps explain its displacement in some areas by rice or potatoes and in other areas by oats and rye, which yield more grain per acre on less fertile soils.

The heavy emphasis the more developed nations place on the consumption of livestock products means that large areas must be used for grain and feed crops, pasture, and range. In high population pressure areas, this can be seen as a wasteful practice, because crops fed to livestock lose high proportions of their food value before they re-emerge as meat, milk, or eggs. The diets enjoyed by average Americans call for use of three or more times as much land as those of workers in Japan and China. This suggests that the United States could support a far larger population than it now does if shifts were made to a more Asian type of diet. It must be noted, however, that nutritional, as well as satisfaction values are associated with diets rich in livestock products. Also, to a considerable extent, animal and crop production represent supplemental rather than competitive uses of land. Under the climatic conditions that prevail in much of the world, systems of mixed farming based, in part, on grazing or grass production give best results for both crop and livestock production.

Improvements in dietary standards in nations that suffer from inadequate food supplies call for cultivation of more land and more intensive use of the areas in current productive use. Capital investments, acceptance of improved production practices, and market and trade developments are often needed for attainment of this goal. Even with these adjustments, the possible production of additional food, fibers, forests, and other materials does not necessarily mean that average consumers will benefit from more nutritious diets or the availability of more consumer goods. Products must be provided at prices buyers are willing and able to pay. When prices rise relative to buying power, consumers do without many products and do the best they can with those they can afford.

As far as the situation in the United States is concerned, farmers must be credited for doing a superb job in meeting the need for increasing food production. Total production for domestic consumption and exports increased dramatically during the 1900s. The U.S. Department of Agriculture's index of farm productivity rose from 52 in 1930 (1967 = 100) to 73 in 1950, 134 in 1980, and 192 in 1999. Meanwhile, the acreage of harvested cropland dropped from 349 million acres in 1930 to 312 million acres in 2000. Some additional areas were brought into use during this time interval, because of land clearing and irrigation. Some areas were retired from use, because they were considered submarginal for cropland use. A total of 32.7 million acres were enrolled under the Conservation Reserve Program, and a substantial area shifted to various suburban uses.

Most of the increase in production can be credited to technological advances. Average corn yields, for example, rose from 28.6 bushels per acre in 1937–39 to 137 bushels in 2000. Comparable increases occurred with other crops, cotton rising from 253 to 632 pounds, soybeans from 19.7 to 38.1 bushels, hay from 1.28 to 2.54 tons, and wheat from 13.6 to 42.0 bushels per acre. Except for the World War II period, the devising of programs to deal with surplus agricultural production was the central concern in American agricultural policy.

Negative externalities of agricultural practices used to create and sustain this increase in production have been widely recognized. These externalities include: loss of soil biodiversity, dependence upon chemical fertilizers and pest control agents, groundwater contamination from chemicals, animal waste, or sediment. Further, water used for irrigation impacts streams and rivers, and less water is available for downstream users. There is a cost associated with increased production; however, farmers and researchers are continually looking for ways to minimize negative environmental impacts.

Need for Fibers, Forests, and Minerals

As is the case with food, the world has need for fibers, forest products, and minerals. Higher per capita demands for these resources has come with technological advances; but prospects for supplying these needs, though pressing, are not foreboding. Meeting a worldwide increase in demand for fibers poses no immediate problems as cotton and synthetic fiber production can easily be increased.

The world has a tremendous need for forest products and the rapid rate at which virgin forest growth is being harvested in various areas can be lamented. It should be remembered, however, that much of our timber harvest still comes from old growth stands. The prospects for tree farming and treating forest growth as an agricultural crop can go a long way in caring for future needs.

Substantial increases in production can come with the adoption of intensive forest management practices. It has been suggested, for example, that the United Stated could supply its emerging needs for forest products through the intensive use of only a third of the area now classified as forestland. Attainment of this objective, however, would call for concentration of management efforts on the more fertile sites. Adjustment also would be needed if emphasis were given to the pursuit of multiple use management goals that recognize the joint use of forested areas for timber production, grazing, game, recreation, watershed protection, and scenery protection services.

Adoption of more intensive forest management practices can also bring increased timber production in other nations. An important worldwide problem that must be addressed, however, is that of avoiding over-harvesting timber in environmentally sensitive areas, such as mountain sides and the Amazon basin. Harvesting practices in these areas, if not properly controlled, can lead to unnecessary soil erosion, serious flooding conditions, and have adverse long-run effects on the world's climate. The Greenhouse Effect is doubly impacted by deforestation as it reduces the earth’s capacity for carbon sequestration, and if the trees are burned, also releases carbon into the atmosphere.

World demand for mineral fuels, metals, and other non-metallic minerals can be expected to rise. As fund resources, their physical supply is fixed and, to a large extent, hidden. Meeting future demands calls for searching for new sources of economic supply, use of lower grades of ore, and recycling metals for further reuse.

The earth's surface contains a tremendous store of minerals and there is little danger that we will run out of many common minerals but we must be prepared to pay more for their recovery for our use. Mineral fuels pose a somewhat different problem than metals, because they are in a sense destroyed through use. With them, we can expect market prices to rise as economic supplies become scarce. Portions of their total physical supply will remain available through the costs of their recovery may exceed our willingness to pay for them. Over the long run the world must look for ways to replace them with flow resources as its sources of energy.

Rare earth minerals, those that are available in very limited quantities and locations, have become a point of contention as developed nations scramble to acquire rights to them. Indeed, access to these minerals is critical for the production of new technology and control of them can provide a huge competitive advantage.

Housing and Urbanization

Important issues in environmental management have come during recent decades with the shifting of a large part of the world's population from residence in rural areas, where their ancestors lived close to the soil, to life in urban areas. Cities, both large and small, have been swelling with the influx of thousands of new residents. For those who have found remunerative employment this has often meant progress. For the many who have found limited opportunities for remunerative employment, it has meant a move from unsatisfactory living in rural poverty to equally lamentable living conditions in urban slums.

Urbanization has brought the crowding of people together, frequent impersonalizing of relations with others, and increased problems with environmental pollution. Every additional household has called for the provision of housing along with the associated needs of sites for commercial and industrial developments, for streets, urban service centers, parks and recreation areas, most of which have required the taking of land areas once used for open space purposes. The area used for urban and suburban uses increased from around 10 million acres in the United States in 1920 to 31 million in 1969 and to approximately 106 million in 2000.

Urbanization cannot be condemned as bad or undesirable. For millions of people it has provided opportunities to earn higher incomes, to enjoy improved standards of living, and use their skills and talents for more fulfilling purposes. At the same time, however, it has given rise to a myriad of environmental problems associated with our use of air, water, and land resources. New cities are springing up worldwide, and others are recreating themselves, with greater attention to the healthy natural environment as pivotal in attracting new knowledge and information technology industries.

Chapter 4: Emerging Concepts on Earth Resources and People

"Think not what your country has done for you,
think what your country can do for you."
~ Soji Adelaja (2011)

The primary challenge of mankind is and always will be how to satisfy the unlimited wants of people under the constraint of fixed resources. With the stock of earth resources seemingly limited, addressing the question of how best to pursue increasing prosperity and high quality of life requires a societal framework for resource allocation. In the distant past, the allocation of earth's resources efficiently was the primary focus of society. The field of economics emerged as the key discipline or philosophy for managing this problem—maximizing the outcomes from the use of limited resources. The associated goals of cost minimization and or profit maximization emerged from the field of economics as key principles and assumptions of a society that is effectively growing its wealth and the quality of life of its people.

Historical Economic Basis for Natural Resource Management

The classical theories and models of economics, which are the backbone of Part One, satisfied the needs of society for a framework for prosperity. That model was hinged on the principle that the value of labor is based on its contribution to the production process, which transforms raw materials and other collateral assets of land into products. But people are not only producers; they are also consumers. In the classical framework, a person simply earns his/her pay from his/her contributions to production and the earnings from such participation represents the purchasing power utilized in purchasing needed goods and services available in the other market, the product market.

Inherent in this simple model of the economy are the notions of exchange, trade or arbitrage. Labor markets (where people sell their labor) and product markets (where firms sell their products) must also be efficient, just like the production system. In the classical economy, consumption is inherently tied to production. People and businesses produce goods and services that are then consumed by people and businesses. A consumer earns income from the skills and resources he applies in the production process, income that is then spent to consume goods and services. A considerable challenge facing society was the need for economic analysis offering newer and better explanations. Neoclassical economics emerged to accommodate the fact that labor and consumer markets exist and that they are tied to the production process. This build-on to basic economics was not so production centric, but acknowledged the fact that markets exist as institutions in and of themselves. The primary difference between classical and neoclassical economics is the recognition by the former that value and prices are determined by markets, not just the production process. Neoclassical economics accommodated the notion that supply and demand forces set value, not the production process or system, and that the production process responds to such market signals.

This summary of the evolution of economic thought is presented to accentuate the point that at the very heart of economics as a field or discipline are such concepts as production, markets, efficiency, trade, prices and natural resources. Of the above, production, or the ability to produce, is central to the functioning of the classical or neoclassical economy and the defining factor in prosperity, either for individuals, places, or the overall economy. The production process itself exhausts natural resources, consumes labor services, and combines natural resources with labor and management through a system that leverages capital. Outputs (goods and services) emerge that are then purchased by people and businesses based on their earning capacity from the same process.

Under the neoclassical model, land is essentially the bearer of much needed resources and people agglomerated in places where land offered the best opportunities for production. Places that had a strong and unique resource endowment to support production historically tended to fare much better, compared with places that did not, if human and other capital are free to move to places of natural resource bounty. While this characterization of the economy is indeed limiting, it provided the basic framework through, which the world was viewed for centuries. It certainly fit well into the nature of the mono-centric industrial world where production drove the economies of places.

Limits of Neoclassical Theory

The neoclassical model of the economy falls apart when one considers market failure;—the fact that markets do not always work well, can be inefficient, or can fail. One source of such failure is market power where people and institutions can exert monopoly or control power over markets and, therefore, prices, production and consumption. In failed markets, where the market system is incapable of efficiently allocating resources to the production of goods or match consumption with production, other explanations are needed. The area of public (non-private) goods where individuals can benefit if they free-ride by not committing their resources or paying the price is another example of where standard market theory breaks down. What about the issue of externalities? The market system often fails to adequately explain production, consumption and distribution when the market ascribes zero or little value to environmental resources. So, a producer can get away with producing cheaply, but commands fair market price and enhances his profits if he can avoid the cost of clean-up, which is then transferred to the consumer in the present period or in the future.

The environment and natural resources are perfect examples of where the production-centric model of the economy falls apart. Obviously, to correct for market failure and other inefficiencies, institutions are needed to correct market imperfection and these institutions exert influence, such as taxes, regulations, fines, incentives and other government or institutional interventions. It is important to recognize that the economist's view of the world, which indeed was representative of the broader view of society, had its foundation in the challenge faced by society in the past—the efficient allocation of the earth's scarce resources to achieve prosperity and a high quality level of life. Indeed, it even acknowledges the existence of non-economic considerations and impacts. Its tendency, however, was to assume away those things in presenting solutions for societal consideration. To the extent to which these non-economic considerations become relevant, the solutions and explanations offered by the field of economics become less relevant in solving society's prosperity objective.

For the field of economics to remain relevant in addressing the problems of society, the objective function it puts forth as a basic foundation to thinking must be well-rooted in other areas where economics traditionally has given little attention. The degree to which economists accommodate those who have principles and ideas that can contribute to the ability to solve problems will probably dictate the relevance of economics as a field and its survival long-term.

The past two centuries were largely ones where the industrial paradigm rose and flourished. The industrial society concerned itself with how to maximize the economic welfare of people, with perhaps less attention paid to other elements of prosperity and quality of life. But in the industrial economy, the depletion of natural resources was not much of a significant problem. Therefore, environmental considerations were secondary to pure economic concerns. Similarly, with so much of a push to increase the economic lot of man, much less attention was paid to distributional issues, or the ethics associated with what our model of the economy prescribed. Even the lower income classes of the American society, for example, enjoyed significant growth of income and purchasing power, so much so, that equity concerns became only noticeable at periods of economic slowdowns. In an industrial economy where capital, labor (human worker), management, and natural resources (the four factors of production) principally drove economic output, places that had them tended to feature prosperity. The environmental and ethical implications of growth were essentially a minor issue that arose only when threats or limits hindered the ability to utilize what was seen as the most inconsequential factor of production—the environment or natural resources. Beyond the environment, other factors that could be relevant to economic well-being were considered intangibles.

Evidence continues to mount that the economic transformation function or framework is not that simple anymore. One of the key indicators that the traditional framework for looking at our society may not be so relevant today is the growing contribution of non-traditional production and non-manufactured goods to our overall economy, particularly its growth. Manufacturing and production shares of the economy are way down (about 12 percent) while service related sectors continue to grow. More recently, in the advent of information technology, society continues to produce an ever growing portfolio of goods, the production of which does not require significant compromise to the environment. So, in a way, the fundamental paradigm of how economic success happens is changing rapidly, so much so that highly productive places or people in the past are not necessarily the most productive today.

Economics in an Increasingly Complicated World

It is obvious from the above and from Chapter 1 that basic neoclassical economic principles, in and of themselves, do not adequately or fully explain problems faced by professionals and practitioners today. This is not only true in decision-making but in overall management of society’s resources. However, the economic view of the world helped shape many of our current thoughts, understandings, and goals about our communities, nations, and world. This view also helped shape most of our institutions and organizations designed to help society pursue prosperity. But the management of society's resources can't be based solely on neoclassical economic principles. That is the view espoused in Part One of this book, especially Chapters 2 and 3 dealing with environmental resources and the demand pressure for their use.

Revisiting Ethical and Environmental Considerations

It is the perspective of the authors that ethical and environmental considerations must also be central to private and public choices as society tries to optimize public welfare. Here, optimization is a key term, not efficiency, in recognition that efficiency pursuits must be done in a way that recognizes that society collectively has objectives, in addition to the objectives of individuals, and such objectives can be in conflict with the goals and aspirations of businesses and people. The recognition that society has something to maximize requires the recognition that governments have an added responsibility to manage the activities of people, communities, and nations. A functional society will both maximize efficiency and optimize production and consumption. Economics certainly explains efficiency and optimality within the realm of its recently developed areas. The fields of welfare economics, institutional economics, political economy, public choice, natural resource economics, and environmental economics are examples of recent developments in economics that emerged to make economics more relevant.

Our point in Part One is that these developments are not sufficient. Our goal is to demonstrate the need for an expanded view of how multiple disciplinary viewpoints are required to address prosperity management problems in a holistic and comprehensive manner. Chapter 1 appropriately starts with a presentation of this holistic definition of society's goals and appropriately defines the environment in a way that the concept accommodates a broad perspective of what has to be managed. The economic component of prosperity has to be managed in a way that not only considers "the environment," but treats the environment as an output or outcome since it is now increasingly entering into the objective function as a goal, not just as a consequence of production or economic activity.

To further complicate things, we acknowledge that the environment is a concept whose definitions vary in the minds of people, be they lay citizens, professionals, intellectuals, or policy makers. Furthermore, the concept has also evolved over time as the stocks and mixes of natural and human resources available for society to work with have changed. The same applies to the ethical dimension of society's real objective function or problem. People vary in their notion of what is ethical, just as society's ethical standards have changed. So, the notion of society's optimum has become more complex, and old principles of economics are less relevant in explaining them. We make the point that ecology and ethics should not be afterthoughts, but key considerations even in pursuing economic solutions for society.

One way to introduce environmental and ethical considerations into society's "optima" challenge is to understand the differences between then (when neoclassical economics was most relevant) and now (a substantially different climate that many call the "New Economy"). The level of human capital has now evolved to the level where basic human skills, expressed largely through what people did with their hands, have become less relevant, while knowledge, expressed through the stock of what people have in their heads, has become critical to economic prosperity. With the advent of advanced information and communications technology, the range of goods that society now produces to meet the basic human needs of society, yet do not require a manufacturing or production pass-through, has grown rapidly and allows people to command huge purchasing power without the need to be locked into the traditional manufacturing paradigm.

The capital base of society has also changed considerably. The nature of necessary capital has changed so much that venture capital has replaced traditional lending and banking-based financing as a key stimulant to the growth of companies, jobs, places, and economies. The capacity to put new forms of capital to work, and the ability to increasingly utilize natural resources to meet the changing needs of society, has also grown with the advent of new advanced technologies for resource extraction, people management, information management, funds management, payment management, and environmental management. A graphic illustration of this shift is seen in the types of technologies and people that have created the recent economic and income growth opportunities in the USA—Microsoft, Google, Oracle, and others. Furthermore, the externalities associated with the heavy production economy of the past may not be so visible today.

Related to this is the notion that societal needs can change as society matures and becomes capable of doing more. What seemed to be a high priority need in the distant past may be of less priority today. Once society mastered the ability to meet primary needs, higher order elements of prosperity become a greater priority. With the achievement of lower order needs that relate to our ability to consume goods, it is natural that the new needs and wants of society will more reflect their desire for stability, consistency, predictability, health, security, wellness, equity, and other elements of a high quality of life. The evolution of the primary goals of society from efficient resource allocation to optimal management of resources and goals simultaneously to achieve higher prosperity is, therefore, not surprising.

Ethics and the Environment in a New Economy

The definition of the environment advanced here was chosen to reflect the growing view that concern about the environment implies a broader view of societal goals and achievement than the strict traditional production, industrial, or economic view of prosperity implies. This definition of the environment brings into focus the linkages between economics, ecology, and ethics. It involves a broader view of what society wants and what tools and resources it has to work with. It involves the notion that institutional, legal, policy, societal, and ethical infrastructure designed to achieve past prosperity goals need to evolve.

The logical direction is a better appreciation of ecological and ethical objectives and considerations. Chapter 1 traces the evolution of the linkages between economics and advancements in the field of ecology and ethics, from the earlier thoughts about the world envisioned through the eyes of economists to more contemporary concepts that more appropriately relate economics, ecology, and ethics. It firmly explains that human beings are dependent on societal ability to draw on the natural and environmental resources that the world has to offer, but we must do so in ways that recognize the often limited nature of environmental resources.

Since views about the environment vary and public understanding or interests are not homogenous, agreement about appropriate principles for managing prosperity through the management of the environment will vary. As it is impossible to envision the one person (man or woman) who typifies the human race, it is difficult to understand the impacts of economic phenomena on people. People differ in earning capacity partly, because they differ in access to education and opportunities. Cultures differ, partly for the same reasons, creating an environment where significant diversity exists in the ability to participate in economic activity, just as differences exist in the environmental consequences of economic activity. So balance becomes important, and the challenge in human welfare maximization is how to balance economic objectives, social objectives, and environmental objectives. Many refer to this challenge as the challenge of "sustainability," or the "triple bottom line." The term "sustainability" has been used to capture the notion that society can balance economic objectives in the current period against future periods in ways that allow balanced benefits socially to various groups and classes, now, and in the future.

Barlowe's predecessors to this book took a strong economic perspective to land use, land management, and the optimization of social welfare, treating land as the base resource upon which nature and the environment derive, treating natural and environmental resources in the context of land as a production input, and focusing on these resources as elements of an allocation problem. It is easy to see how economics, as a field that informed past books, emerged the way it did. In the not too distant past the world faced abundant natural resources and limited pressures on these resources. For example, while the stock of oil reserves has not increased, due to industrialization and the growing middle class, the demand for oil has grown. Similarly, as humans have drawn more oil from the ground to power their cars and other motors, the associated environmental pollution has increased significantly. What seemed to be a very simple choice in the past—extracting oil to provide energy—now involves significant environmental costs to oil-producing communities; compensation the market system does not provide for.

This goes back to the issue of ethics and equity and the triple bottom line. Does economics fully explain everything? While economics recognizes "externalities" and market failure, it certainly does not provide a framework to effectively address the more wicked equity problems that arise when markets fail. More importantly, even when markets do not fail, there remain significant issues in management, such as intergenerational benefits optimization in equity. These are some of the reasons why a more rational framework for more problem-solving in the future must involve economists, ecologists, and ethicists working together.

The remainder of this chapter will revisit the concepts presented in Chapters 1–3 by offering ideas more deeply rooted in sustainability as a goal in providing more contemporary views of these concepts.

Maximization of Economic Returns, or the Optimization of Prosperity Returns

Just as the economic man is not content with just securing some economic benefits, and seeks to maximize benefits possible above his cost of operation, the more wholesome thinker is not content with just getting some economic, social, and environmental benefit, and seeks to maximize such benefit in ways that are consistent with society's prosperity objectives. The old way of thinking about this is that there is a trade-off between economy, environment, and ethics, and that increasing levels of all three are virtually impossible and society has to compromise. Evidence is mounting, however, that society can achieve some sweet spots in areas where the emerging economic paradigm has resolved the conflict between the economy and the environment, or the economy and the achievement of ethical goals. Examples of these sweet spots include the area of renewable energy, the green economy, community-supported food systems, recycling, advanced waste management, and biofuels.

With these sweet spots come opportunities to do well by doing good. In the past, economic principles largely focused on maximization of the physical and financial returns from inputs, with one of the most critical inputs being natural resources. Natural resources were treated largely as exhaustible. With society facing an abundance of these resources, the opportunity costs of marginal reductions in the stock of natural resources was presumably low enough for the protection of those resources not to be an issue—the marginal cost of losing them was minimal at the margin. In the past 200 years, the growing pressures on our natural resource base and the diminishing stock of such resources automatically translated into higher values, prices, and opportunity costs, suggesting that alternatives that involved slower rates of absorption will be increasingly favored. Of course, the areas of renewable energy, where beyond the upfront costs, the incremental costs of generating output become minimal, represents an area where with some changes in orientation, we can create clean power while escaping the negative externalities associated with such sources of power as coal, diesel, and nuclear. What all these mean is that the world has changed and, therefore, simple concepts, such as maximizing returns (greater output with less resources), don't always hold. Society can actually produce more with less.

Revisiting Economists' View of Land

In the 1700s, land was treated as one of three basic factors of production, alongside labor and capital. In that context, land was defined to include all other physical and biological factors that come with it, including water, minerals, and other natural resources. As long as land and all the attributes that come with it are exhaustible, the view that growth is resource exhausting dominated public thinking about how to manage land. The general historical view, that we lose land and natural resources to gain progress, which may have been true then, is not true today. In many cases land is seen as a bearer of amenities that the public wants to protect. Land is seen as an indicator of a trade-off between the past and the future, because it has so much wealth associated with it. Land features, such as parks, trails, bike paths, beautiful place designs, trees, forests, and scenic landscapes, are increasingly some of the resources that society actually wants to maximize, suggesting that the neoclassical economic model does not adequately explain land as a resource.

In today's society, rather than treating land as a simple input to production, it has increasing value without alteration. Historically economists tended to treat land as an asset that needed to be in contact with human activity for it to be valuable. Within that framework land in extremely remote areas would be considered relatively worthless. The introduction of ethical and environmental issues into the discussion of land brings in non-production elements of human interaction with land. In the advent of concern about global warming, is the huge acreage of land in Alaska or the Upper Peninsula of Michigan only worth the value associated with extraction for oil and lumber, or are there associated values tied to carbon sequestration, preservation of natural diversity, long-term medicinal value of potential wild-crafting activities, or the benefit of reserving it in storage for the next generation? Obviously, when we consider the ethics of intergenerational transfer and/or environmental issues related to maintaining a quality environment, land becomes a conduit to many important but controversial factors in society, and the assignment of value becomes subject to public opinion, societal priorities, policy choices, politics, and science, as well as ethics. The main point here is that there is a gradual transition from a heavily production-focused economy to one where value creation is less dependent on production, and the fact that this transition complicates how society views and manages natural resources, especially land.

Positive and Negative Externalities

In Chapter 1, we define positive externalities as positive consequences of economic activity where benefits spill over beyond the intended purpose. Positive externalities are like windfalls where an innocent bystander who is not directly engaged in an economic process benefits from such process. But positive externalities also mean that a purely non-economic process could yield positive economic benefits for an unintended audience. A contemporary example is a development project whose very design is innovative, is perhaps LEED certified (Leadership in Energy and Environmental Design), is of a mixed-use nature, and that commands much greater benefits for society by attracting visitors and high levels of economic activity to the community that hosts them. In other words, the economy benefits, because of the attractiveness of the development to visitors and tourists where the private developer himself and the future buyers of the home may not benefit.

Negative externalities are in essence the opposite of positive externalities. They arise when a process generates adverse benefits beyond its purpose. One example is the negative externalities associated with the use of automobiles (traffic and CO2). While fairness dictates that a management framework is needed to redirect negative externalities and hold perpetrators more accountable, implementing solutions becomes complex, because of the political and economic interests of actors involved in the game. To determine if externalities are negative, a fuller cost accounting than what is typically conducted by economists is required.

With the shift away from the production economy came the realization that what economists previously treated as externalities now have to be considered as more relevant to management choices. Consequently, markets are increasingly being designed to accommodate factors that were previously considered externalities. By incorporating tools into markets, which aim to ameliorate negative externalities and enhance positive externalities, by using approaches that range from rules and regulations to political and societal discourse, the traditional notion of the market becomes complex. Obviously, externalities are created by people and businesses that have real interest in the outcomes of government interventions. Therefore, one can't adequately address the issue of positive and negative externalities without accounting for political/economic/institutional influence and the imperfections that this brings to decision-making. Neoclassical explanations of societal choices to manage the environment are relatively simple. Recognizing their inadequacy, however, resource managers are increasingly looking for new ways to capture multiple dynamic factors rooted in ethical and environmental concerns and how society deals with them.

We use the example of one of the emerging areas of policy interest; place-based strategies (or placemaking). Placemaking projects are highly creative in project design, making it possible for the project to return higher value to the developer while generating huge economic benefit to the community based on its attractiveness to tourists, visitors, and companies who are in need of relocation destinations. The benefits to the community (better tax revenue, business attraction, job creation, community image, etc.) can be viewed as externalities. More and more communities are recognizing these positive externalities and co-financing the components that make these projects "placemaking," recognizing that such investments will yield value to the community. But then, in addition to design, many of the things that developers leverage in creative placemaking projects are assets that are already in the community (transit corridors, trails, bike paths, consumer demand for unique housing experiences, etc.). Obviously, an influential developer could extract more out of the community in support of the project than a less influential developer. This raises the issue of the extent to which a positive or negative externality may be considered truly positive or negative.

In the world today it seems there are greater opportunities to generate positive externalities. Many natural resources that were typically degraded to generate economic value through the production process can now be conserved and, in fact, enhanced to create value for society. The process of creating such value is increasingly involving public-private partnership models. For example, when a natural resource asset is viewed largely from the market and economic perspectives as a production asset, and its benefits (or losses) begin to involve the general public (a public good), simple approaches that treat the asset as an input are no longer sufficient as the asset can easily be viewed as an output or conduit to quality of life.

Highest and Best Use

The concept of highest and best use (discussed in earlier chapters) derives very directly from a strictly economic view of how markets work. The notion that the intensity of land use increases as one moves closer to central business districts, that industrial and commercial property are far better valued than residential and vacant land, and that markets create situations that allow the spread between values to be maintained, are all tied past economic paradigms. Of course that model explains much of our history but fails to explain most economic phenomena today. In an environment where people value parks, trails, and open space, maybe the highest and best use observed in some cities would be various forms of open space.

In the not too distant past, the industrial classification of land was considered the highest and best use, over and above commercial, residential, agricultural, and vacant properties. Many industrial lands are now brownfields, which probably constitute some of the least desirable lands today. Trails, which were considered benign in the past, are increasingly being shown to represent a better use than many industrial classifications as society is becoming more interested in conservation and an amenities-based quality of life. In an environment where the industrial economy is waning, the concept of highest and best use has changed. There is general agreement that the U.S. is evolving into a green economy and a digital knowledge economy. The traditional ways of looking at land use may no longer hold water. There are better opportunities to grow the economy, while valuing land in uses that were not previously considered favorable.

Discounting Future Returns

In Part One, we discuss discounting future returns, highlighting the fact the future benefits are considered in economics to be less valuable than today's benefits. This may explain the reluctance of society to fully consider the future and may be at the heart of the sustainability problem. Obviously, if value delivery in the future is less relevant than today's value creation activities, we will allocate more of nature's resources to support today's activities while discounting the implications for future generations. In other words, if this logic is applied, society may be predisposed to operating in an unsustainable mode. This raises the issue of government intervention to promote the right societal interests and objectives.

Another important factor to consider with respect to discounting is the issue of risk (or uncertainty). In the Old Economy, which was characterized by stability, interest rates were clearly observable by the private and public sectors, and markets were very well-established. The interest rate, or the price of capital, was a major signaling factor for economic activity. The cost of a 50-year project could be discounted readily, making it easy to compare the past to the future. With so much uncertainty (oil prices, commodity prices, manufacturing, public opinion), it has become very difficult to convert today's activities into tomorrow's. At the heart of private financing was discounting. It is more difficult to finance a project in an environment where discount rates are not clear due to an increasingly changing risk profile.

Venture capital has emerged as perhaps a more relevant concept than traditional capital. What is unique about venture capital is its mobility on the landscape and capacity of venture capitalists to invest, not in traditional places, but places that have the right mix of assets and opportunity. Natural resource assets are not immune to venture capital investments. Indeed a number of new funds have emerged during the last decade that invest in conservation, preservation, green technology, and the green economy. Many of these funds make investment decisions not just based on returns on investments, but on environmental, ecological, social, and ethical returns. So, while the collateral for investments in the past tended to be such things as inventories of goods, natural amenities are beginning to have greater collateral value.

The New Economy also introduces the notion that many high-end economic activities have no relationship to production. Therefore, how do you value future opportunities that are not tied to production? For example, what is Google's discount rate for a new product, especially when its opportunity costs might dictate a discount rate of up to a 1,000 percent a year? How might that compare to a mom-and-pop shop across the street, which has to borrow money from local banks who must ascertain whether the project is bankable. So, the feasibility of projects is no longer necessarily dependent on some market rate of interest, but in the unique opportunities surrounding the project. This is one of the limitations of using strictly traditional economic concepts to explain current day phenomenon.

Technological Limitations

At the very heart of the traditional economic view of natural resource management is the notion that the earth offers bounties, which can be harvested and used in generating production and economic activities. Humans have unlimited wants, but the earth faces a resource constraint, thereby forcing a technical limit to production on society. In the past, the production-oriented perspective largely ignored technological change. Pollution and waste were essentially outcomes of the production process, which often posed a significant threat to the environment. The rapid explosion of population, since the 1950s, increasingly drew our attention to the possibility that the growth in human consumption may outstrip the ability of earth's resources to support humans. Technological advances have allowed the mitigation of pollution in many cases but there are still limits to technological possibilities.

Obviously, technology allows society to produce more from the same natural resource base. The rapid growth in human capital also suggests greater ability to produce given the earth's resources. The critical issue is whether or not production and consumption are sustainable. In the future, can we continue to produce goods at current and increasing levels to meet the needs of future generations, especially given the uncertainty of what those needs will be? This relates directly to the issue of whether increased production through technology precludes the depletion of natural resources below rates that are sustainable. The Club of Rome, a global environmental think tank, previously took the view that the earth is approaching doomsday despite the potential for technological advancement. They have since, modified their view and now believe that it is possible for technology (along with lifestyle changes) to help us address the sustainability problem (Meadows et al., 2004).

The key problem today goes beyond the role of technology. Successful management of the natural environment, both now and in the future, requires a multidisciplinary perspective that draws from the natural and the social sciences. It requires planners to consider the physical and biological limits of the earth, while simultaneously exploring new ways to live with fewer negative ecological impacts. It is impossible to say how many people can live sustainably on the planet without considering how they live, their levels of consumption, the waste they produce, and technological innovations that allow them to do more with less. Acceptable levels of natural resource amenities or degradation are social decisions that must be worked out over time and in different places.

Part Two:

Economic Considerations in Resource Use

Chapter 5: Marketing and Production Decisions

"Economics . . . is concerned with that aspect of behavior, which arises from the scarcity of means to achieve given ends."

~Lionel Robbins

Realistic economic analysis calls for a broad understanding of the many factors that affect economic behavior. In their search for explanations, economists ordinarily employ an inductive approach. They recognize that complications can arise when one deals with interactions that involve the use of several variables at the same time. Their desire to identify and isolate the factors that most affect economic behavior prompts their use of models in which all factors other than the ones being studied can be held constant. This procedure allows them to observe the interactions between what are assumed to be key factors, and in so doing, develop meaningful theories of economic behavior.

This approach is basic to fundamental economic analysis. As a method of analysis, it has the advantage of focusing attention on important relationships that might otherwise be hidden by the simultaneous operation of the maze of variables that complicate everyday life. The validity of this approach is always conditioned by the nature of the assumptions on which it is premised. Unrealistic assumptions give rise to unrealistic theories. Because of this situation, theories should always be tested in the light of reality and their worth appraised in terms of their usefulness in explaining real world problems.

Basic Economic Assumptions

Like most theoretical concepts, the body of economic thought that has been developed to explain the practices and processes utilized in our use of the earth's bounty of environmental resources rests on a number of assumptions. The most important of these is the assertion that operators are rational beings who behave in a logical and reasonable manner. This basic assumption underlines a number of other important assumptions. Two of the other most important assumptions are that 1) operators normally try to maximize their self-interests, and 2) that prices tend to allocate resources.

Before turning to these two basic concepts, it should be noted that economic analysis is usually based on simple cause-and-effect reasoning with the assumption of other things being equal. The far-reaching nature of this assumption can be illustrated by the simple statement that "other things being equal, operators will buy more of a product at a lower price than at a higher price." The condition of "other things being equal" in this case assumes 1) no appreciable change in consumer income or consumer tastes; 2) no change in the price of other goods; 3) no anticipation on the part of buyers of possible further price reductions; 4) no new substitute for the good in the market; and 5) no complications of prestige value that could cause buyers to buy products simply because they are high in price.

Economic analyses frequently assume conditions of perfect competition with buyers and sellers enjoying all relevant information, perfect mobility of goods and productive factors, and a perfectly elastic supply of productive factors. These assumptions can be criticized as being unrealistic. But they have value, because they make it possible for analysts to ignore the operation of many factors, while they zero in on the interaction of specified aspects of economic behavior.

The prototype of the economic man is often used as a prime mover in society. He is motivated by desire to maximize his net economic returns. He has an uncanny awareness of his alternatives and of what can logically be expected to happen under varying production, price, and cost situations. The assumption of perfect knowledge gives him a tremendous advantage over operators found in the real world. The assumption of primary emphasis on maximization of self-interest is generally realistic. Most businessmen are inclined to push plant production to an optimum level; farmers try to combine their productive factors in a way that can maximize their returns; workers demand the highest wages they can get for their labor.

All rational operators try to optimize their value returns and the satisfactions they derive from life. Wide differences exist between individuals though in the extent to which they measure their satisfactions in monetary returns. Some people place a high value on profits and making the most money. Most, however, regard monetary returns as an intermediate rather than a final goal. For them, money is a means to the attainment of more ultimate ends. When profit maximization conflicts with other goals, they often settle for less money and more leisure, more security, or more of some other goal. Recognition of this factor is important, because it explains why people frequently fail to behave in a strictly economic manner, even when it might be clearly to their financial interest to use environmental resources in a different manner than they do.

It is important that operators carefully consider available facts and weigh their alternatives before they act. Their knowledge and willingness to take risks steers them beyond policies of inaction. At the same time, intuition may cause them to back away from long-shot decisions that could lead to fortune but will more likely result in failure. Following a middle course often leads to a less spectacular economic action but it provides operators with a reasonable return and saves many from possible ruin.

Economics can be described as the science that deals with the allocation of scarce resources. In this sense, it deals with prices, because in our society the amounts people are willing to pay usually determines who gets what. Rights for the use of land and water resources tend to gravitate to buyers who can bid and pay the highest prices. Rising market prices for these resources often prompt the bringing of more resources into use and more intensive use of the resources already in use. Declining prices, on the other hand, can force retrenchment policies, shifts to lower uses, and sometimes project abandonment.

Though prices tend to allocate resources under free market conditions, there are occasions when other factors interfere. Such factors as haste, ignorance of the facts, custom, conspicuous consumption, or the maximizing of other than monetary returns can prevent prices from playing their normal role in the allocation of resources. Failures of prices to allocate resources in accordance with accepted concepts of distributive justice may lead to ameliorative measures. Merchants sometimes ration their sales of scarce commodities. Governments follow similar policies when they institute price controls and rationing programs and assign priorities for the purchase and use of vital materials. Community chest, charity, and public welfare programs also use other allocation criteria when they make resources available to people who have difficulties in commanding their use in competitive open markets.

Goals in Marketing

Two of the most important applications of economic principles to the management of environmental resources come with its application in the distribution of products and services and the guide it provides for their production. Markets occur at the places where the interests of buyers and sellers are brought together and determinations are made of the prices at which goods and services are purchased and sold.

Markets occur with the simple assumptions assumed in Figure 5–1. The supply curve SS' in this diagram represents a schedule of the increasing quantities of a product sellers would offer in the market over a given time period at a series of rising price levels. The demand curve DD' in turn represents a schedule of the increasing quantities of a product buyers would take in the same market during the same period at a series of decreasing prices. With these supply and demand schedules, the only possible equilibrium price occurs at *P*, the point of intersection between *SS'* and *DD'*. At this price, the quantity of product offered and the quantity buyers are willing to purchase are equal. If the price was set at a higher level, such as at *P'*, sellers would be willing to supply larger quantities of the product but buyers would take less and some might drop out of buying in the market. With a lower price, such as *P'*, the reverse situation would hold.

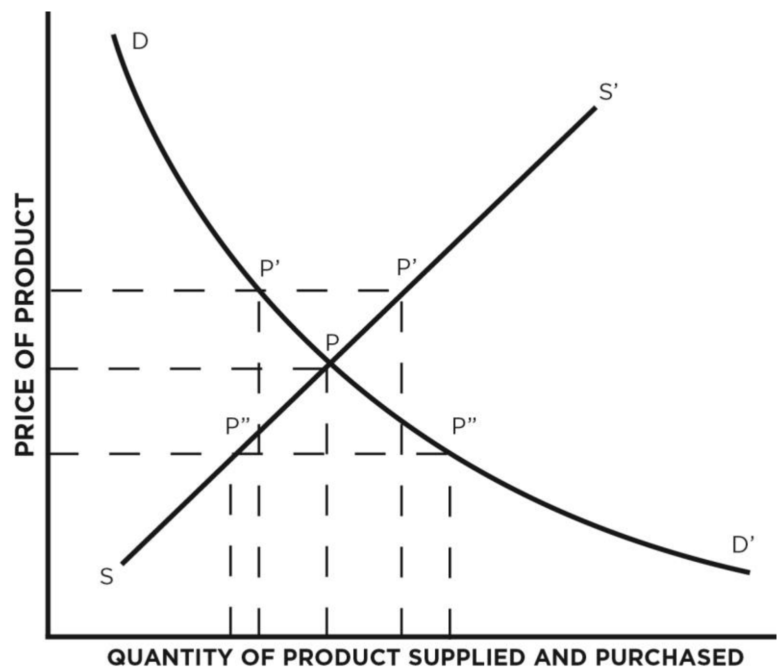


Figure 5–1. Interaction of Supply and Demand Factors in Determining Market Prices under Free Market Conditions

This diagram provides the basic model analysts start with when they proceed to examine the effects changing assumptions, such as higher or lower production costs, more or less demand, payment of taxes, or compliance with government regulation may have on market decisions.

Dozens of variations are possible as adjustments are made for varied assumptions as to supply and demand. In every case economic feasibility provides the guide for the decisions operators are expected to make. Buyers still want to secure the products they want at the prices they can pay and sellers want to sell at the highest prices they can.

Business operators will not try to supply environmental products if they do not anticipate selling them for enough to meet their costs. It would be irrational for them to do otherwise. They are cost conscious, because holding costs down provides an avenue for maximizing their benefits. At the same time, they are keenly aware of their opportunity costs, their assumptions concerning the possible income they could have received by investing their inputs in other enterprises.

Input-Output Relationships in Production

Maximization of net returns is more easily visualized when one deals with the marketing of products rather than with their production. When emphasis is placed on production, one must examine the input-output relationships that exist between the various inputs of land, labor, and capital used to produce products. This process involves a concept known as proportionality, which expands on the physical concept of diminishing returns and guides the decisions operators make as they proportion their various inputs in their attempt to maximize their net economic returns.

Law of Diminishing Returns

It has long been observed that when successive inputs of a productive factor are added to a limited fixed factor, a point is soon reached after which the additional or marginal output of product per unit of input decreases and eventually becomes a negative quantity. This principle, known as the law of diminishing returns, warrants detailed attention as it is one of the most important factors that affects people in their use of land resources. Without the operation of this principle, operators could concentrate all of their production activities on one spot. They could raise the world's entire food supply in a flower pot.

The concept of diminishing returns can best be illustrated by use of an example, such as that reported in Table 5–1. This table assumes a single unit of land as the fixed input factor (column 1), with composite homogeneous units of capital and labor treated as variable input factors (column 2). Applications of successive units of the variable product, up to the 14th unit, to the fixed factor bring increases in the total output (column 3), which is called the total physical product.

Table 5–1. Illustration of the Operation of the Law of Diminishing Returns

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
1	1	2	2	2	$1.00	$1.60	$2.40
1	2	6	3	4	$2.00	$3.20	$4.80
1	3	13	4.33	7	$3.50	$5.60	$8.40
1	4	23	5.75	10	$5.00	$8.00	$12.00
1	5	35	7	12	$6.00	$9.60	$14.40
1	6	49	8.17	14	$7.00	$11.20	$16.80
1	7	64	9.14	15	$7.50	$12.50	$18.00
1	8	78	9.75	14	$7.00	$11.20	$16.80
1	9	91	10.11	13	$6.50	$10.40	$15.60
1	10	102	10.20	11	$5.50	$8.80	$13.20
1	11	111	10.09	9	$4.50	$7.20	$10.80
1	12	118	9.83	7	$3.50	$5.60	$8.40
1	13	122	9.39	4	$2.00	$3.20	$4.80
1	14	123	8.79	1	$0.50	$0.80	$1.20
1	15	121	8.07	-2	-$1.00	-$1.60	-$2.40

Column 1: Inputs of fixed factor (land)
Column 2: Inputs of variable factor (capital-labor)
Column 3: Units of total output (total physical product)
Column 4: Average units of output per variable input unit (average physical product)
Column 5: Increase in output per additional variable input (marginal physical product)
Column 6: Values of marginal physical product at 50 cents per unit
Column 7: Values of marginal physical product at 80 cents per unit
Column 8: Values of marginal physical product at $1.20 per unit

Source: Dr. Raleigh Barlowe, Michigan State University, 2012.

The average yield or output per variable input unit is known as the average physical product (column 4). This measure is determined by dividing the total physical product by the number of units of variable input used in its production. For example, the use of eight units of variable input unit brings a total physical product of 78 and, thus, results in an average product of 9.75 (78 divided by 8 = 9.75). The point of highest average return in this illustration comes with the tenth variable input unit.

In addition to the concepts of total and average physical product, operators are interested in the amount of output associated with the use of each additional or last unit of input used. This concept is known as the marginal physical product (column 5). In the example, the use of six units of variable input resulted in a total physical product of 49, while a seventh input pushed the total product up to 64. The difference between these totals (64 – 49 = 15) represents the additional yield or marginal physical product associated with use of the seventh variable input.

The concepts of total, average, and marginal physical product are symbolized by the letters *TPP*, *APP*, and *MPP*, respectively. These concepts may be depicted graphically as in Figure 5–2. As this diagram indicates, the changes in total production associated with the use of each successive unit of variable input suggests a series of steps that go up to a peak level and then start down again. For analytical purposes, these steps are usually smoothed out and depicted by production curves. The *TPP* curve in Figure 5–2 shows the cumulative increase in total physical product (measured on the vertical axis) that comes with the addition of each successive input of variable factor (measured on the horizontal axis). Whenever an input-output relationship can be described by a continuous curve of this type, it may be described as a production function.

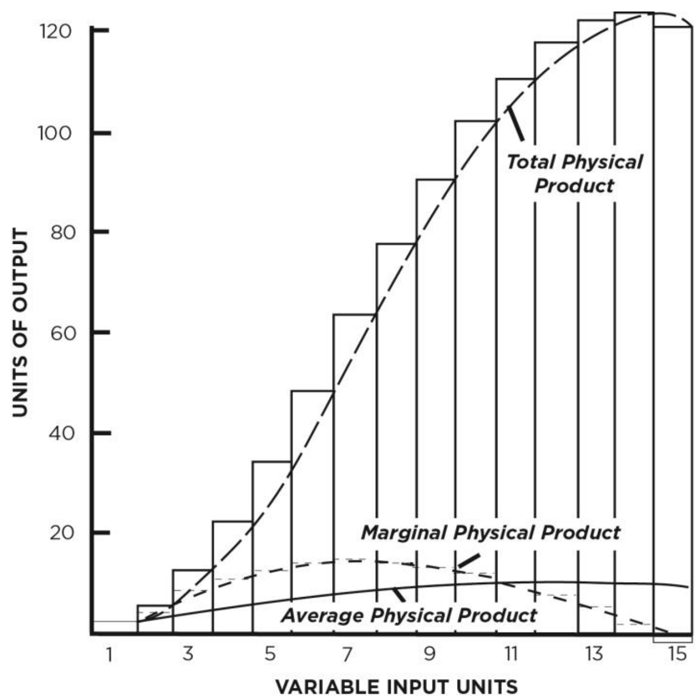


Figure 5–2. Illustration of Production Function and Input-Output Relationships Involved in Operation of Physical Law of Diminishing Returns

As Figure 5–2 indicates, every production function involves three points of diminishing return. Total product increases at an increasing rate until the *MPP* curve reaches its highest peak.

From this point on, the marginal physical product diminishes, while the total physical product continues to increase at a decreasing rate. The *TPP* curve reaches its highest level—the point of total diminishing returns—at the same point on the variable input scale as that at which the *MPP* curve intersects the base line and becomes zero. Any additional application of variable inputs beyond this point results in both a decrease in total physical product and a negative marginal physical product.

The *APP* curve always reaches its maximum height at the point at which it intersects the declining *MPP* curve. Beyond this point, the average physical product gradually declines. An operator could continue to add variable inputs until the added inputs reduce both the total and the average physical products to zero. It does not make economic sense, however, to add inputs beyond the point of highest physical production.

Economic Law of Diminishing Returns

The concept of physical diminishing returns is basic in production, but most operators are more concerned with the effect their input-output relations have on their prospects for positive monetary returns. They think not only of the physical relationships they must deal with but also of the costs and returns associated with their input and output units. They realize that securing a maximum in physical production may not mean that they are maximizing their net economic returns. Whether they realize an excess of returns above costs involves operation of the economic law of diminishing returns.

Transition from the physical to the economic law of diminishing returns can be achieved simply by assigning a cost to each variable input factor and a market price to the value of each unit of output produced. With this adjustment, one can speak of the total, average, and marginal returns associated with each unit of output and of the total, average, and marginal costs associated with each variable input used. With this transition, operators find it most profitable to push production to the point at which the value of their marginal physical product equals the cost associated with its production. This is the point of diminishing economic returns. As long as operators are careful to combine their variable inputs around their scarce or limiting factors, they can always secure their highest returns by operating to this point.

Most economic analyses involving production problems build on the economic concept of diminishing returns. In their applications of this concept, economists sometimes find it desirable to calculate costs and returns on an input-unit basis. On other occasions they find it more appropriate to deal with them on an output-unit basis.

Input-unit approach. As long as costs and returns are computed on an input-unit basis, one can shift from the physical to the economic concept of diminishing returns simply by assigning a value to each unit of physical product and a production cost to each unit of variable input factor. With this adjustment, the value of the marginal physical product may be described as the marginal return per unit of input or more simply as the marginal value product (*MVP*). Similarly, the terms total value product (*TVP*) and average value product (*AVP*) are used to describe the monetary values of the total and average physical products, respectively.

On the cost side, the term factor cost may be used to describe the costs associated with the variable factors or inputs. The additional cost associated with the application of each successive variable input thus becomes the marginal factor cost (*MFC*), and the cost per unit of input is known as the average factor cost (*AFC*).

The input unit or value product approach can be illustrated by simply assuming a value of $1.00 for each of the physical input and output units listed in Table 5–1 and shown in Figure 5–2. With this assumption and accepting land as the fixed factor, operators would find it most profitable to push production to the 14th input unit. At this point, MFC = MVP.

Assuming the production function listed in Table 5–1, the most profitable combinations of variable inputs with their fixed factor would change with varying assumptions as to costs of variable inputs and unit values of physical product. With variable inputs costing $4.80 per input unit, it would pay to push production to the tenth variable input if the units of output were valued at 50 cents each (see last three columns of Table 5–1). With an average value product price of 80 cents, it would pay to use 12 units of variable input, and at $1.20, to use 13 units of variable input. With higher unit costs of the variable inputs, operators would reduce the number of variable input units used. Conversely, with lower variable input-unit costs it would pay to use additional units of variable input.

Value product analysis highlights the choices available to operators as they make decisions concerning combinations of successive numbers of variable inputs with their fixed factor. Operators want to maximize their returns; and this point of maximization of net returns always comes at the point at which *MVP* equals or just exceeds *MFC*. This mathematical truism favors the focusing of economic analysis on the relationships between marginal value products and marginal factor costs and between average value products and average factor costs.

Figure 5–3 provides a diagrammatic example of the simplest form of value product analysis. In common with similar value product or input unit diagrams, it assumes a single fixed factor (land), a single fixed type of homogeneous variable input, a fixed price per unit of product, and fixed cost per variable input.

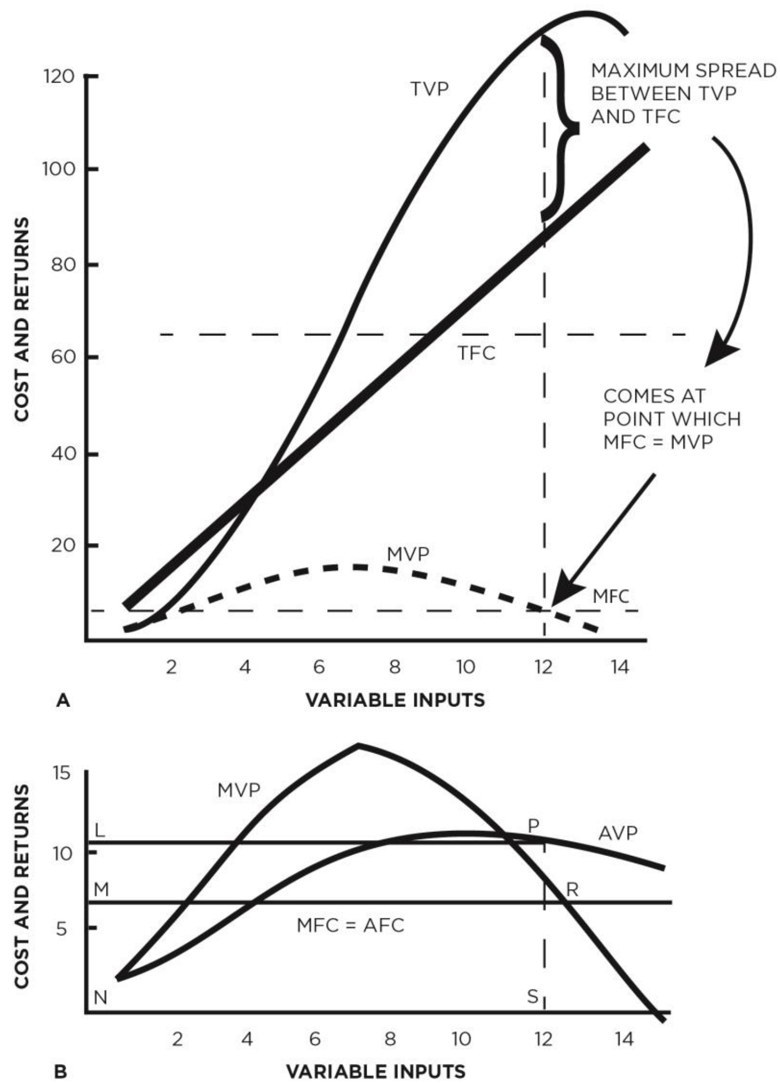


Figure 5–3. Use of Value Product Curves to Determine the Net Return to a Fixed Input Factor (Land) at the Most Profitable Point of Operations

The example in Figure 5–3 assumes the production function reported in Table 5–1, an average factor cost of $7 per variable input, and an average market value of $1.10 for each unit of product. With this combination of factors, one would find it advantageous to stop with the 12^{th} unit of variable input, because this is the last logical breaking point before *MFC* = *MVP*. At this point, total value product (*AVP* times the number of variable inputs used in Figure 5–3B) is represented by the large rectangle *LNSP*, while total factor cost is represented by the lower rectangle *MNSR*. The rectangle *LMRP* represents the share of the total value product above factor costs that may be credited as income to the fixed factor.

Computed in arithmetic terms, the operator secures a total value product of $10.817 times 12 (AVP times the number of units of variable input used) = $129.80. Total factor costs are $7 x 12 = $84, and the net return is $129.80 – $84.00 = $45.80. If only 11 units of variable inputs were used, the net return would be $45.10, with 13, it would be $43.20.

Transition to cost curves. While economists make frequent use of the input unit or value product approach, they also have need on numerous occasions to view production in terms of the costs and returns per output unit. Output unit or cost curves are used for this purpose. Like the input-unit approach, these curves have their own set of production concepts.

When product values are computed on an output-unit basis, they are called returns or revenue. The value of the total physical product thus becomes the total return and the average value associated with each output is the average return. In similar fashion, the value of the marginal or last additional unit of production is called the marginal return. With this approach and the assumption of a uniform price for all product units, the concepts of average return and marginal return can be depicted in diagrams by a horizontal line, which represents the assumed price level.

Three cost concepts—total cost, average costs, and marginal costs—also play significant roles in cost curve analysis. Total cost represents a sum of all the production costs incurred at any given point in the production process. In practice, the concept involves a combination of fixed and variable costs, each of which is often illustrated by its own set of cost curves. In an effort to keep the analysis simple, however, a uniform cost is assigned here to each unit of variable input factor used. This assumption on the cost side has its parallel with our treatment of composite units of variable inputs as being representative of the many different types of capital and labor inputs used in production.

With this assumption as to the nature of costs, total costs (*TC*) is equal to total factor costs (*TFC*) and to the cost associated with the use of x number of units of variable input. The term *average cost* or average total unit cost is used to describe the prorated share of total costs attributed to the various units of output (total costs divided by the number of units of output). *Marginal cost* represents the addition to total costs associated with the production of an additional unit of output.

Table 5–2. Illustration of Economic Costs and Returns (Calculated on an Input-Unit and on an Output-Unit Basis Assuming the Production Function Used in Table 5–1, at a Standard Price of $1.10 per Unit of Output, and a Uniform Cost of $7.00 per Variable Input Unit)

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11
1	2	2	$1.10	$2.20	$2.20	$2.20	$7.00	$7.00	$3.50	$3.50
2	6	4	$1.10	$6.60	$4.40	$3.30	$7.00	$14.00	$2.33	$1.75
3	13	7	$1.10	$14.30	$7.70	$4.77	$7.00	$21.00	$1.62	$1.00
4	23	10	$1.10	$25.30	$11.00	$6.33	$7.00	$28.00	$1.22	$0.70
5	35	12	$1.10	$38.50	$13.20	$7.70	$7.00	$35.00	$1.00	$0.58
6	49	14	$1.10	$53.90	$15.40	$8.98	$7.00	$42.00	$0.86	$0.50
7	64	15	$1.10	$70.40	$16.50	$10.06	$7.00	$49.00	$0.77	$0.47
8	78	14	$1.10	$85.80	$15.40	$10.73	$7.00	$56.00	$0.72	$0.50
9	91	13	$1.10	$100.10	$14.30	$11.12	$7.00	$63.00	$0.69	$0.54
10	102	11	$1.10	$112.20	$12.10	$11.22	$7.00	$70.00	$0.69	$0.64
11	111	9	$1.10	$122.10	$9.90	$11.10	$7.00	$77.00	$0.69	$0.78
12	118	7	$1.10	$129.80	$7.70	$10.82	$7.00	$84.00	$0.71	$1.00
13	122	4	$1.10	$134.20	$4.40	$10.32	$7.00	$91.00	$0.75	$1.75
14	123	1	$1.10	$135.30	$1.10	$9.66	$7.00	$98.00	$0.80	$7.00
15	121	-1	$1.10	$133.10	-$1.10	$8.87	$7.00	$105.00	$0.87	

Column 1: Number of variable units used with fixed factors
Column 2: Total units of physical produce produced (TPP)
Column 3: Marginal physical product
Column 4: Standard price per unit of output (AR and MR)
Column 5: Value of total physical product (TVP and TR)
Column 6: Marginal value product (MVP)
Column 7: Average value product (AVP)
Column 8: Uniform cost of variable inputs (AFC and MFC)
Column 9: Total cost of variable inputs used (TFRC and TC)
Column 10: Average cost per output unit (ATUC and AC)
Column 11: Marginal cost per output unit (MC)

Source: Dr. Raleigh Barlowe, Michigan State University, 2012.

With the cost curve diagram shown in Figure 5–4, the operator should produce to the 118th unit of output, because this is the last unit of output that can be produced at a cost less than its product value. The 118th unit has a value of \$1.10 and a marginal cost of \$1.00; the 119th would cost \$1.75. The operator's total returns (total units produced times the average return per unit are represented in the diagram by the large rectangle *LNSP*. Production costs (total units produced times the average cost per unit) is represented by the lower rectangle *MNSR* and the return to the fixed factor by the rectangle *LMRP*. This net return may also be calculated by subtracting average costs from average return and multiplying the difference by the number of output units. Measured in this way (\$1.10 – 0.7119 x 118 = \$45.80), the net return in Figure 5–4 corresponds with that of the value product diagram Figure 5–3.

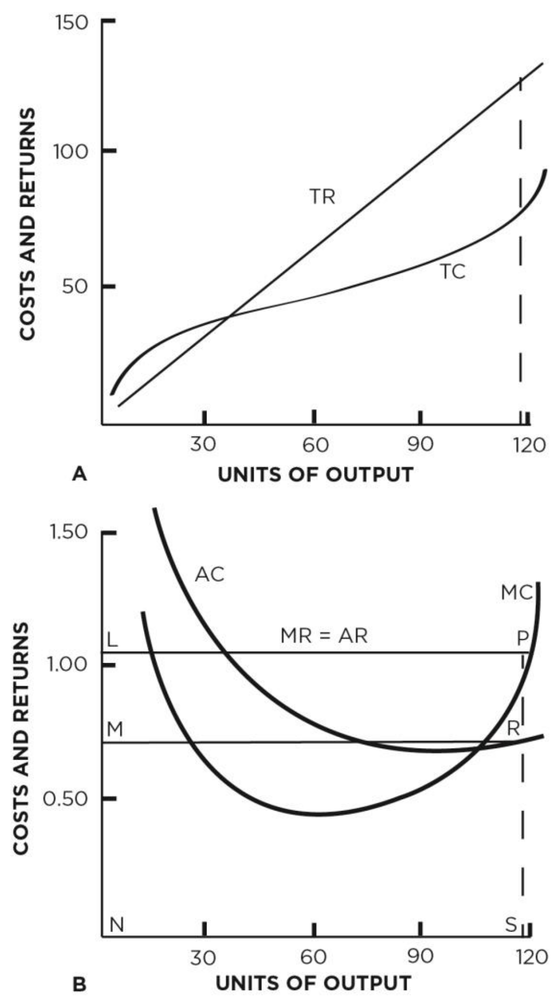
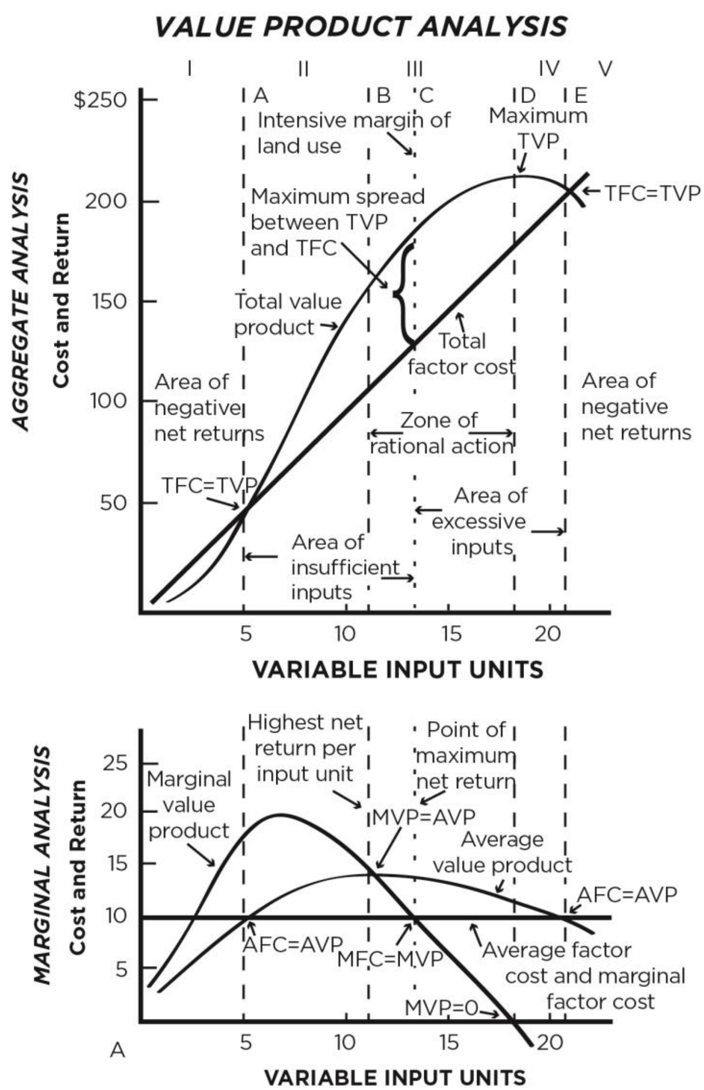


Figure 5–4. Use of Cost Curves to Determine the Net Return to a Fixed Input Factor at the Most Profitable Point of Operations

Figure 5–5 provides a detailed picture, based on the production data reported in Table 5–1, of the interrelationship between the value product and cost curve approaches employed in economic analyses together along with an identification of the various zones of action. Economists make considerable use of these models together with possible modifications that involve use of added assumptions in their examinations of production situations. In their analyses, they are, for the most part, concerned with the right-hand portions of the two diagrams—with what happens after production reaches the points of highest marginal returns to variable inputs and lowest marginal costs per output units. Stopping operations before these points are reached would be economically irrational and operations in this zone are accordingly usually disregarded.

(The following two sets of graphics comprise a single figure.)



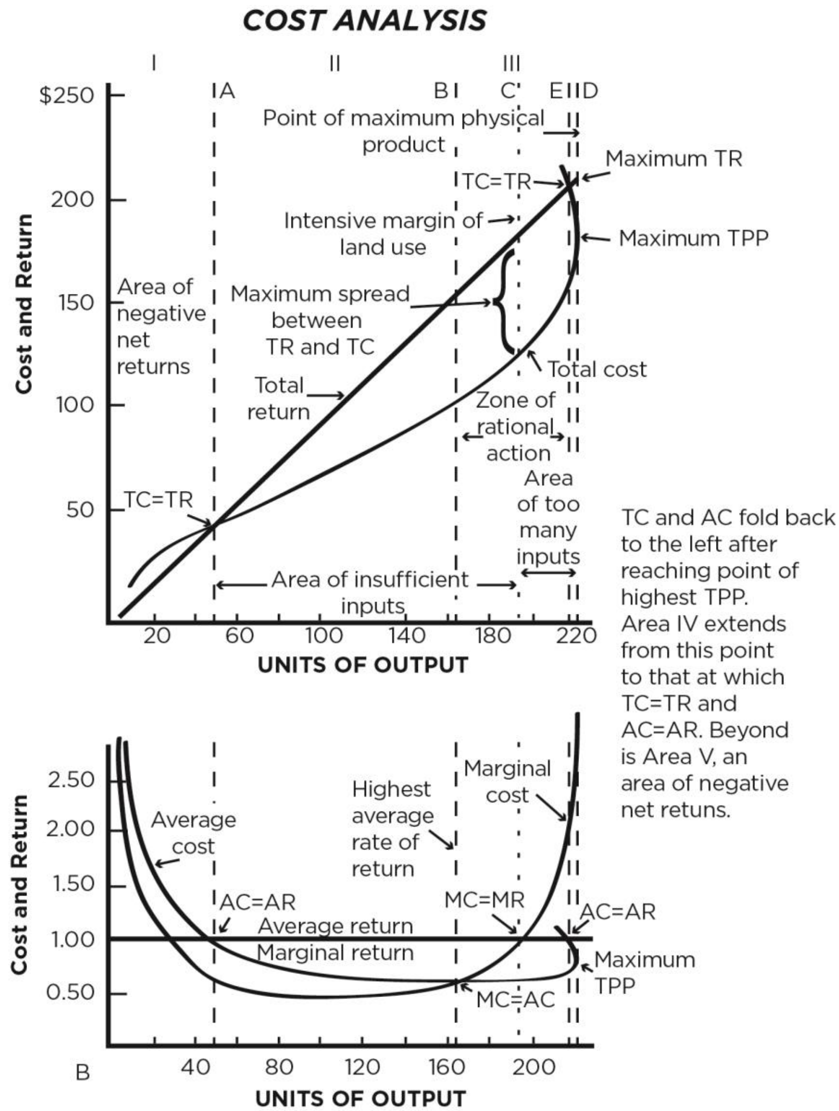


Figure 5–5. Comparison of Value Product and Cost Curve Approaches to Input-Output Productivity Analysis

Some Applications of Proportionality

With perfect knowledge and foresight average operators would find it relatively easy to use static input-output models in proportioning inputs to the exact point of maximum returns. But this assumption seldom applies in the real world. The success with which operators apply the proportionality concept is conditioned both by the clarity of their reasoning and by their response to the problems of uncertainty and imperfect knowledge.

Applications of the proportionality concept are of just as much importance in the management of the earth's bounty of resources as it is to business operators. In both cases, managers seek what they consider the best uses of the resources they have at hand. The only difference, if there is one, is that managers of the environment often work with different sets of inputs and have a responsibility to work for the long-term welfare of mankind. At times, this calls for optimizing social welfare rather than maximizing profits. Proportionality provides guidance in both cases, because however their goals may differ, proportionality tells how inputs of productive factors can best be used to attain one's goals.

Use in Managerial Decisions

Proportionality calls for combining the production inputs one has at one's disposal in a way that will maximize net returns. All of us are concerned to a greater or lesser degree with this objective. True, many have never heard of 'proportionality', and some still pattern their practices on those of their fathers. But consciously or not, it is an objective that most of us pursue on a daily basis regardless of whether we are business people or students. Success in life depends, in large part, on the skill we display in putting together the resource inputs with which we work. Economic efficiency is attained when business operators proportion their inputs in a manner that maximizes their net returns. It must be noted though that this objective gives no weight to distributional justice or social welfare. Moreover, the smooth path to the attainment of this objective can be disrupted by market imperfections and instability, by monopolistic and oligopolistic pressures, or by the unequal access many operators have to knowledge and needed resource inputs.

Examples of operators using the proportionality concept are easy to find. It is what we expect with successful management. This is as true with management of the environment as with those who simply use it for their own benefit. The difference is that managers of the environment should build concern for protecting the environment into their decision framework. A farmer will try to make efficient use of his inputs at the same time he adopts soil conservation practices or decides to leave rows of un-harvested grain for the birds. Operators who see limited supplies of water as their limiting factor will cut back on the acreages they otherwise might try to irrigate. Ranchers can maximize their long-term returns and still limit the size of their herds to the grazing capacity of their ranges.

Similar concerns for the environment may cause foresters to accept multiple use practices in the management of their forest holdings or prompt a decision to adopt a selective cutting rather than a clear cutting program for a harvesting operation that could otherwise leave an ugly scar on the scenic view of a mountain side. Developers of housing sites in and around cities display comparable concern when they dedicate areas for parks and open space uses.

Real life operators seldom have the ability to predict in advance the exact combinations of inputs that will bring them the highest net return. New enterprises call for experiments with various input combinations and identification of new points of highest economic and physical return. Even when one has the necessary experience or data to determine new optimal combinations; it is necessary to cope with vagaries of climate and other changing conditions and with the uncertainties occasioned by new cost, price, market supply, and consumer demand relationships.

With these complications, one may logically ask how an operator can use the proportionality concept in the decision-making process. How can one use static economic models with rigid assumptions, such as those assumed in Figures 5–3, 5–4, and 5–5 as guides when operators lack perfect knowledge and foresight? One must be concerned with unpredictable changes in input costs, product prices, and yields. What does one do when land is not fixed in supply, when it is not the truly limiting factor in production, when important inputs are large and indivisible, or when it is possible to substitute other inputs for those in short supply? Real world operators make adjustments in their decisions as they relax these static model assumptions. Some of their most important adjustments involve 1) efforts to operate within a zone of rational action; 2) reformulation of planning models to accept changed conditions; 3) adjustments for multi-production functions; and 4) acceptance of the equi-marginal principle in operations involving two or more enterprises.

Zone of rational action. Most successful managerial operations involve what is known as the zone of rational action. This zone covers the range of input-output combinations with any given production function within which operators can best expect to maximize their economic returns. Lacking perfect foresight, they seldom find it possible to gauge their inputs to exact points of diminishing returns. But by using economic input-output models for particular enterprises they can push production to points near the economic optimum. One can visualize the points at which $MFC = MVP$ or $MC = MR$ as the central bull's-eye point on a target. In aiming at this target, operators may sometimes overshoot it, sometimes undershoot it. As long as they can be consistent in hitting the target within close proximity of the bull's-eye, they can optimize their returns even though they may never hit the bull's-eye.

Shown graphically as in Figure 5–5, the zone of rational action can be visualized as the distance between *B* and *D*, or between the points at which *MVP* = *AVP* and *MVP* = 0, in the value product diagram (Figure 5–5A). With cost curve analysis (Figure 5–5B), this zone again occurs between *B* and *D*, this time between the points at which *MC* = *AC* (the lowest point on the average cost curve) and the point of maximum physical product.

The zone of rational action is usually illustrated with value product curves, such as those shown in Figure 5–5A. Examination of this diagram shows that its production map can be divided into five subareas. Subareas *I* and *V* are areas of negative returns, in which average factor costs exceed average value product and total factor costs exceed total value product. Rational operators do not voluntarily operate within these zones.

The area between points *A* and *E* can be divided into two, three, or four production zones. The zone between *A* and *C* may be described as an area of "insufficient inputs" and that between *C* and *E* as an area of "excessive inputs." *C* comes at the point at which *MFC* = *MVP* and represents the production point that provides operators with the highest possible net return. Within the areas of insufficient inputs, operators have an economic incentive to add inputs at least as far as point *B* at which they secure their highest average return per variable input. Likewise, in the area of excessive inputs between *C* and *E*, it is best to stop production near *C* and, thus, avoid the rapid decline in net returns associated with operations near and beyond point *D*, the point of maximum physical product at which *MVP* = 0.

Figure 5–5A designates the portion of the area of insufficient inputs between *A* and *B* as area *II* and the portion of the area of excessive inputs between *D* and *E* as area *IV*. The most productive portions of these areas lie between points *B* and *C* and *C* and *D*, respectively. These two areas are shown together in Figure 5–5A as area III and represent the zone of rational action.

The zone of rational action can be thought of as the larger target at which operators aim their production decisions and which they hopefully will hit as they combine their inputs in ways they hope will maximize their net returns above production costs. Yet even the best managers sometimes undershoot or overshoot this goal. Their failure to operate at the rational stage can be attributed to factors, such as faulty foresight, inadequate knowledge about production relationships, lack of know-how or managerial ability, or poor allocation of resources. Unexpected changes in factor costs and sudden changes in market prices can cause a firm to produce for a time at an uneconomic level. Natural catastrophes, such as floods, droughts, or fires, can have similar effects on operations.

Adjustments to dynamic conditions. In their attempt to stay within the zone of rational action, operators must always cope with the problem of uncertainty. Unlike the "economic man" whose perfect knowledge obviates concerns about uncertainties, operators in real life must always be ready to adjust their decisions to the changing conditions of a dynamic world. Decisions made at any given time are based partly on one's understanding of certain known facts and partly on expectations regarding future costs, price, and yield conditions.

With the passing of time and unfolding of the production process, an operator's original expectations may or may not materialize. When things work out as planned, production can continue with the assumptions of the operator's original static planning model. When they change, an alert operator will substitute updated models that make adjustments for the changed circumstances. The new models are forward-looking. Past inputs that lack salvage value may involve fixed costs that must be paid, but aside from this detail, their relevance to the new decisions can be written off as matters of historical value only. Like spilled milk, operators should forget them and focus emphasis on securing a positive return from this point on.

With an improved market price outlook for a given product, the new planning model may favor additional application of inputs (payments for overtime, bonuses for extra work, applications of additional fertilizer for crops) that can contribute to higher production. Declining market prices, on the other hand, may cause firms to scuttle expansion plans, sell existing inventories at reduced prices, or try to salvage what value they can from alternative uses of their product. Farmers whose income prospects are dashed midway through a crop season by a hail storm may adjust to the situation by harvesting a crop for what little it is worth, converting it to cattle feed, or plowing it under as a soil-building measure. Operators must always plan ahead.

They have no option of stepping back in time to reclaim the value of inputs already applied. The salvage value of their misplaced inputs is usually low. The need to treat past inputs as fixed naturally narrows the alternatives available to operators as they approach the end of their production process. The significance of this situation is illustrated by the example of a speculative builder of houses. Before the building process begins, the operator can choose between several options as to style or type of residential structures. Once the foundation is laid and the building process begins, fewer and fewer changes remain economically feasible as each new stage is reached in the building process.

Multiple-production functions. Throughout the discussion to this point, it has been possible to think in terms of a simple example of input-output relationships that involves the successive application of a series of composite inputs to a fixed factor of land. This centering of attention on a single production function has facilitated isolation and recognition of the principles involved with proportionality. However, a look at the real world shows that very few operators deal with single production functions.

Production normally involves the combination of a variety of non-homogeneous inputs (different types of raw materials, machinery, and labor) with one's fixed factor. Sometimes these inputs are complementary and must be used together; sometimes they may be regarded as substitutes for one another. Sometimes they are indivisible and must be used as whole units; at other times they can be divided for smaller applications. As a rule, they are applied separately at different times and often in different sequences, have different costs, and can be combined differently with other factors with different results.

Each of the several types of variable inputs used in production has its own production function. Some of these parallel or complement the production functions of other necessary inputs. But with typical production processes calling for the concomitant use of many types of inputs and each type responding in its own way to combinations with other types of inputs, operators face the prospect of having to choose among hundreds of possible input combinations. How can they make the right decisions in proportioning their inputs to optimize their returns? In times past, operators experimented on a hit-or-miss basis until they found arrangements that worked. These patterns were copied by others and often acquired custom status and were then passed on from generation to generation as approved or expected ways of doing things. In more recent times, scientists, inventors, and innovators have questioned these ways of the past and have experimented with new combinations. In doing so they have often opened up vast new opportunities for increasing production, and have highlighted promising frontiers for additional research.

What options do average operators enjoy in coping with the multiple-production function problem? Three dimensional diagrams can illustrate the problems that arise when operations call for the use of two kinds of variable inputs in the production of a single product. With operations that call for the use of more kinds of variable inputs and for more than a single product, the problem of determining the exact optimal combinations of variable inputs soon taxes the capacity of the human mind. Operators must fall back on their feel for choosing the most workable combinations. Some may cling to following customary procedures, because they feel they cannot afford to take the risk of failure that comes with experiments with new approaches. Others may accept the advice of specialists. Still others may experiment with possible adjustments that hopefully will lead to favorable results. Regardless of their approach, they find it best to exercise what they consider as reasonable judgment in selecting the practices they use.

Equi-marginal principle. Up to this point, we have assumed that the operator deals primarily with one enterprise and has a plentiful supply of variable input factors to combine with a single fixed factor. With these two assumptions one might logically expect operators to push production to the point of diminishing economic returns. Under practical conditions, however, operators usually have limited supplies of variable inputs together with alternative enterprises on which they might use them. This situation calls for modifications of the operator's production goals. Instead of always pushing production to the point at which $MFC = MVP$ (or $MC = MR$) operators with limited resources should push their production with any particular enterprise only to the point at which their marginal value products equal or promise to drop below the return they could secure by using their marginal variable inputs in a recognized alternative use.

In this equalizing process, operators with limited resources apply the equi-marginal principle. This principle asserts that maximum profits can be secured only when each input of land, capital, labor, or management is used in such a way as to add the most to total return and when the various resources used in any one enterprise produce a marginal value product at least equal to that they could secure from their best alternative use.

This principle encourages operators to allocate their available units of variable inputs to those combinations of enterprises and to those combinations of competing units of the same enterprise that will contribute most to maximization of their expected total net returns. An illustration of this concept involving three tracts of land of different use-capacities is presented in

Table 5–3. With this illustration, it assumed that an operator has 30 units of variable inputs costing $3 each that can be applied to three tracts of land each of which has a different production function. With no limit on the supply of variable inputs, it would pay to push production to the point at which *MFC* = *MVP*, to the 16th unit of variable input with the first tract, to the 13th unit with the second tract, and to the 9th unit with the third tract. Production at these points would call for 38 units of variable input. But the operator has only 30 units. She could apply an equal number (10 units) to each tract. This would provide a total value product of $95 + $80 + $59 = $234. This obviously is not the best combination, because the 10th input on the third tract does not pay for its cost. By shifting this last input to the first tract, a marginal value product of $9 can be substituted for $2, and thereby increase total value product to $241 ($104 + $80 + $57 = $241).

Table 5–3. Illustration of Application of the Equi-Marginal Principle in the Allocation of 30 Variable Inputs Costing $3 Each to Three Tracts of Land with Different Production Functions When the Product Has a Market Value of $1 per Unit

Number of Variable inputs	First Tract		Second Tract		Third Tract	
	TVP	MVP	TVP	MVP	TVP	MVP
6	$47	$11	$45	$10	$42	$9
7	$59	$12	$56	$11	$49	$7
8	$72	$13	$65	$9	$54	$5
9	$84	$12	$73	$8	$57	$3
10	$95	$11	$80	$7	$59	$2
11	$104	$9	$86	$6	$60	$1
12	$112	$8	$90	$4	$60	$0
13	$119	$7	$93	$3		
14	$124	$5	$95	$2		
15	$128	$4	$95	$0		
16	$131	$3				
17	$133	$2				

Source: Dr. R. Barlowe, Land Resource Economics, 1986.

Further experimentation shows that the operator secures a higher total value product and the maximum net return when the variable inputs are apportioned between the three tracts in a manner that provides approximately equal marginal value products from each tract. By using 13 units of input of the first tract, 10 on the second, and seven on the third, the operator receives marginal value products of $7 from the last variable inputs used on the three tracts and secures maximum total value products of $119 + $80 + $49 = $248 and a total net return of $248 – $50 = $158.

Importance of Limiting and Strategic Factors

Another important issue with proportionality involves the need to identify and make adjustments for limiting and strategic factors. This problem arises, because the scarce and frequently indivisible nature of the resources available to producers. Every operator deals with a limited supply of productive resources and ordinarily treats one limiting factor as the fixed factor around which other inputs are combined. Some operators have access to all of the variable inputs needed for optimum input combinations with their fixed factor. But the scarce supply or strategic nature of particular inputs frequently causes them to stand out as "bottleneck" factors that prevent the normal functioning of the production process.

All things considered, lack of knowhow is probably the most limiting factor with which we must deal. Most operators try to make the best use they can of the knowledge they have in working out productive combinations of their available resource factors. In this process, they must often make adjustments for the strategic roles played by particular inputs and note that some factors may play strategic roles at particular moments and yet be of no more than routine importance on other occasions. An adequate supply of water or moisture for industrial or crop use, for example, may be more or less taken for granted under ordinary circumstances. It may suddenly loom as a critical factor, however, if a well ruins dry, a water main bursts, or an area is affected by drought.

Successful operators must be able to identify their limiting factors and shape their production decisions around their most practical use. When the supply of some factor, such as water, is scarce it may be necessary to ration its use and try to combine its input with other factors in a way that will secure the highest return to the critical factor. Similarly, when supplies of capital, labor, or management are limited, it may make more economic sense to treat these factors rather than land as the fixed factors around which one proportions productive inputs.

Indivisible inputs. Indivisible inputs provide an important example of limiting and strategic factors. With them operators must often choose between using larger supplies of a resource than they need and being content with a smaller supply than that required for most effective use. Many resource inputs are highly divisible. Such items as chemicals, fertilizer, or water may be used in minute quantities or be added by the ton. Some inputs, however, are indivisible, or if divisible, come in large units. Labor, for example, may be calculated in hours and minutes; but the services of a skilled laborer must usually be treated as a unit that is sold by the day, month, or year. Similarly, two industrialists may find it possible to share a drop forge or two farmers a grain combine. Neither may need the entire unit, but desire for ownership control may cause both to consider the purchase of a whole unit even though this forces them to choose between the diseconomy of operating with insufficient equipment or having equipment with unused capacity. Situations of this order may give operators a rationale for expanding the scale of their operations to the points at which they can make more efficient use of their indivisible inputs.

Land is often thought of as an easily divided factor, and it is true that fields and lots can be divided or enlarged. Yet farms, urban lots and buildings are usually sold as units, not as 10-acre tracts, so many square feet or separate rooms. This factor causes many operators to content themselves with the continued use of cramped quarters, because no adjacent space is available for their use. Others may see it as a reason to relocate or buy adjacent properties so that they might operate on a larger scale.

Resource substitution in production. Operators frequently find that they can use different combinations of input factors to secure approximately the same net return. In this process, they can sometimes adjust for their limiting factors by substituting other resources for those in short supply. Most producers are mindful of their opportunities for substituting resource inputs for one another. They are intensely interested in finding ways to increase production at less cost. They seek new materials and processes that they can use to cut costs or increase production, and they have a natural inclination to favor acceptance of new combination arrangements if this can bring them higher net returns.

On an individual operator basis, the relative scarcity of any particular input is usually gauged by the operator's opportunity to find a satisfactory substitute. When the price of a resource input increases relative to that of a possible substitute, and when the substitution process involves only nominal cost and trouble, operators ordinarily shift to use of substitutes. Thus, an increase in labor costs relative to machinery costs will often cause operators to consider installation of automated equipment. Similarly, the high value of land relative to other input costs in land-hungry nations favors acceptance of labor intensive uses of land.

Opportunities for resource substitution also play an important role in favoring technological developments. With the progress engendered by the Industrial Revolution, people have found it possible to substitute many new materials and devices for other factors in production. Steam engines and gasoline engines have displaced millions of units of animal and human labor. Mass-production techniques have been substituted for less efficient uses of labor in cottage industries. Machinery, such as the combine harvester, has saved great quantities of farm labor for other uses. Additional developments may be expected in the future as we acquire and utilize new ways of dealing with limiting factors in production.

Intensity of Land Use

Much of our economic theory regarding the use of environmental resources, and most particularly land, is rooted in the concept of proportionality. This concept, with its emphasis on marginal analysis, input-output relationships, and considerations that affect operator decisions concerning the proportioning of resource factors, provides the keystone for production economic theory. As such, it helps explain why we use land resources as we do and also a number of other land economic concepts, such as rent, land values, highest and best use, and allocation of land resources among competing uses.

Another direct application of proportionality concerns the intensity with which land resources are used and the intensive and extensive margins of land use. When applied to land use, the term intensity refers to the relative amounts of capital and labor combined with units of land in the production process. Enterprises that involve considerable use of capital and labor relative to limited areas of land are intensive uses, while those involving low ratios of capital and labor used are extensive uses.

Intensive and Extensive Margins of Land Use

In contrast to the concept of intensity of use, the <u>intensive margin of land</u> use occurs at the point with any given use of land at which the marginal or last variable inputs of capital, labor and management barely pay their costs. This concept applies to all uses of land. As shown in Figure 5–6, the intensive margin is reached with the last successive available input that can be applied before *MFC* = *MVP* in a value product diagram or before *MC* rises above *7* in a cost curve diagram.

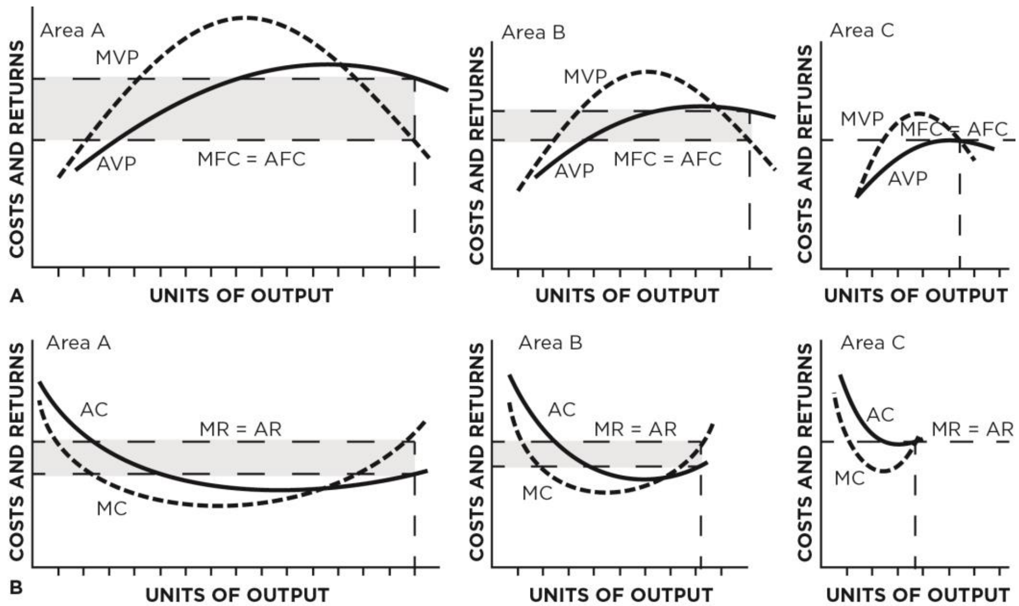


Figure 5–6. Use of Value Product and Cost Curves to Illustrate the Location of Intensive and Extensive Margins of Land Use on Three Areas of Differing Use-Capacities

In contrast to the intensive margin that can be reached with any use of land resources, the extensive margin of land use applies only with the lowest grade of land or least accessible site that can be used to economic advantage for any given use. This margin occurs when typical operators who are applying their variable inputs to the intensive margin for a given use of land find that they are using the lowest grade of land of decreasing use-capacity they can afford to operate. At the extensive margins (area *C* in Figure 5–6), the average value product is at its highest level and equals the average factor cost of the variable inputs (*AFC* = *AVP* at the point at which *MFC* = *MVP*), the average cost of the variable inputs is at its lowest level and equals the average return per output unit (*AC* = *AR* at the point at which *MC* = *MR*), the total value product equals total factor costs (*TFC* = *TVP* and *TC* = *TR*), and there is no economic surplus above production costs. It is irrational for operators to apply variable inputs beyond the extensive margin, because sufficient returns to pay for the cost of their input can no longer be secured.

The intensive and extensive margins of land use shown in Figure 5–6 assume the same enterprise on three land areas of different use-capacities. Area A has the ability or economic capacity to absorb 15 variable input units to advantage, whereas area *B* can absorb 10 inputs and the operator in area *C* barely breaks even with an optimum combination of five variable inputs with the fixed factor. With this difference in economic capacities of the three sites, the intensive margin with area *A* comes with the application of 15 variable inputs, 10 with area *B*, and five with area *C*. With *C*, the value of the product produced just equals its cost of production. No area of lower use-capacity can produce enough value product to cover its production costs.

The situation portrayed in Figure 5–6 may also be visualized as a continuum, such as that pictured in Figure 5–7. With this illustration, the horizontal axis measures decreasing use-capacity, and the vertical axis indicates the economic capacity or number of variable inputs that can be used to economic advantage with each successive grade of land. Note that area **A** uses 15 inputs at its intensive margin, whereas *B* uses 10 inputs, and *C* uses five inputs. Other land areas with use-capacities between *O* and *R* could be located along *OR* and would find their intensive margins along *MN*. The line *NR* in this example represents the extensive margin of land use. By intersecting the points on the horizontal axis and on line *MN* at which no economic surplus above production cost occurs, it indicates the point beyond which it does not pay to bring new units of land into use.

Changing price and cost conditions often bring shifts in the location of both the intensive and extensive margins. If production costs increase or if product prices drop, it may no longer pay the operator on area *A* to add the 15th unit of variable input. In such an event, it may be economic to apply only 14 or 13 units. The operator on area *B* may find it best to stop with nine or eight units of input and the operator on area *C* would stop production entirely. With this situation, the intensive margin would drop to *M'N'*, while the extensive margin would shrink back to *N'R'*. A drop in production costs or an increase in product prices could have an opposite effect in encouraging *A* to add a 16th unit of input, *B* to add an 11th unit, and *C* to go to six units. Under this circumstance, the intensive margin would rise to *M''N''* and the extensive margin would move out to *N''R''*.

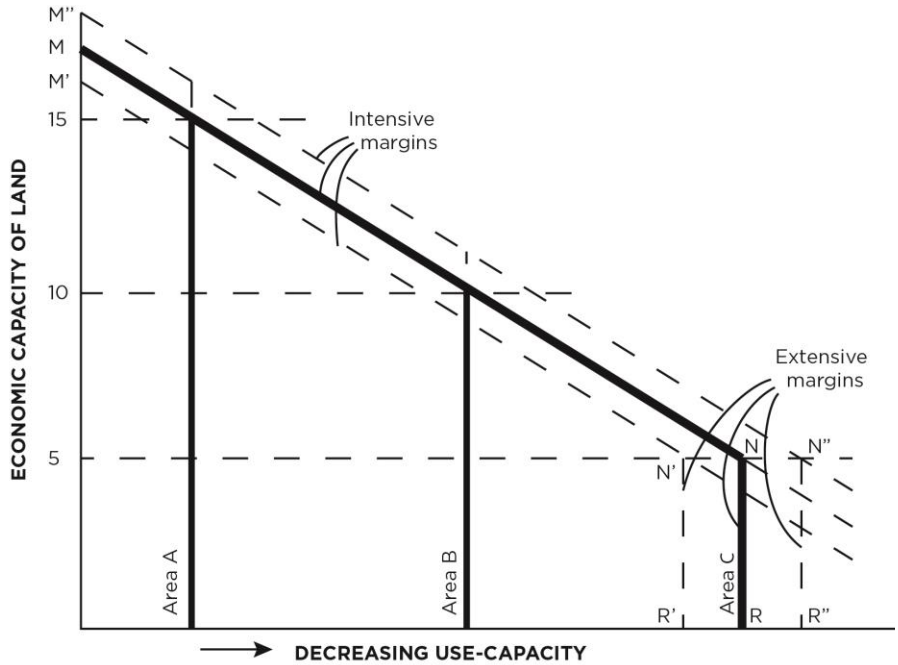


Figure 5–7. Illustration of the Intensive and Extensive Margins of Land Use

Marginal and sub-marginal land. Past experience shows that operators have sometimes brought new lands into production or shifted already developed lands from lower to higher uses only to find that they are not economically suited for the uses contemplated. These examples involve a malallocation of resources. Once this fact is recognized, the sub-marginal uses are usually abandoned and the lands revert to lower levels of use.

Changing price conditions provide a second major cause of sub marginality. During the depression of the 1930s, large areas that had paid their way in production under more favorable price and business conditions suddenly became sub marginal when lower product prices forced a leftward shift of their extensive margins. These conditions forced many operators out of production. In numerous instances, operators continued to produce at a financial loss and were able to continue only by drawing on family reserves, accepting substandard returns for their labor, or by accepting financial aid or subsidies from the public and private agencies.

With the passing of the depression years, less was heard about marginal and sub-marginal lands. The reason was simple. With higher price levels and better business conditions, extensive margins shifted to the right, and it again became profitable to bring the afflicted lands back into production.

Factors Affecting Intensity of Use

Levels of use intensity are often dictated by the types of use to which land resources are put. Areas used for commercial and industrial purposes, for example, ordinarily call for much larger applications of capital, labor, and management per unit of land than if they were used for residential, farming, grazing, or forestry purposes. With any given type of use, the level of intensity can also be affected by characteristics of the land, changing supply and demand conditions, one's mix of productive factors and operator attitudes.

Family and operator attitudes have important impacts on intensification practices. Certain immigrant groups and religious communities have at times displayed willingness to accept hard labor and low levels of living. With this set of values, they have often found it possible to push production further than most of the operators with whom they have completed. This willingness to accept the lower marginal returns to labor and management that have come with their intensive land use practices has frequently made it possible for them to outbid other prospective operators for the purchase and use of land.

All things considered, the intensity with which land is used always involves the interrelation of several contributing factors. Areas of high use-capacity can ordinarily be used more intensively than areas of lower productive potential. Whether this relationship follows in actual practice depends on the impact of other conditioning factors, such as population pressure, the stage of economic development, availability of capital and labor, and the attitudes and goals of those who own and operate the land. Differences involving these factors sometimes result in the intensive use of areas of limited use-capacities, while nearby areas of greater productive potential remain underdeveloped or underutilized.

Chapter 6: The Returns Called Rent

"Rent, in short, . . . [arises] from the reduction to individual ownership of natural elements, which human exertion can neither produce nor increase."

~ Henry George

The surplus of value product above the producer's total factor costs that was identified in Chapter 9 as a net return for the use of the operator's fixed land inputs is commonly thought of as rent. This concept provides a key building block in economic analysis in that it supplies a meaningful basis for explaining several aspects of our thinking and behavior affecting the use and management of environmental resources. Important among them are the values we attribute to real estate resources, the periodic payments property owners collect from tenants who use their properties, and the economic incentives they provide for land development and conservation. Comparable returns can be associated with the fixed supplies of other types of factors. In practice, however, the concept of rent is mostly associated with uses of surface land. In our use of this economic concept throughout this book we will refer to it simply as land rent.

The Nature of Land Rent

The term "rent" is another of those common words for which economists have specialized meanings. In our day-to-day use of this term, people usually think of the payments made to property owners for use of their land and buildings. We speak of house rent, room rent, and the rent paid for commercial and farming sites. Like other people, economists often use the term in this popular sense. When they think in economic terms, however, they find it appropriate to distinguish between three concepts of rent: contract rent, land rent, and economic rent.

Contract rent refers to the actual payments tenants make for the use of the properties of others. The amount of these payments is normally agreed upon by the landlord and tenant in advance of the period of property use and, thus, stems from mutual agreements as to the amounts paid. This concept is generally synonymous with the popular meaning ascribed to the term rent.

Land rent is a more specialized concept. It represents the theoretical earnings of land for its use in production. As used here, it represents the economic returns due to both bare land and land with improvements on it. When distinctions are made between classes of land rent, it is sometimes expedient to distinguish between ground rents and improvement rents and between rents that arise because of location as compared with differences in production capacity.

Economic rent is also a specialized concept. For more than 100 years, this term was used by economists to describe the economic earnings of land and had a meaning more or less synonymous with the present concept of land rent. With the refinements in economic thinking that have come during the last century, the focusing of more and more economic discussion on topics other than land and natural resources, and the frequent tendency of economists to view real estate investments as a type of capital, a new meaning was ascribed to the concept of economic rent. It is now defined as the surplus of income above the minimum supply price it takes to bring a factor into production.

As now defined, economic rent is treated as a short-run surplus that a productive factor or its owner can command, because of unexpected demand or supply conditions. Over longer run periods, supply and demand conditions affecting the property are expected to come into balance and the phenomenon of economic rent disappears. This situation does not apply to land rents as they have no prospect of disappearing over time. Indeed, for land rent to equal economic rent, one would have to assume that land has a supply price of zero. It is possible, however, for property owners to secure economic rents on top of their land rents. Should the coming of a new business cause a sudden bulge in the demand for housing in an area, for example, apartment house owners may be able to command an economic rent, an excess of contract rental payments beyond their normal contract rent, until builders of new properties have time to provide the additional housing needed to bring supply and demand conditions back to normal.

Land rent and contract rent are the most important rent concepts that affect management of the environment. These concepts differ from each other in one important respect. Contract rent involves actual payments to property owners. This payment may be above or below the amount of land rent theoretically earned by a property. When it exceeds the amount that should be paid as land rent, tenants contribute the difference from returns that should go as payments for their capital, labor, or managerial inputs. When it falls below this level, tenants are able to pocket the surplus return.

Land Rent as an Economic Surplus

Land rent can be viewed as a residual economic surplus, as that portion of the total value product or total return that remains after payment is made for total factor costs or total costs, respectively. As illustrated by the value product and cost curve diagrams shown in Figure 6–1, land rent is the surplus depicted by the shaded rectangle *LMRP* that remains after the cost of the variable inputs (lower rectangles *MNSR*) are subtracted from the total value of products produced, which is represented by the large rectangles *LNSP*. With the value product diagram (Figure 6–1A), land rent is equal to *AVP – AFC* times the units of *variable inputs* applied. With the cost curve diagram (Figure 6–1B), it is equal to *AR – AC* times the *units of output* produced.

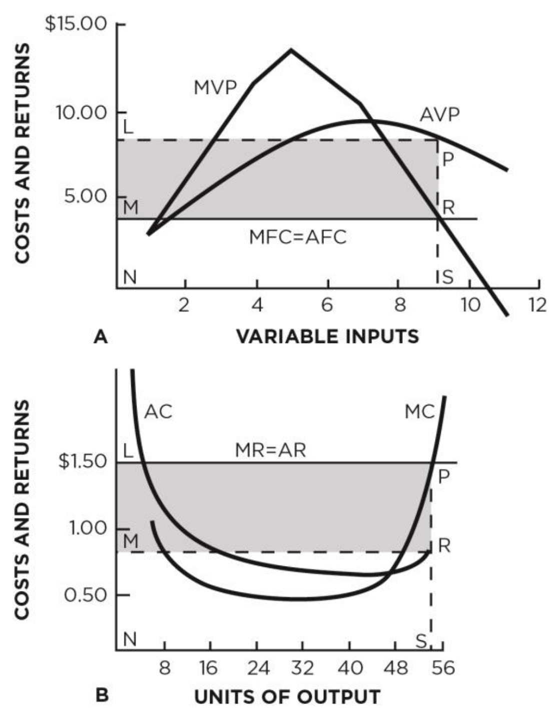


Figure 6–1. Use of Value Product and Cost Curve Diagrams to Illustrate the Concept of Land Rent as a Residual Economic Surplus, which Remains after the Payment of Production Costs

This simple formulation is both flexible and all-inclusive in its consideration of the factors that influence rental values. Value product and cost curve diagrams can be used to explain differences in the amounts of land rent that accrue on different grades of land. With the cost curves shown in Figure 6–2, for example, the units of output secured from three different grades of land can be assumed to have the same market value. Meanwhile, the average cost of production per output unit is lower on the *grade A* tract than on the *grade B* and *C* tracts, because its production costs are spread over more units. With these differences in average unit production costs, the *grade A* tract yields considerable land rent, and the *grade B* tract a smaller amount, while the *grade C* tract is at the extensive or no-rent margin and produces barely enough to pay its production costs. The amount of rent that accrues on each grade of land depends on the relationship between price levels and costs. With higher prices or lower costs, rents will rise on every grade of land. Lower prices or higher costs, in turn, would have a depressing effect on the rent secured on the *A* and *B* tracts and could force the *grade C* lands out of use.

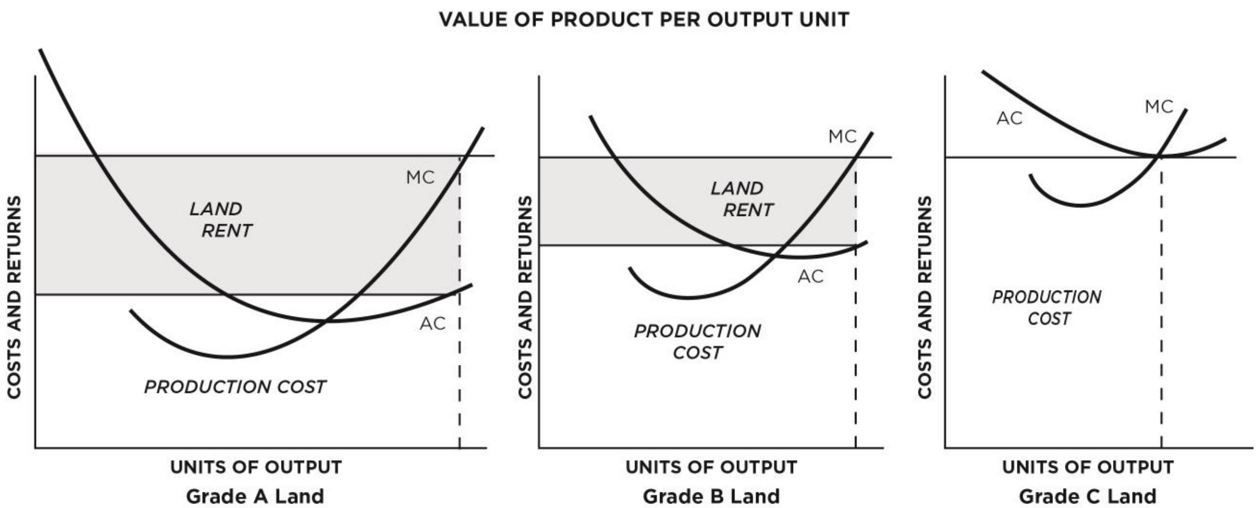


Figure 6–2. Illustration of the Effects that Differences in Land Quality Have on the Amounts of Land Rent that Accrue to the Three Grades of Land

A similar comparative approach may be used to illustrate the effects of differences in location on the land rent produced on tracts of comparable quality. The left hand diagram in Figure 6–3 indicates the amount of land rent that can be expected on a *grade A* site located at the market. Lands located at greater distances must pay a shipping cost to get their products to market. Since this cost is proportional to the number of units of output sold, it may be treated as a price-depressing factor that lowers the net price per output unit received at outlying production points.

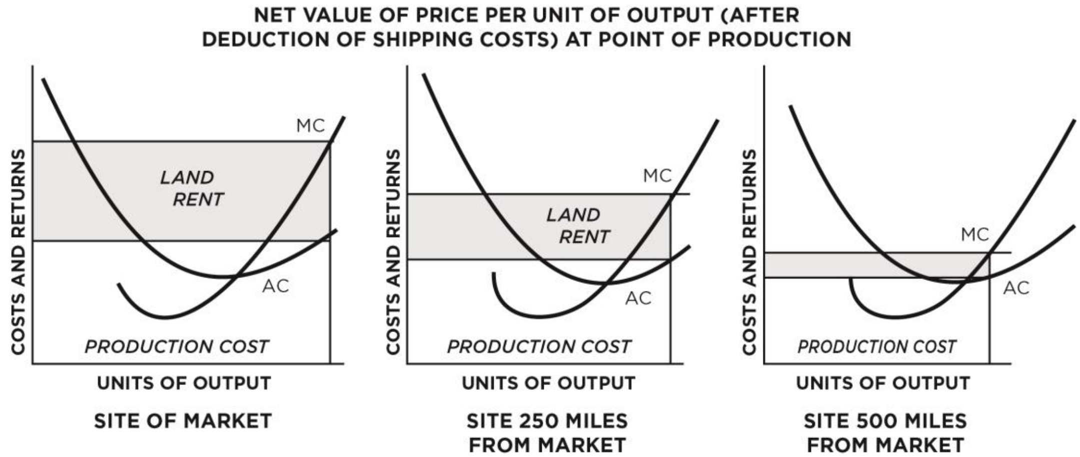


Figure 6–3. Illustration of the Effects that Differences in Accessibility Have on the Amounts of Land Rent that Accrue to Three Tracts of Land of Comparable Quality Located at Different Distances from Market

As Figure 6–3 indicates, the lower net price received by producers located 250 and 500 miles from market lowers the amounts of land rent received at these locations. These areas are just as productive as those located at the market; but with a transportation cost handicap, operators at these sites must gear their production to a lower net price level. The lower land rents associated with the less advantageous locations may be attributed both to the lower net prices received by operators at these locations and to the effects lower net prices have in cutting back the number of variable inputs operators can profitably employ in production.

Viewed as presented in Figures 6–2 and 6–3, land rent may be considered as an economic leveler. Operators, who are free to move, and who can apply their managerial talents equally well to different tracts of land, would realize no advantage in using one tract of land as compared with another. The returns to their non-land inputs would the same in any case. This situation highlights a weakness of this type of analysis. In its treatment of land as a residual surplus that remains after payment is made for all other factors of production, marginal-productivity analysis assumes that the return to other factors can be determined with some precision. This assumption is often unwarranted. The returns attributed to non-land factors in calculations of land rent are usually arrived at through an accounting process. They may represent the actual cash payments made for these factors, the going rates for these payments, or estimates of what a fair or normal return should be. Each of these methods gives value figures that have the same relationship to actual productivity as contract rents bear to land rent.

The marginal productivity approach can be used to measure the economic return attributable to non-land factors, as well as to land. When it is used for this purpose, it is usual practice to impute a fair return to land just as fair returns are imputed to non-land factors when the approach is used to measure land rent. The accuracy of the final answers secured by this approach depends on the accuracy of the base data used in the calculations. With superior management, the returns attributed to land may easily be too high if the return to management is gauged to average going rates. Conversely, with mediocre combinations of productive factors, too little return may be attributed to land if the other factors are compensated at their average going rates.

It should also be noted that while rent is viewed, as it is here, from the standpoint of society as a residual surplus, it is regarded quite differently by those who pay contract rent for use of the land and other environmental resources. For them it is a fixed payment like many of their other production costs. They are more apt to see management or labor as their fixed factors and see the residual surplus as a payment for their managerial or labor inputs.

Classical Formulations of Rent Theory

Little consideration was given to the economic nature of land rent until relatively recent times. Sir William Petty made some pertinent observations regarding rent in 1662, as did several other writers during the next 150 years. While some of these observations date back more than 400 years, the beginnings of classical rent theory are usually associated with the writings of a group of English economists at the conclusion of the Napoleonic wars.

Britain's Parliament was considering the controversial Corn Laws at the time, and the attention given to them prompted several economists to publish papers regarding the nature of rent. Three writers of this period—Thomas Robert Malthus, David Ricardo, and Joann Heinrich von Thunen—made significant contributions to present land rent theory. Malthus outlined a residual surplus concept, which was largely ignored at the time but that foreshadowed the marginal productivity concept of rent as a residual surplus described in the last section. David Ricardo attributed rent to differences in soil fertility and presented his views with such force and clarity that they were widely accepted as the basis for classical rent theory. Von Thunen authored an independently developed complementary theory, which explained rent in terms of differences in location with respect to a central market.

Ricardo's emphasis upon differences in fertility. Ricardo was concerned with the problem of agricultural rents. He started his analysis by assuming a newly settled country with an abundance of rich fertile land, a very small proportion of which needs to be cultivated to provide food for the population. He then argued that only the most fertile land would be brought under cultivation, and that no payment of rent would be associated with its use. Rent arises only when increases in the demand for land justify the bringing of less fertile land into use. In Ricardo's words (Ricardo, 1817):

> *"If all land had the same properties, if it were unlimited in quantity, and uniform in quality, no charge could be made for its use, unless where it possessed peculiar advantage in situation. It is only, then, because land is not unlimited in quantity and uniform in quality, and because, in the progress of population, land of an inferior quality, or less advantageously situated, is called into cultivation, that rent is ever paid for the use of it. When in the progress of society land of the second degree of fertility is taken into cultivation, rent immediately commences on that of the first quality, and the amount of that rent will depend on the difference in the quality of these two portions of land.*
>
> *When land of the third quality is taken into cultivation, rent immediately commences on the second, and it is regulated as before by the difference in their productive powers. At the same time the rent of the first quality will rise, for that must always be above the rent of the second by the difference between the produce, which they yield with a given quantity of capital and labor. With every step in the progress of population, which shall oblige a country to have recourse to lands of a worse quality, to enable it to raise its supply of food, rent on the more fertile land will rise."*

Ricardo's theory of rent determination may be illustrated by an example, such as that portrayed in Figure 6–4. This example assumes four grades of land with yield capacities of 50, 40, 30, and 25 units of product, respectively, for a given amount of capital and labor costing $100. With this assumption, it costs $2.00 to produce each unit of output on *grade A* land, $2.50 on the *grade B* land, $3.33 on the *grade C* land, and $4.00 on the *grade D* land. As long as there is enough *grade A* land to provide all the needed output, the market price of the product would correspond with the $2.00 per unit cost of production. No rent needs to be paid, because every land user is able to bring equally fertile land into use, and any operator who attempts to raise the product price would be undersold by other producers.

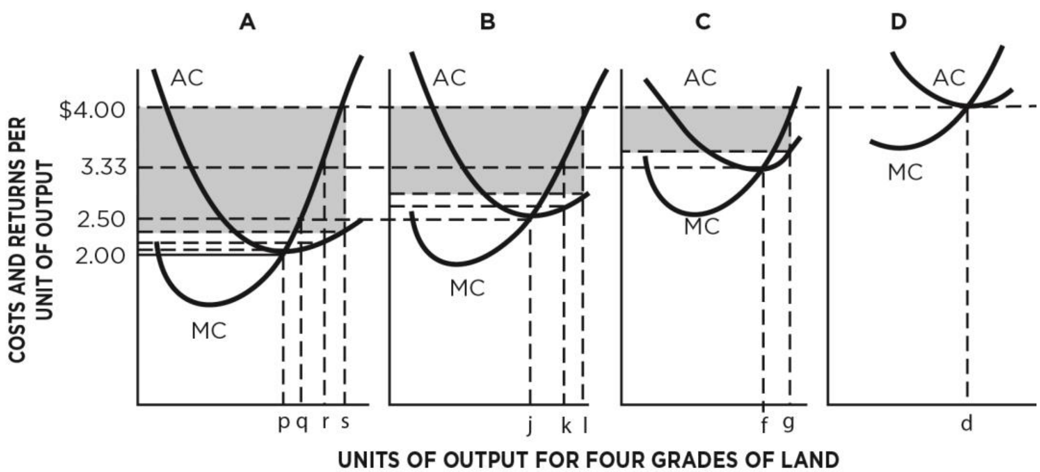


Figure 6–4. Effects of Bringing Lower Grades of Land into Use on Intensive Margins of Use of Better Grades of Land with Ricardo's Concept of Land Rent

This situation changes when *grade B* lands must be brought into use to provide products for the growing population. At this point product prices must rise to the $2.50 level to cover the cost of production at the new extensive margin of cultivation. The higher product prices, which encourage operators to cultivate the *grade B* lands provides an economic surplus of 50 cents per output unit to the operators of the *grade A* lands. This surplus is not needed to ensure continued production from the *A* lands, but since it exists it goes as land rent to the owners of these lands.

Product prices must rise to the $3.33 level if the *grade C* lands are to be cultivated. This price provides a land rent of 83 cents for every unit of output produced on the *B* lands and an additional 83 cents per unit of output for operators of the *A* lands. A price of $4.00 per unit of product is needed to bring the *D* lands into use. A land rent of 67 cents per unit of output goes to the *C* lands at this point and additional rent is paid on the *A* and *B* lands.

Ricardo held that farm product prices are determined by production costs at the intensive and extensive margins of cultivation. As he saw it, product prices rise:

> *". . . in comparative value . . . because more labour is employed in its production of the last portion obtained, and not because a rent is paid to the landlord. The value of corn is regulated by the quantity of labour bestowed on its production cost on that quality of land, or with that portion of capital, which pays no rent. Corn is not high, because a rent*

> *is paid, but a rent is paid, because corn is high; and it has been justly observed that no reduction would take place in the price of corn although landlords should forego the whole of their rent. Such a measure would only enable some farmers to live like gentlemen, but would not diminish the quantity of labour necessary to raise raw produce on the least productive land in cultivation."*

Rent arising from location. Ricardo made passing references to the effects of location on land rent, but it was von Thunen, who was writing a few years later, in Germany without knowledge of Ricardo's work, who emphasized the fact that when crops produced for a central market are grown on lands of like fertility, the lands located nearest the city enjoy a rent-producing advantage over those located at greater distance. The extent of this advantage corresponds with the differences in transportation costs that arise with shipment of products from different distances to market.

In the days of oxcart and wagon transportation, shipping costs were definitely a limiting factor in determining whether land could be used profitably to provide crops for distant and even nearby markets. In the American colonies, for example, there was a premium on locating near navigable waters, because it was often not expedient to ship crops, such as wheat, over land to markets more than 30 miles away. Technological progress has brought tremendous changes in this situation. But transportation costs still have significant effects on rent-paying capacity and the extent of the areas in which products can be profitably produced.

This situation can be illustrated by the example assumed in Figure 6–5 of a bulky product worth $150 a ton delivered at a factory at a transportation cost of 30 cents per ton-mile. If the product can be produced for $138 per ton (including loading costs and a fair return to the operator's capital, labor, and management), a surplus of $12 a ton will be available as land rent if the product is produced at the market. Produced at a distance of 20 miles, the rent drops to $6 a ton and at 40 miles a no-rent margin is reached beyond which it would be unprofitable to produce the product for sale.

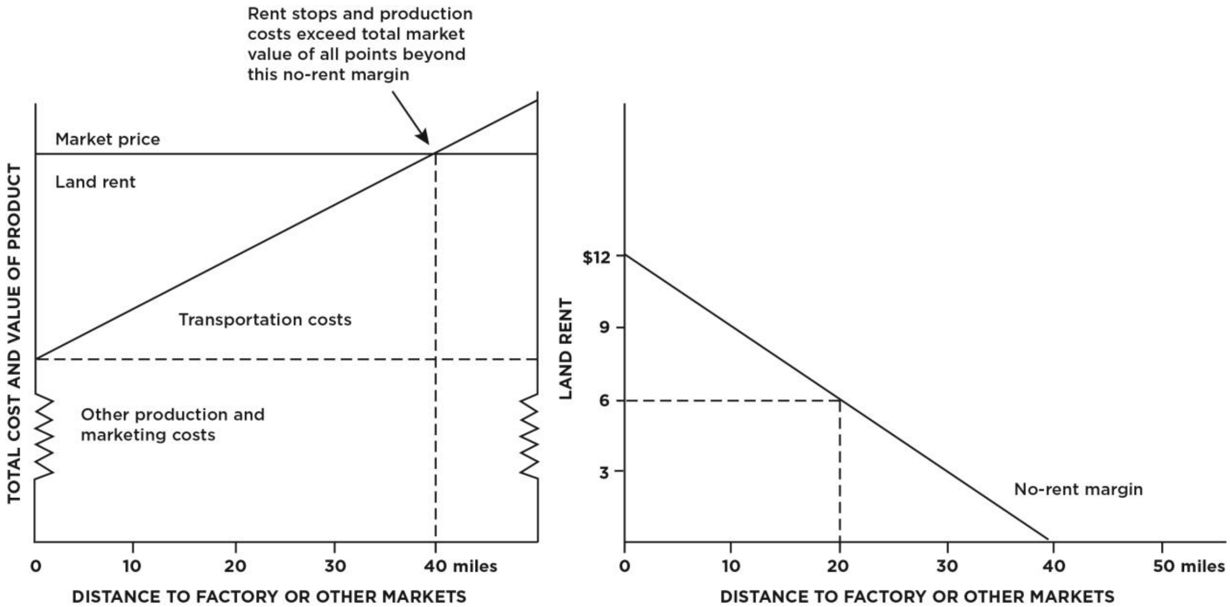


Figure 6–5. Effect of Transportation Costs Associated with Shipment of Products from Various Locations to Market on Land Rent

Fortunately, the no-rent points for different land use enterprises occur at different distances from market. This factor, together with the multitude of markets found in modern society, gives almost every tract of land some rent-producing capacity. Lands located near the market or near the 100 percent spot of a central business district usually have high income and rent-producing capacities for any of several alternative uses. Lands located at more distant sites are usually beyond the no-rent margins for many uses. The operators of these lands have fewer choices of enterprises and frequently find it most profitable to concentrate on extensive land use operations, such as ranching.

Use-capacity and rent-paying ability. Differences in rent-paying capacity are often explained in terms of variations in either soil fertility or location. By themselves, neither of these factors provides a completely satisfactory explanation of the ability of land to pay rent; and even when the two are considered together, they can leave significant aspects of rent-paying capacity unexplained. Land rents can reflect amenity considerations, such as a desirable neighborhood, a pleasing view, ready access to water supplies, or nearness to educational and recreation facilities. Convenience of access and possible savings in time-distance of travel can also influence the rent-paying potential of various sites.

The cumulative impact of the various factors that affect land quality, including soil fertility, location, and any other items that affect accessibility, is measured by the concept of land <u>use-capacity</u>. This concept has particular value, because it permits useful comparisons of the income producing potential of various sites. Areas with the highest use-capacities ordinarily have the highest values, the highest income production potential, and yield the most land rent. The relationship between land use capacity and the appearance of land rent is shown in Figure 6–6. This diagram assumes a continuum of lands of decreasing use-capacity ranging from areas of highest use-capacity at *A* to lands of much lower use-capacity at *D*. As society resorts to the use of the lower-grade, less-productive, and less advantageously situated lands—as the extensive margin of land use shifts to the right—unit production costs gradually increase, and the net price per output unit rises enough to command whatever additional production is needed. When only the lands between *A* and *B* are used, prices are pegged at the *LR* level and the surplus above production costs available for land rent is small. When the extensive margin of land use shifts from *B* to *D*, prices climb to *NT*, and the total volume of land rent increases from the area included within the triangle *KLR* to that within the triangle *KNT*.

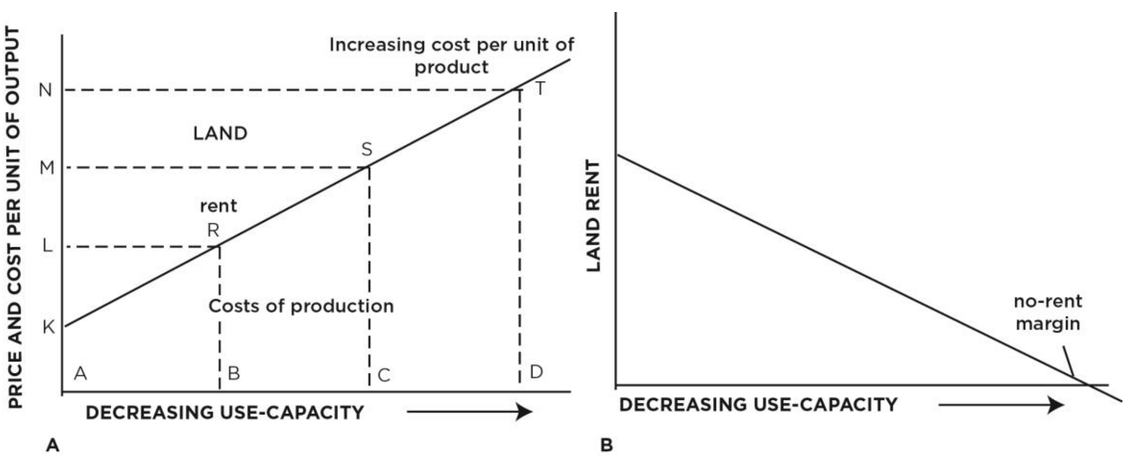


Figure 6–6. Illustration of the Relationship between the Use-Capacity of Land Resources, Production Costs, and the Appearance of Land Rent

Figure 6–6A assumes a continuum of lands of diminishing use-capacity and shows the quantities of land rent that arise at different sites as prices rise to meet the cost of utilizing lands at the extensive margin for some given uses. The triangles *KLR* at price *LR*, *KMS* at price *MS*, and *KNT* at price *NT* indicate the amounts of land rent produced as the assumed uses are extended out from *A* to points *B*, *C*, and *D*, respectively. For analytical purposes, the land rent triangles can be detached from the remainder of the diagram, turned over, and shown as land rent triangles, such as that pictured in Figure 6–6B. Land rent triangles or profiles of this type can be utilized to show the relationship between decreasing use-capacities and the amounts of rent produced for any given land use.

This analysis assumes some abstractions from reality. The concept of a continuum of lands of decreasing use-capacity assumes that 1) society proceeds in its use of land resources from sites and areas of highest use-capacity to those of lower potential; and 2) areas with various levels of use-capacity are distributed more or less uniformly along the horizontal axis. Neither of these assumptions fit real world conditions where lands have usually been brought under cultivation in newly settled areas on a "what area lies next" basis and where tracts of varying use-capacities often occur in nature mixed up like different chopped vegetables in a salad bowl. As a theoretical frame of reference, however, the concept portrayed in Figure 5–6 has value, because it provides a meaningful explanation of the effect varying levels of use-capacity have on land rent, and more importantly, it supplies an analytical basis for the concept of the land-rent triangle.

Other Views Concerning Rent

Although widely accepted, the marginal value productivity concept of land rent has had its critics. Some have attacked Ricardo's assumptions concerning the order of new land developments, have challenged his assertion that rent does not enter into the determination of prices, and have attributed rents to customary arrangements or the monopoly position held by land owners. These criticisms can be ignored as not affecting the long-run operation of the land rent concept. Two alternative views of the nature of land rent, however, deserve special attention. These are the concepts of rent as a return on capital investment and rent as an unearned increment.

Rent as a return on investment. Mention has been made of the fact that real estate resources are often viewed differently from the standpoint of society than from the perspective of individual operators. Society sees land as a nature-given resource that was supplied in its original form at no cost to its users. Most investors, owners, and tenants, in contrast, see land rent as a return on their real estate investments. These operators are not particularly concerned with the fact that real estate involves intermixtures of nature-given land and man-made improvements. To their way of thinking, the real estate resources they work with are a type of capital. For them, the development of these resources calls for sizable investments in time, effort, and money, whereas the acquisition of used or already developed properties call for purchase or leasing arrangements. They see real estate as a capital good that can be bought, sold, or leased, and land rent as a return on the market value of land resources.

Tenants typically view contract rental payments as an operating cost, not as a residual economic surplus due landowners because of the particular income-producing advantages associated with their properties. Landlords and owners, in turn, think of contract rent as a return on the capital value of their investments and compare these returns with those they could receive from alternative capital investments.

Rent as an unearned increment. Ricardo treated rent as an economic surplus, as a payment to landowners that is not required to keep land in production. With this approach, it was an easy step for later observers to conclude that rent is an unearned increment or windfall return for which landowners do nothing and that they receive only because of their favored "monopoly" position.

This view of rent was accepted by three important 19th century economists. John Stuart Mill (1848) regarded rent in this light and suggested that this unearned increment be subject to taxation. Henry George used it as the basis for his crusade favoring the single tax. Karl Marx saw rent from land as an unearned and unjustified monopoly return that owners could claim, because of the institution of private property.

There is no necessary conflict between land rent and the concept of rent as an unearned increment. In some instances, rent may be regarded as something akin to a monopoly income. This is particularly true in areas where vestiges of feudal landownership systems persist, a high proportion of the land is controlled by a few families, or factors, such as tradition or prestige of ownership discourage market transactions. In an economic sense, real estate ownership can provide owners with important differential advantages, but the presence of other owners holding similar ownership rights prevents the existence of a true monopoly.

Rent can be viewed as an unearned increment any time it arises from the mere holding of land. Whenever property owners enjoy an increase in land rent from the acts of others and not because of their own improvement efforts, the increase can be regarded as an unearned increment. Unearned increments of this type can be associated with most factors of production as would be the case with a business CEO who receives $5 million in income benefits for services worth only a fraction of that amount. They are often hard to identify, and are complicated in cases involving real estate, because owners frequently make property improvements during their tenure of ownership.

Unearned increments are ordinarily capitalized into the selling prices of properties at the time of sale, and their value goes to the seller. The new owners then start with properties that are supposedly worth no more than their purchase price. When buyers use savings from work along with current earnings to acquire properties, it is normal for them to regard land rent as a fair return on their investment rather than an unearned income for which they have done nothing. Increases in rent and property values after one has acquired it are a different matter. Insofar as these increases are unearned, they represent capital gains that many people feel should be taxed as income at rates no lower than those workers pay on income earned by their sweat and toil.

Significance of Land Rent

Theoretical concepts, such as land rent have little importance in and of themselves. Their real significance arises, because of their value as tools of analysis that can be used in explaining real life situations. Land rent is significant in this sense, because it provides a key for explaining some of our most basic behavior regarding land resources. Four of the more important of these applications involve its relation to contract rent agreements, to property values, to land resource developments and investment decisions, and to the allocation of land areas between competing uses.

Effects on Rental Arrangements

No rental arrangement is complete without some agreement on the amount of rent a tenant will pay for use of a landlord's property. How the concept of land rent affects the contract rental rate is best illustrated by the workings of the rental bargaining process. Under ideal bargaining conditions, both parties should have an accurate understanding of the fair amount that should be paid as contract rent. In a hypothetical example, both parties may know that $10,000 represents a fair rental. Landlords could see it to their advantage to demand the full $10,000 plus any additional payment they can get. Tenants, in turn, would refuse to pay more than $10,000, and would naturally favor payments of less than this amount. Should tenants agree to a higher amount, they would find themselves giving up portions of the return that should go to their labor, management, or capital inputs, while any willingness of landlords to accept lower payments would rebound to the benefit of the tenants.

With the ideal conditions assumed in this example, the contract rental rates agreed upon would closely approximate the theoretical land rent. Deviations from this model are common when landlords and tenants operate with differing assumptions and knowledge concerning the rent-producing capacity of the land or when the two parties do not bargain as equals. And even when they enjoy equal knowledge and bargaining power, contract rental rates may differ from the theoretical land rent, because of the failure of future production and income to match the conditions anticipated at the time the agreement was made.

The rental bargaining process may involve sharp negotiations in which both parties argue their position, or it may involve placid acceptance of terms already determined by the landlord. In either case, the problem of inadequate knowledge may cause landlords and tenants to guess at what is a fair rental rate. This guessing process can easily result in inequitable arrangements. Partly because of this situation, landlords and tenants long ago started modeling their rental arrangements on practices that had proved satisfactory in their areas. Acceptance of these precedents has often given rise to customary rental systems, such as the “half and half” sharecropping system that prevailed for several decades in the South and the somewhat standardized housing rental rates accepted in many residential areas.

Customary rental arrangements often start with payments that correspond closely with theoretical land rent. As these customary systems continue and spread, they may be applied under conditions that no longer fit the original assumptions. This situation can result in inequities for either the landlords or the tenants. Once established, these systems often resist change or modification. But adjustments can be made for changing supply and demand conditions. Landlords make rental concessions during periods when numbers of tenants are low. When an opposite set of conditions prevails, landlords frequently demand more rent. Prospective tenants who have needed land have on some occasions assisted them in bidding up contract rental levels.

Numerous examples may be cited to illustrate these two extremes. At the time of the Black Death in England, serfs frequently used their strong bargaining position to secure more desirable tenure conditions and to work out favorable long-term leasing arrangements. Comparable benefits are sometimes enjoyed by residential tenants. During serious business recessions, apartment owners often reduce their rental rates or use special inducements, such as periods of free rent or agreements to redecorate, to attract new tenants. Increased competition between tenants, in turn, can lead to landlord demands for higher rental rates. The housing shortage experienced in many urban areas during World War II, for example, provided landlords with opportunities to increase rents, a situation that led to the adoption of rent controls.

Similar demand pressures have been a common phenomenon in land-hungry areas of the world, and have often contributed to peasant unrest. Counter bidding among tenants together with landlord greed gave rise to the famous "rack rents" of 19^{th} century Ireland. Exorbitant rental arrangements of a comparable nature also persisted for long periods in countries, such as Egypt and India.

Short-run changes in supply and demand conditions can result in wide disparities between contract and land rental levels. Over the long run, however, they ordinarily move in the same direction. When contract rents decline, because of a decrease in the relative demand for land, land rents also decline, because of the lower net returns attributable to land. With the reverse situation land rent tends to rise. Adjustments may cause changes in the income-producing capacity of land, but they also reflect the relative bargaining positions of landlords and tenants.

The effect of differences in landlord-tenant bargaining power on land and contract rent may be illustrated by an example of two areas with lands of comparable productivity shown in Figure 6–7. The principal difference between operating conditions is that tenants in 6–7A live in an area where they enjoy plentiful opportunities to find remunerative employment elsewhere, a situation that allows them to demand a good return for their inputs of capital, labor and management. The tenants in Figure 6–7B, in contrast, live in an area where few opportunities are available for them to work off the land, where there is heavy competition between tenants for farming opportunities, and tenants are willing to sacrifice much of the return that could go for their labor as a price of survival.

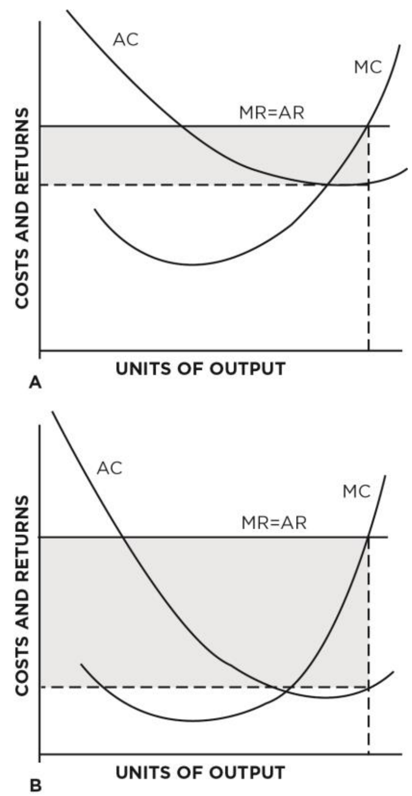


Figure 6–7. Illustration of the Effects of High and Low Tenant Bargaining Power on Land Rental Levels

A somewhat different situation can arise when landlords and tenants share the amount of land rent produced. As the example depicted in Figure 6–8 indicates, owner operators and cash tenants would find it to their advantage to push production to *R*, the point at which their *MFC* = *MVP*. With half share tenants in agriculture and retailers in shopping malls who pay 10 percent of their net returns as contract rent under a percentage lease, the tenants would have no incentive for adding variable inputs beyond *S*, the point at which their share of *MFC* equals their share of *MVP*.

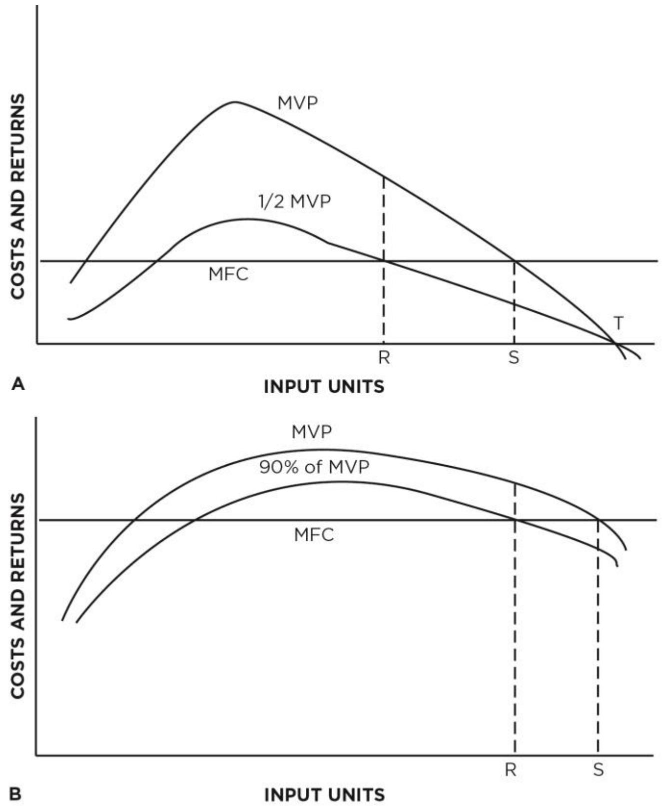


Figure 6–8. Illustration of the Possible Effects of (A) a One-Half Share Rental Arrangement and (B) a 10 Percent Leasing Arrangement on the Tenant's Willingness to Apply Additional Inputs in the Production Process

Despite the theoretical soundness of this rationale, it is surprising to find that share tenants usually apply their variable inputs in much the same way as owner operators. Several reasons can be given for this situation. Tenants in some cases may be unaware of the mistake they are making. A more important reason lies in the power of the short-term lease. Tenants may see it to their advantage to operate like owners should they want to have their leases renewed and if they want to establish reputations that qualify them for grants of production credit and mortgage funds should they choose to buy farms. Share leasing arrangements with farms is also often complicated by agreements that have landlords sharing the cost of harvesting, providing seed and fertilizer, or other expenses. The percentage leases used in shopping centers may also be complicated with provisions specifying hours of operation, advertising requirements, and other operations details.

Another version of this problem with sharing arrangements occurs in land-hungry areas where tenants have few alternative opportunities. Tenants with half share leases in these circumstances may find that they have unused supplies of labor inputs available once they have reached the point at which their one-half of $MVP = MFC$. With nowhere else to use their labor inputs, they may push production on to point *R* and even to *S*, because some return to their otherwise unused labor inputs is better than no income at all.

Relation to Land Values

From a theoretical view, real estate resources have current market values equal to the present value of all of their expected future land rents. The process used in determining these values calls for estimates of the value of the future flows of land rent expected from given properties and a discounting of these values to determine their present worth. Discounting represents a negative premium on waiting, and with this process at work, properties that can produce endless flows of land rents into the future have current market values that are little more than the sum of the expected rents that can be received in the next 20 to 25 years.

In illustrating the discounting process, one may assume a tract of land that is expected to produce net rental returns of $1,000 annually for *x* years into the future. The expected rental return for next year and for each year thereafter has a current market value of something less than $1,000 for the simple reason that the operator must wait to receive it. If the operator tried to sell or borrow money against this expected rental return for a given year or series of years in the future, the potential buyer or lender would calculate the present value of each year of expected return in terms of the sums it would take when invested now at acceptable interest rates to yield $1,000 in the year in which the rental return would be realized.

When discounted at five percent, an expected rental of $1,000 one year hence has a current market value of $952.40, a return due in 10 years a current market value of $623.90, and a return due in 20 years a current value of $376.90. Summation of the discounted present values of a flow of annual land rents of uniform size that are expected to continue indefinitely into the future can be expressed by the formula $V = a/r$, in which V is the value of the property, a is the annual average expected rental return, and r is the rate of capitalization. By way of illustration, if one assumes an expected average annual land rent of $1,000 and a five percent capitalization rate, the land resource in question has a market value of $1,000 divided by 0.05, or $20,000. Capitalized at a four percent rate, its value would be $25,000, and with a 10 percent rate only $10,000.

Income capitalization is one of the two valuation approaches most used by appraisers in their determination of the market values of properties that yield continuing flows of land rent. The other approach calls for market comparisons with the sales prices of recently sold properties of comparable value. A third approach, which involves analysis of reproduction costs, can also be used with property improvements. The three approaches are often used as checks against each other. With properties that have continuing flows of expected future land rents, heavy emphasis is usually given to income capitalization. Care must be exercised with its use, however, because what appear as small mistakes in assumptions about rates of production and future market prices can easily lead to off-base conclusions about current market values.

Applications to Resource Development Decisions

Expectations concerning future flows of land rents provide an important guide to operator decisions as to whether one should invest in or proceed with prospective land resource developments. Enterprising investors will display interest in clearing land, building a shopping center, or drilling an oil well if the promise of future flows of rental returns is satisfactory. When the promise of future net returns is small or nonexistent, they have good reasons to look elsewhere for places where they can use their funds and efforts to advantage.

In projecting their expectations concerning future costs and returns, operators make whatever assumptions seem appropriate. They can assume that production, product prices, operating costs, and land rents will rise, remain constant, or decline. With an investment in an agricultural land development expected to yield a continuing flow of land rents and profits at some given level for an indefinite time period, they may visualize an undiscounted model, such as that portrayed in Figure 6–9. The amount of land rent and profit represented by the difference between of *AR′* level total returns and the *DR* level of operating costs would then be a key factor influencing their decisions as to whether they should proceed with the contemplated development.

Developments often involve investments with limited economic futures in which case use might be made of the undiscounted model suggested by Figure 6–9B. Investors in this instance would visualize the surplus of rents and profits they could receive in the immediate future with the prospect that this flow of positive returns would drop down to or below their cost level in *M* years. How long they would proceed with this prospect of declining returns would depend in large measure on their expectations concerning future rents and profits together with their expectations about the prospective returns they could receive by redeveloping their properties for comparable or higher uses. Discounting would lead to lower estimates of the current values of expected future returns.

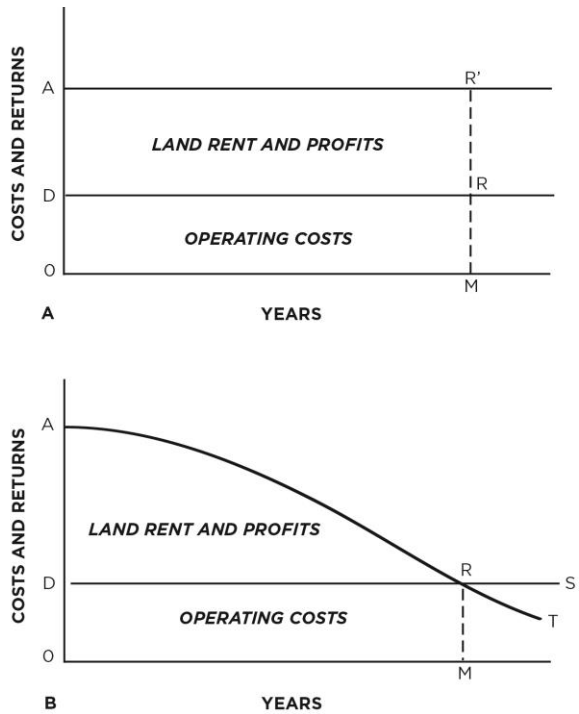


Figure 6–9. Illustration of the Effects of Expected Costs, Returns, and Net Land Rents on Resource Development and Investment Operations

Effects on Land-Use Allocation

Our discussion about economic returns to land resources to this point has assumed a single type of enterprise. In practice, operators can usually choose between a number of alternatives. Most operators concentrate on those uses that will maximize their returns at their particular location and with their combinations of productive factors. But they may also work with complementary enterprises, divide their attention among a variety of enterprises, or choose enterprises for which they have personal aptitudes and preferences.

In their choice of enterprises, operators are ordinarily interested in comparisons of the income-producing potentials of their various alternatives. These comparisons may be based on general observation or may involve calculations of the probable economic returns to land and management they can expect from each alternative. From an economic standpoint, comparisons of this type, particularly those involving both uses and locations, may be thought of in terms of overlapping rent triangles. The individual rent triangles for different land uses vary considerably in size and shape for different land uses. With the examples used in Figure 6–10 they range from the high narrow triangle *EOP′* that depicts the land rent secured from use *A*, to the low broad triangle *HOT*, which represents use *D*.

The four land rent triangles pictured in Figure 6–10 (*EOP′*, *FOR′*, *GOS′*, and *HOT*) may be used to describe the competition between four types of land use. Considered from an overall standpoint, they may represent commercial uses, residential uses, arable farming, and forestry or grazing, respectively.

The hypotenuse of each of the four land rent triangles in Figure 6–10 represents the intensive margin for a particular use. The intensive margin for use *A* follows the *EP′* line, and the intensive margins for uses *B*, *C*, and *D* follow the lines *FR′*, *GS′*, and *HT*, respectively. The points at which these intensive margins intersect are known as <u>margins of transference</u>. The intensive margins for uses *A* and *B* intersect at *ab* (point *P* on the horizontal axis). At this point, it is more profitable to shift to use *B* than continue with *A*. Other significant margins of transference occur at points *bc* or *R*, where it becomes more profitable to shift to use *C* than continue with *B*, and at *cd* or *S*, where it becomes more profitable to shift to *D* than continue with *C*.

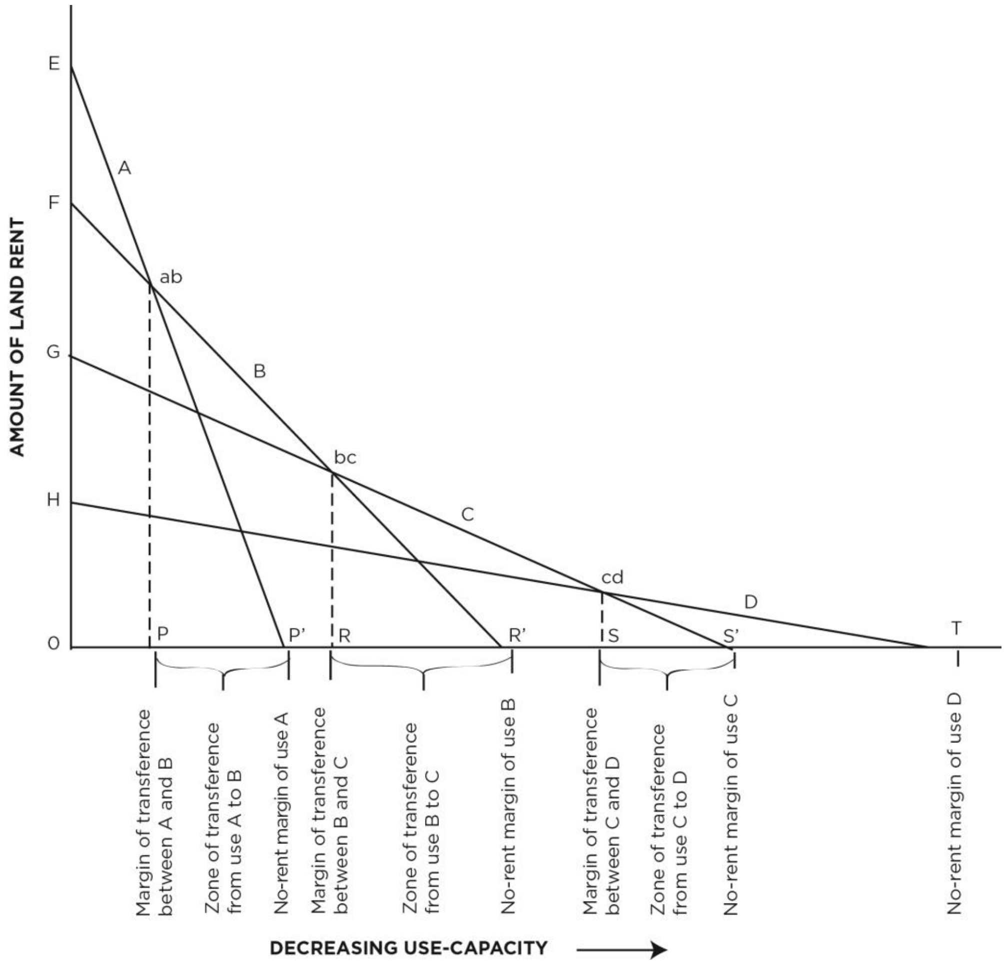


Figure 6–10. Illustration of the Relationship between Relative Ability of Land Areas to Produce Land Rent and the Allocation of Land Areas between Competing Uses

One can continue to receive land rents for operations between these margins of transference and the extensive margins for each use. Operations carried on within these zones of transference are profitable, but they are never as profitable as they could be if operators shifted to their highest and best uses. As this example suggests, the concepts of land rent and highest and best use can be used to explain both the competition between land uses and the resulting allocations of land resources between uses. This competition continues as a never-ending process, and its effects are observable in the continual allocation and reallocation of land resources that takes place between various uses and users.

Applications of the Margin-of-Transference Approach. The margin-of-transference approach provides a meaningful technique for explaining the allocation of land areas between uses with different rent-paying capacities. Figure 6–11 can be used to illustrate the allocation process that takes place in and around typical cities. When cities are small, the triangles for use *A* (commercial) and use *B* (urban, residential) may be reasonably narrow. With urban population growth, the triangles for these uses expand both in height and width with the result that some sites used for residential purposes shift to commercial uses while farmland around the city shifts to residential use.

Figure 6–11 depicts two problem situations involving uses of land in urban areas. The first situation concerns the margin of transference *ab* at point *J*. This is the present margin between commercial and residential uses. Property owners just to the right of point 3 may assume that urban growth will soon push the margin to *a'b'* at point *K*. Anticipating this emerging higher use, they hold back on plans to remodel, repair, or rebuild properties in the transition zone between *J* and *K*. Should the expected emerging use develop, this decision may prove financially wise.

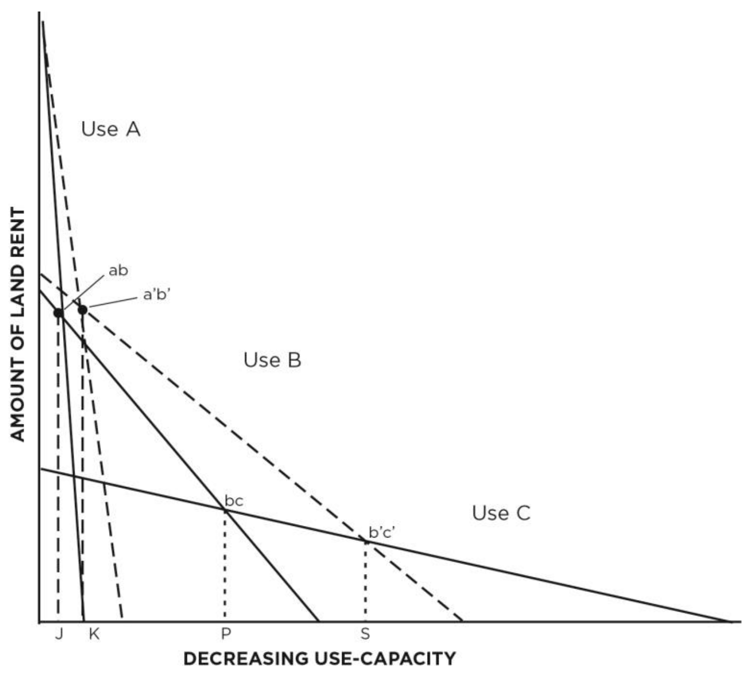


Figure 6–11. Example of an Application of the Margin-of-Transference Approach

Unfortunately, the demand for the expected higher uses does not always materialize, or, if it does, it may not come until years after it was first anticipated. Without strong positive measures, the result is often a circle of spreading blight, slums, and urban decay around downtown commercial centers. Individual owners frequently sacrifice rental returns and satisfactions they could have had, although they may salvage their situation by acting as slumlords. The real tragedy in these cases involves the transference of social costs to the public, for it is society and the urban community that usually bears the major losses.

A second land-use problem centers on the margin of transference between residential and agricultural uses. In an earlier time, when most urban residents lacked automobiles the edge of the urban residential area occurred at point *P* in Figure 6–11. An increase in city size would have called for gradual extension of the residential zone around the city's edge. With the relaxation of transportation constraints that has come with the widespread ownership of automobiles and the building of improved streets and highways, however, urban workers can now commute to work from point *S* in less time and with less effort than their grandparents expended in traveling from sites located to the left of point *P*.

Relaxation of the transportation constraint has facilitated a suburbanization and residential scatteration trend. It has also greatly complicated the problem of retaining land in agricultural use in rural areas located in the vicinity of expanding cities.

This problem is most serious when occasional tracts between *P* and *S* are acquired for residential development while large areas are expected to remain in agricultural and open space uses. The higher rent-bid prices offered by developers may call for only a small portion of the land area, but they affect land prices, tax assessment values, and the expectations of owners throughout the entire area. The new urban-oriented residents who move into the area often demand local public services not previously provided and add to the population that must be educated and protected. Farmers and other rural land users may feel that they are being squeezed out by rising property taxes and the larger investments required for any expansion of their business operating units; and speculators attracted by the prospect of capital gains, may acquire lands that are often allowed to lie idle. Society again suffers as large areas can be blighted for agricultural and other rural uses before a genuine need develops for residential or other urban purposes.

Another application of the margin-of-transference approach can be visualized with public and private decisions concerning choices between single purpose and multiple-purpose alternatives in resource management. Individual uses, such as commercial forest production, public recreation, or game management, for example, could be identified as dominant uses that should be emphasized in a forest management program. As an alternative, joint emphasis on two, three, or more objectives could be stressed in a multiple-use management program.

Realistic comparisons of the relative benefits associated with these management alternatives call for examination of the economic and social costs and returns associated with each management option. For multiple purpose-use management to receive top emphasis, the sum of the economic and social land rents associated with the approach should exceed those attainable when managerial emphasis is given to any single dominant use. Once the economic and social land rents are determined, an agency may rationally decide, for example, that public recreation should be the dominant use of area *A*, multiple-use management should be applied to area *B*, and commercial forest production and game protection should be emphasized in areas *C* and *D*, respectively.

Relation of land rent to intensity of use. Land rents are often correlated with the relative intensity with which land is used. In practice, however, the two concepts are separate. Land rent represents the economic return land receives for its use in production while intensity of use refers to the relative amounts of human and capital resources used in association with a given tract of land. These two concepts parallel each other, because intensive use practices are often associated with high land rents; but it would be a mistake to assume that this situation always holds. Intensive use practices can be used to overcome the inherent deficiencies of low rent sites. Businessmen with poorly located sites sometimes use costly advertising programs to attract customers to their place of business. Farmers with soil of low natural fertility often use large inputs of fertilizer to increase the productivity of their lands. In similar fashion, peasant operators and workers in cottage industries often find that lavish inputs of family labor are needed if they are to eke out a livelihood from their limited land resources.

Similarly, the fact that a site commands a high land rent does not necessarily mean that it is subject to intensive use. Low-rent housing facilities are usually subject to more intensive human use than high-rise luxury apartments. Low-rent commercial and industrial sites may be used just as intensively as the high-rent locations found in downtown areas. Small family farms in low-rent areas are frequently used more intensively on an acre-to-acre basis than the larger commercial units found in areas of higher productive potential.

Chapter 7: Cost Considerations

"The best things in life are free."

~ an American Proverb

"There is no such thing as a free lunch."

~ unknown

Some of the best things about the environment, little treasures like enjoyment of a beautiful sunset, taking a breath of fresh clean air or a drink of cold water, seem to be free. Most of our uses of environmental resources, however, come at a cost. Fortunately for many of us, this cost is often borne by others, a fact that makes us free riders in society. Definite costs arise though with the development and protection of most environmental resources; and it is essential that full recognition be given in their management to their existence and to the effects they have on managerial decisions.

Resource managers have strong incentives to secure as much rental and other returns as they can from their operations. If they are monopolists or operate in cooperation or collusion with others they may be able to make decisions that influence the price levels at which their products sell. Acting alone, however, they must usually accept market prices as they occur. This means that they find their best opportunities for increasing their net returns in the possibilities they have for reducing production costs. Their concern about costs has added importance to them, because it often provides a guide as to what to produce, and how, when, and where to produce it. The costs that arise with the development and management of environmental resources take several forms and are sometimes obvious, sometimes hidden. Consideration of their overall significance calls for their identification and for examination of the roles they play.

A Family of Costs

The many different costs operators must consider in their managerial decisions involve payments they or someone else must make, incomes that must be foregone, or charges that can be levied against their operations. Viewed together, they can be seen as a family of interrelated costs. Before business managers can start their normal production operations, they must first acquire and develop the land and capital foundations that will provide the base for their expected operations. This need calls for identifying investment and development outlays as a first set of cost considerations. A second major grouping of costs comes with normal business operations and can be recognized simply as operating costs. An important third classification involves the social costs that arise when one's operations have negative impacts on others. These costs are now most often described as externalities.

Still another cost concept known as opportunity costs arises when operators weigh the expected benefits and returns they can get from their chosen enterprises against those they could receive from alternative investments. An opportunity cost exists when operators could secure a higher net return from the alternative investment than from the one with which they are engaged.

Investment and Development Costs

The many environmental resources we associate with the flow of nature's benefits can be thought of as being totally or almost free goods. So they were in the beginning, and still are with various examples, such as the amenity values we attribute to pleasing scenery, wilderness environments than can be the delight of limited numbers of users, or the awareness values we can associate with knowledge that the Amazon forests or the polar bears of northern Canada are still there. Hardly any of the natural resources we use to satisfy our production and consumption needs, however, are free. Virtually all of them have been appropriated to public or private ownership; and definite monetary costs are associated with the process of making them available for productive use.

Operators who are embarking on business careers must usually think first of acquiring the properties they will use as the seat of their operations. In times past, they frequently had to start from scratch in developing these properties. Today, a substantial number start by buying or leasing properties already developed by others. For would-be owners, the acquisition process calls for outlays of investment funds and frequently the added investment costs associated with acquiring credit, brokerage fees, and costs of registering title. Renters, in a sense, take over this initial investment cost when they agree to leasing arrangements that have them paying sufficient contract rent to justify the property owner's continued investment.

Land developments typically call for direct outlays of capital and labor. The extent and nature of these outlays vary both with the type of development undertaken and the period during which it takes place. Virgin forests may be opened for economic use through the building of logging trails. Modern skyscrapers, in contrast, call for tremendous expenditures of capital and labor. The monetary and labor costs of taming and modifying the raw gifts of nature to make them available for mankind's productive use have been matters of concern since the beginnings of settlement. Settlers in what is now the eastern United States favored locating on the oak openings they found in forests, because that saved them the arduous task of clearing land of its forest growth. They settled on dry lands, because it saved them the cost of drainage. Suburban land developers still follow this rule by choosing sites already developed for agriculture in preference to rougher lands, because these areas already have the roads, utilities, and access services they would be expected to provide.

Much of the farm making that took place along the American frontier was accomplished with relatively low initial cash outlays. Settlers in Illinois, in 1835, could buy 320 acres of prairie or woodland from the government for $400 and were able to supply themselves with a cabin, corncrib, and stable, and hire others to break the prairie sod and fence 160 acres for cultivation for an additional $745. Most settlers saved on these costs by clearing their own land, breaking the sod, and putting up their buildings and fences. This process required long hours of arduous labor but substantially reduced the monetary costs of establishing a productive farm. By 2002, the average market value of these farms had risen to $2,640 an acre. Costs for clearing land, providing drainage and buildings had also climbed so that farms of that size now had seven figure values.

High land development costs are expected with the development of land for most non-agricultural uses. The process of platting and subdividing raw land for residential, recreation, and other urban-oriented uses usually involves substantial outlays of time and money for planning and surveys; for providing roads, sewers, utilities, drainage facilities, and site improvements; and for securing final official approval. These costs can easily add up to $10,000 to $20,000 or more per lot.

High price tags also are associated with the construction of residences, office buildings, shopping malls, and industrial facilities. Urban renewal projects are expensive both, because of the high cost of acquiring already developed sites and demolishing the structures found thereon and, because of the ambitious redevelopment programs that follow. The 12-acre Rockefeller Center in New York City, constructed during the 1930s at a cost of $150 million, was considered a high-cost development at the time. Comparable large urban projects now have price tags of several billions of dollars. High investment costs of comparable nature are associated with public improvements, such as the construction of super-highways in cities, the building of subway systems, and providing flood protection facilities for cities, such as New Orleans.

Time Costs

Land development always involves some passing of time. The costs associated with the necessary waiting periods are often disregarded by operators but are nonetheless real and should be counted in calculations of project development costs. Weeks and sometimes years can elapse before improvements are completed and developed resources are ready for productive use. Throughout this time interval, land developers ordinarily find that their investments are tied up in assets that are not as yet ready to yield an economic return. They also find that they must gauge their present plans and operations to expectations concerning market conditions that will prevail after their properties have been developed. This process involves elements of risk and sometimes unexpected extensions of the time intervals that elapse before developed properties can be sold or put to economic use.

The time costs associated with the holding of land developments under these conditions fall into two sub-classes; waiting costs and ripening costs. Waiting costs arise, because of the periods that elapse between the time of an operator's first outlay of capital and labor, and the time when he or she can either sell the development or put it to productive use. Allowances for interest on invested capital and taxes paid during the development and normal sales periods are two leading types of waiting costs. Of the two, tax payments represent a definite cash outlay promoters cannot avoid without endangering their investments. Allowance of interest on the borrowed capital needed for acquiring, holding, and preparing a development for its ultimate sale or use represent losses of opportunity cost returns they could receive when they supply the needed funding from their own resources.

Significant examples of waiting costs occur with most types of land development and building activity. People who have houses built to order must pay interest, and often taxes as well, on their land and building investments for the weeks or months that elapse before their houses are ready for occupancy. The only real difference that arises in these cases and those associated with the planting of an orchard, drilling an oil well, or building a skyscraping office building stems from differences in the size of the investments involved and the duration of the time periods over which the waiting costs occur.

Closely related to waiting costs is a parallel concept of ripening costs. This concept applies to those increases in the costs of holding property that stem from the ripening or imagined ripening of properties from lower to higher uses. Typical examples occur when tax assessors treat cutover land in the same property value class as cultivated farmland, farmland in the same class as residential sites, or residential lots in the same value class as commercial sites. In every case, the increase in property taxes paid during the period that elapses before the land areas actually shifts to the higher use may be regarded as a ripening cost.

Ripening costs are a frequent problem with premature developments in which operators proceed with the mistaken expectation that a market will exist for their product once it is produced and ready for sale. Examples have occurred when residential subdivisions and new office buildings have been provided with the expectation that all of the lots could be sold or offices rented within a few months only to find that they were victims of a downswing of the business cycle. Some operators are able to carry their ripening costs under these circumstances until an upsurge in market conditions permit the sale of their product. Those who operate with considerable borrowed capital, however, may find their equities wiped out. With them, they must often choose between the alternatives of offering their products for sale at distressed prices or face the prospect of bankruptcy, debt foreclosure, and tax reversions.

Unfortunately, for their investors, numerous highly touted resource development projects have been based on wholly unwarranted assumptions concerning economic demand. Once examined in the cold light of reality, it has become obvious that they were picked too green to go through a normal ripening process. Instead of ripening to a higher use and acquiring higher values with more earning capacity, they have often stagnated and sometimes remained idle and even been abandoned. Abandonment has led to land title problems for potential future users together with considerable social waste; all of which illustrate the fact that it takes more than high hopes and high taxes to make land resources shift to higher uses.

Supersession Costs

Much of the world's land area is used with little change over extended periods of time. Some sites, however, experience a succession of uses. With these sites, changing value and use patterns often make new types of use economically desirable, even though this frequently calls for writing off the investment value of earlier improvements. The costs associated with this redevelopment process are known as supersession costs.

Typical examples of supersession costs arise when city lots that have been used for residential purposes ripen for possible commercial use. An owner with a house valued at $150,000, which produces a land rent of $1,000 a month, for example, may see an opportunity to replace it with a million dollar office building that will provide a significant increase in net rental returns. If the lot, which has a bare land value of $50,000, were vacant, there would be little question as to what should be done. With a house that represents a substantial investment on the building lot, the operator must choose either to hold onto the income the house now produces or sacrifice its building value so that the opportunity to replace it with a higher valued structure can be realized.

Comparable supersession cost considerations arise when business operators question whether they should suspend their operations and scrap part of the value of their present quarters, while they remodel or rebuild with the hope of improving their future competitive and income status. Public and private agencies also incur large supersession costs when they spend millions of dollars for properties in blighted neighborhoods and for relocating displaced families so that they might provide space for the construction of updated facilities.

Property owners who are unwilling or unable to undertake complete redevelopment programs often work out piecemeal compromises. These arrangements try to tap part of a property's potential higher production capacity, while minimizing the actual cost of supersession. Familiar examples are provided by the many houses that are converted into shops, restaurants, and office buildings; by houses that have commercial additions on what were once were their front yards; and by merchants who remodel their stores, while carrying on business as usual. The results of this expedience are often less satisfactory and less sightly than those provided by complete redevelopment but they can involve lower supersession costs.

Operating Costs

Substantial current outlays of operating costs are associated with most uses of resources for production purposes. Even with the example of primitive man picking fruit from a tree or snaring a rabbit for his next meal, outlays of effort were needed to accomplish his production goal. In our modern society, operating costs arise with arrangements that range in simplicity from the case of peasants planting seeds to grow vegetables to the highly integrated activities of giant firms that conduct business operations all over the globe.

With typical business operations, managers must give direct attention to the full array of costs that arise in their production operations. Important among these are the amounts they pay for their supplies of raw materials, the wages, and salaries paid to employees, any contract rents paid for the use of commercial or industrial space, charges for water, power, telephone service, heat, and air conditioning, and the taxes they pay as their share of the cost of supporting local, state, and federal government. In addition, they have other operating costs, such as their outlays for advertising, for accounting and legal services, and for the recreational, health, or pension programs provided for their employees.

In their work with operating costs, economists frequently find it advantageous to distinguish between fixed and variable costs. Variable costs are tied directly to the number of input factors that are used in the production process, and that increase or decrease as operators decide whether to push production further or cut back on production. Fixed factors, in turn, involve items, such as commitments to pay contract rent, taxes, insurance, and the costs of providing heat, light, water, and other utilities; all charges that remain relatively constant throughout any given short run production cycle.

The different impacts that consideration of the separate effects fixed and variable costs have on production decisions is ordinarily shown by drawing separate lines for their effects on economic model diagrams. This practice, of course, complicates the simplified analysis, which assumed a single unified production cost that was used with the discussion of costs in Chapters 5 and 6.

The discussion in these earlier chapters also assumed production under short-run conditions; short run being defined as a production period during which an operator is limited by the fixed supply of some particular input units. Under short run conditions, land resources are almost always considered as a fixed factor, and the costs associated with the acquisition and holding of land resources, property taxes, insurance, and commitments to pay cash rent, are classified as fixed costs. This situation stems from the fixed location of real estate resources, the ownership rights concepts we apply to them, and the tendency of most enterprises to be tied to particular sites throughout their production periods.

Individual producers normally operate in a series of short run periods during which the scope of their activities is limited by the nature of various fixed factors, such as land. With land, the duration of these periods varies with the conditions under which land is owned or leased and may involve the time needed to grow a crop, complete a production cycle, or justify certain expenditures. When these periods are treated together as parts of a long-run situation, all fixed factors become variables. The supply of land available to individual operators, over the long run, can change with individual adjustments. Industries can secure new plant locations; commercial operators relocate, remodel, or rebuild their establishments; tenants renegotiate their leases; and owners can add to the size of their real estate holdings. Changes can also occur in the ownership, size, and value of holdings and in rental rates, tax, insurance, and other charges associated with their use.

As one shifts from long-run to the shorter run situations under which most operations take place, many variable inputs become fixed factor costs. At the critical stage of the production process when an operator goes into business, a commitment is made as to the size and location of the operator's base of operations. Later changes can be made, but once firm decisions are made, the site and size of the land factor are fixed for the assumed operating period and the cost of acquiring and holding the unit becomes a fixed or "sunk" cost.

Economies of Scale

The long run variable nature of land costs makes it possible for operators to adjust the size and scale of their enterprises to an optimum level at which they can secure the highest possible net return from their combinations of inputs. But what is the optimum size of a factory, an apartment development, or a farm?

Optimum size is directly related to operations at that scale that permits the operator to enjoy the highest possible economic returns relative to cost. As long as increases in their scale of operations lead to the increasing net returns that come with decreasing production costs per output unit, producers enjoy increasing returns to scale. With this situation and even with constant returns to scale, they have an economic incentive to increase the size of their enterprises. Once they experience a decreasing rate of return it is time to quit making additions to their scale of operations.

Cost economies occur whenever operators find that a larger scale of operations can facilitate more effective use of their managerial abilities or better utilization of the underused capacity of particular input factors, such as specialized equipment. Similar economies result when expanded operations permit job specialization, work-simplification techniques, increased use of labor-saving equipment, and savings from bulk purchase of materials and supplies. In addition to these internal economies, operators may also benefit from external economies. A producer may benefit, for example, from the improved processing or marketing facilities made possible by a larger volume of production. In similar fashion, a large subdivision or apartment development may benefit from the improved bus, school, and community shopping facilities it may attract.

In addition to the cost economies that can come with increasing scale, diseconomies may also arise with the enlargement of enterprises. Some of these result from operator delegations of managerial responsibility to individuals of lesser ability. Others may arise when an operator substitutes impersonal dealings with hundreds of employees for earlier personal contacts with a smaller labor force; when communication and transport problems develop, because enterprises are spread over larger areas; or when larger scales entail greater risks from disease, fire, and other hazards.

Over the long run, operators find it to their advantage to shift to that size or scale level at which their cost economies most exceed their possible diseconomies of scale. They can visualize a planning curve, such as that shown in Figure 7–1, which displays the cost curve situations that could exist with operations conducted at a series of levels of increasing scale. With this model in mind, they should choose the size of operations that offers the lowest possible average cost combination. Operation at this point permits maximum enjoyment of economies of scale.

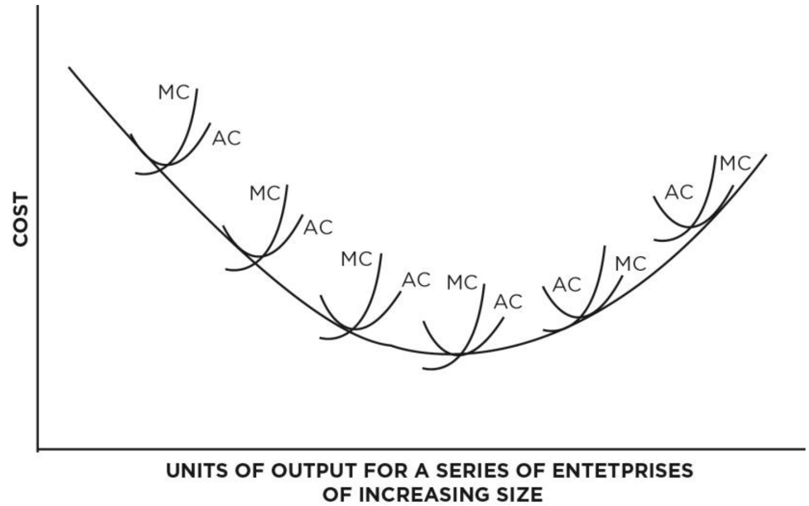


Figure 7–1. Use of a Planning Curve to Indicate the Effects of Economies and Diseconomies of Scale on the Optimum Operating Size of an Enterprise

Most operators who use land resources work with production combinations of less than optimum size. Profit-minded operators are conscious of this situation and many have moved to expand the scale of their operations. Huge corporations are merging with others and seem intent on acquiring each other. These activities are prompted, in part, by desire to attain greater economies of scale, which undoubtedly happens in some cases although not necessarily in others.

Numerous operators are left behind in this race to optimum size. Some who would like to expand the scale of their operations are held back by lack of opportunities to acquire the additional land, capital financing, or other resources they might need. Some may be held back by lack of imagination or initiative. Many, however, choose not to run, because maximization of their personal goals can be attained by means other than participation in the race. As long as they are satisfied with their rates of return, they can argue that life can be beautiful with operations of less than optimum size.

Externalities

Most of the costs that arise in developing and processing natural resources are borne by the investors and operators directly involved with the decisions made for their use. It has not been unusual though for developments to have positive and negative impacts on others. Prior to the late 1900s, economists usually concentrated their analyses on the internal operations of businesses, while they dismissed the external effects they had on others as social benefits or costs that could be largely ignored. This situation changed when emerging public awareness of problems, such as smog, declining air quality, water pollution, rising health costs, and a perception that society's opportunities to enjoy the beauties of nature were being eroded, led to popular demands for programs that could provide protection of the environment. With this surging of popular concern, economists joined with ecologists, lawyers, politicians, and others in focusing attention on the newly recognized need to control the adverse effects of externalities.

Concerns about matters that had been pushed aside as social benefits and costs were now identified as positive and negative externalities. Positive externalities exist whenever a development provides benefits without cost to others. A common example exists when factories or popular recreational developments with their need for highways, railroad connections, utilities, other urban infrastructure, and public services locate in what had been a rural area. Their presence provides an economic base for the rise of new urban communities and with them a stream of benefits for prospective employees and local residents. The location of Disneyland in what until then had been a bedroom community, for example, provided major benefits for nearby property owners as new urban infrastructure was provided and crowds of visitors came to the area with their demands for goods and services. Developers have valid reasons for trying to capture the benefits associated with these operations. Their limited ability to do so allows large numbers of people both within and sometimes outside their development areas to benefit as free riders from the new opportunities and services provided. While those who directly benefit from the new economic activity see this development as a positive externality, others may resent the increased traffic and changes in their community and see the same development as a negative externality.

While positive externalities exist as a common phenomenon, it has been negative externalities that have attracted the concern of ecologists and economists and that have become a key issue in ecological and environmental economics. Very few of the activities that produce negative externalities are undertaken for other than honorable purposes. Operators are in business to produce goods and services that can be used by others, but in their effort to keep operating costs down, they have often generated spillover costs that have had negative effects on others. It has not been their intent to cause harm and they would be quick to deny any such intention. The negative side effects of their operations have been generally accepted in the past as unfortunate but necessary costs of advancing civilization. Nature provided a cushion or a sink to absorb many of the wastes created; and it was not until the volume of wastes exceeded the ability of nature to handle them that strong demands emerged to control and prevent further pollution.

The principal negative externality issues that impinge on the environment concern problems that arise with our use of air, water, and surface land. These issues will be examined in greater detail in Chapters 14–19. It may be noted at this point though that all three (air, water, and surface land) were long regarded as natural sinks for the disposal and handling of wastes. It has been our growing awareness of the inability of nature to absorb the huge volume of wastes now created by our society and still provide its normal flow of benefits to mankind that now makes the control of negative externalities a problem of major consequence.

Since the beginning of human settlements, people have expected the movement of air to take away the smoke from their fires. Few problems were created as long as fires where kept under control, because the particles of carbon fell back to earth and the carbon dioxide created was absorbed by plants through the process of photosynthesis. When the chemicals belched forth from factories started to show injurious effects by killing nearby vegetation, the problem was met by building taller smokestacks. This answer sufficed until dealing with increasing volumes of wastes led to a worsening of air quality in local communities, to injurious effects on plant life and buildings, to the creation of acid rain in downwind areas, and to concerns about its contribution to global warming.

Similar developments have affected our use of water resources. Disposal of wastes, along with provision of water supplies for household and community use, for irrigation of crops, for sustaining fisheries, for industrial cooling and washing purposes, for transporting people and goods, and for satisfying recreation desires was long considered part of its normal duty. Once it became apparent that the dumping of wastes was exceeding water's natural capacity to absorb them, water pollution became a problem for its many other uses and moved to center stage as a public policy issue. Discovery of the relationship between water supplies and water borne diseases made clean water a public health, as well as a general welfare, issue. Public awareness of these developments led to demands that action be taken to restore the nation's water resources to their earlier standard of quality.

Surface land resources have provided a sink for the disposal of wastes in the past in the same way as air and water resources, the major difference being that the wastes were expected to stay where they were put and not seep into the underground water supplies or be carried away by wind, flowing streams, or ocean tides. Farmers spread animal wastes on their fields knowing that their breakdown could add to soil fertility. Families had their waste piles, cities their landfills, and industry its waste dumps. Problems emerged when enlarged feedlots provided more wastes than farmers could spread on their fields, landfills filled up, junk yards became ugly eye sores, and the oil, paints, chemicals, and toxic substances stored in surface dumping grounds failed to disintegrate and instead contaminated underground water supplies.

Land pollution has and is taking place faster than answers are being provided. An extreme example of the waste management problem exists with the question of what to do about the nation's growing piles of nuclear wastes. Were the problem one of dealing with horse manure, nature could handle it in a few months. With nuclear wastes that have half lives of thousands of years, the waste management problem is one that will challenge the ingenuity of managers of the environment for generations to come.

Methods of Cost Evaluation

It is ordinarily assumed that resource developments should not be undertaken unless there is evidence that their expected benefits will more than pay for their costs of development and operation. With large privately funded operations, attention is almost always paid to this rule although there is no advance guarantee that every project will yield the returns expected. With private undertakings of a smaller nature, other considerations may lead operators to invest in projects of doubtful pay-off ability. A comparable situation should exist with public projects where political considerations have often played a more important role than economic reasoning in determining how and where public funds are spent.

Congress recognized this problem by inserting a provision in the Flood Control Act of 1936 that made possession of a positive benefit-cost ratio a requirement for federal flood control project approval. The concept was later applied to other land and water resource developments, and gave rise to a process known as <u>benefit-cost</u> analysis. Somewhat later, a generalized version of the same process, now called <u>cost-benefit</u> analysis, was applied in the evaluation of other proposed public programs. Difficulties associated with its applications, however, have favored a shift to the use of a more simple evaluation technique known as cost-effectiveness analysis with projects that involve hard to measure future benefits. Environmental impact statements provide another measure of project assessment, expressed this time in terms of the environmental costs they pose on society.

Benefit-Cost Analysis

Benefit-cost analysis provides a guide for the effective economic use of resources in project development. The technique was developed during the late 1940s, and received considerable attention during the period from 1950–1980 during which several federal water resource development projects were undertaken. Less use has been made of it since that time, because the most logical sites for development are already developed, because the required use of higher discount rates makes it harder for proposed projects to get favorable benefit-cost ratios, and because Congressional interest in large-scale land and water resource developments has lagged. Favorable benefit-cost ratios are still required, however, as a condition for appropriation of federal funds for resource development projects.

It is not the only basis for approving or disapproving resource development projects, as national defense and political considerations often play governing roles. But insofar as economic considerations prevail, benefit-cost evaluations can point the way to efficient use of public funds with developments involving environmental resources. It assumes that 1) projects have economic value only to the extent that a need or desire exists for their services; 2) each project should be developed at the scale that provides the maximum excess of benefits above costs; 3) every project or separable segment thereof should be developed at the least practicable cost commensurate with the overall objectives of the project; and 4) the development priorities assigned to various projects should follow the order of their economic desirability.

Concept of Benefits and Costs

A first step in benefit-cost analysis calls for defining the scope of the terms benefits and costs. Prevailing practice calls for recognition of three types of benefits: primary, intangible, and secondary benefits. There are four primary types of costs: project, associated, external diseconomy, and secondary costs.

Primary benefits are associated with the first level of resource values secured with completed projects. With large reclamation projects in the West, this product has involved water stored in reservoirs. A market-value of a given price could be assigned to these waters; but since no monetary charge has normally been made for their use, it has become accepted practice to treat the value of the first level of products secured from the use of the stored water as the primary benefit. These products have included the value of electric power-generated crops grown, municipal water supplies, flood protection, recreational amenities, and other intangible benefits provided by the projects. Intangible benefits have been attributed to services, such as the recreational use of the waters stored behind a dam that are not easily measurable in monetary terms and, thus, hard to quantify in economic terms.

Secondary benefits involve additional values that result from activities stemming from or induced by a project. These benefits usually involve a second level of resource utilization made possible by completion of a project. They may involve calculations of the value added by using electric power in industrial activities, processing grain into flour, or operating recreational concessions. These benefits have a potential for inducing regional economic growth and can provide major justification for resource developments.

Projects often have externalities or side benefits and costs that are hard to evaluate in market value terms. Contentious questions have been raised about the extent to which these non-market values should be considered in benefit cost analyses. A new road in a mountainous area, for example, may provide riders with opportunities to see a waterfall, an eagle's nest, or perhaps a roadside bear. These are items of value that many users appreciate, but how and to what extent should they be included in the benefit measurement process?

Several techniques have been suggested for their measurement. One of these, known as contingent valuation, calls for securing answers from panels of possible users on the values they would ascribe to various amenities. The answers given may range from zero, or even negative values in the case of the bear, to fictionally high figures that have little relation to what the panelist would actually be willing to pay.

Travel costs, a measure of the amounts people have paid or might be willing to pay in going to particular amenities provides another measurement technique. Benefit transfers, the acceptance of the benefits attributed in other cases, provides another approach. Hedonic pricing in cases in which benefits can be decomposed into parts or characteristics that can be valued separately has also been used particularly in cases of real estate valuation.

Questions of how non-market values should be treated still remain unsettled. Meanwhile, the problem of their valuation has been handled in some cases with the simple assumption that non-market value costs equal non-market value benefits. In some other cases, arbitrary assumptions have been made that non-market valued benefits should be ascribed benefit values equal to some given portion, say 15 percent of a project's cost.

Project costs include the full value of the land, labor, and materials used in developing, maintaining, and operating the project. Associated costs arise with the expenditures of capital and effort needed to secure primary benefits. They include the cost of generating and marketing electric power, the cost of taking water to fields and growing an irrigated crop, the cost of distributing municipal water supplies, and so on. External diseconomies involve the social costs associated with possible negative externalities, such as losses of scenic or environmental values that may result from a project. Secondary costs involve the value of any expenditures needed to produce secondary benefits. If an excess of value of bread or flour above the value of wheat is claimed as a secondary benefit, the cost of transporting and storing the wheat, milling it into flour, operating a bakery, and distributing the bread to customers must be charged as a secondary cost.

Once these calculations are made, any surplus of primary benefits above project and associated costs is called net primary benefits, and any surplus of secondary benefits above secondary costs is called net secondary benefits. The two types of net benefits are treated together in determinations of benefit-cost ratios.

Planning and Formulation of Projects

Realistic planning requires making certain that every approved project meets the test of being physically and biologically possible, economically and technologically feasible, and institutionally acceptable. Water storage projects call for the presence of both adequate water supplies and suitable reservoir sites. Engineering designs and economic calculations are needed to determine their technological and economic feasibility; and political decisions must be made concerning their political, social, and financial acceptability. Early in the project planning and formulation process, serious consideration should be given to the question of whether proposed projects are actually needed and, if it is decided that they are, to determinations of their optimum scale and to ascertaining the most economic means for securing their development.

As a first step, care should always be taken to establish the fact that a need or demand exists for the product or services of the proposed project. If a definite need is found to exist, consideration should be given to the probable benefits and costs associated with projects of varying size. Information of this order is needed for decisions relative to the optimum scale of the proposed developments.

Projects are at optimum size when they produce more net benefits than can be secured at any larger or any smaller scale level. The determination of this scale level can be illustrated by the two diagrams presented in Figure 7–2. Both diagrams show the changing relationship between benefits and costs that occurs as projects increase in size. Point *B* indicates the scale of development that has the highest ratio of benefits to costs. Point *C* represents the scale level that produces the greatest excess of benefits above costs. As the lower diagram indicates, this is the scale level at which the marginal benefits associated with increasing size or scale of project equal the marginal costs; the point at which the ratio between marginal benefits and marginal costs become unity. Points *A* and *D* represent the levels at which total benefits equal total costs and the points at which a unity ratio exits between benefits and costs.

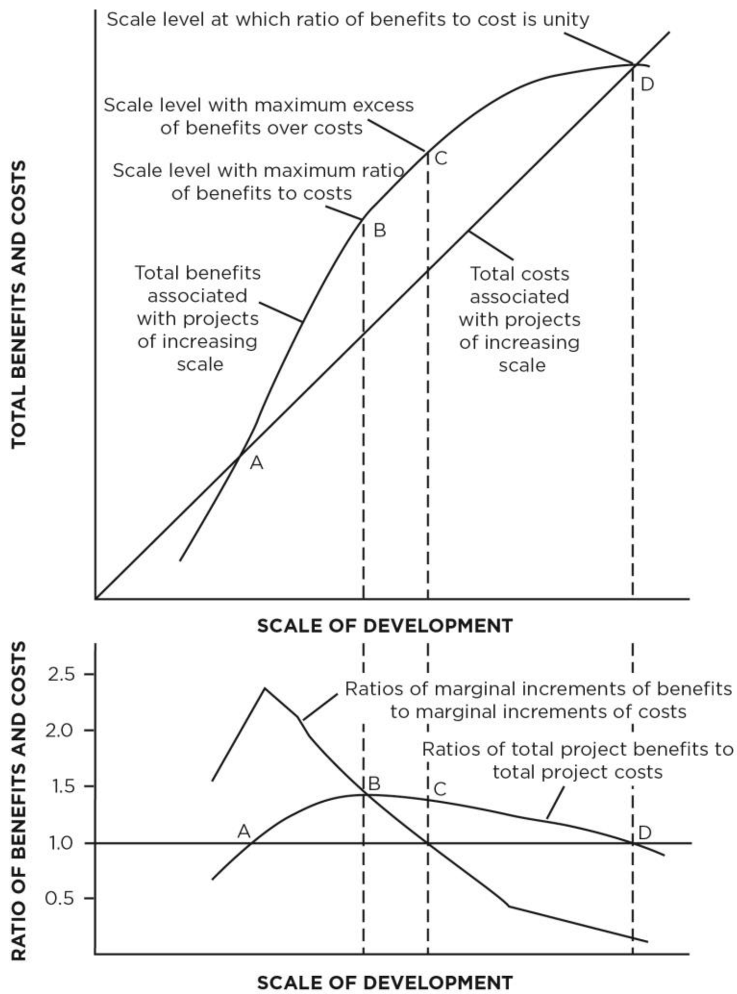


Figure 7–2. A Relationship between Benefits and Costs with Projects Involving Different Scales of Development

Under conditions of perfect competition, the optimum scale for a project is always found at scale level *C*, the level at which the benefits added by the last increments of increased scale just equal its incremental costs. As is the general case with input-output relationships, this situation holds only with an assumption of unlimited resources. With the more realistic assumption of limited development funds, the optimum scale level depends on the location of the point of equi-marginal returns. It thus shifts to some scale level between *B* and *C*, to a point at which the marginal benefit-cost relationships of all the projects being considered for approval at a given time are in balance.

In actual practice, there has been far less comparison of alternative projects and of possible alternative scale designs for single projects than might be considered economically desirable. Projects frequently can be brought into being at only one specific site and it has been engineers working with technological considerations rather than economists dealing with relationships between benefits and costs that have made the decisions as at the appropriate size or scale of projects. As a result, single proposals have usually been presented for benefit-cost consideration. The possibility of using benefit-cost ratios as a determining factor in choosing between alternative projects also has been ignored as Congress has made no use of this technique in its decisions concerning the project proposals it should support.

Once the size of the project has been determined, steps should be taken to make sure that the project and all of its separable parts have their lowest practicable cost. A project is poorly formulated when its objectives or the purposes of some of its separable parts can be attained at less cost by other means or when separable parts do not provide more benefits than costs.

Determinations of Economic Feasibility

As benefit-cost analysis involves current evaluation of the expected flows of benefits that projects will produce in response to current and future cost outlays, care must be exercised in determining realistic estimates of the present value of both the expected benefits and expected costs. Consistent standards have been developed by the U.S. Water Resources Council to guide federal agencies in their analyses. Expected benefits can be counted for periods of up to 100 years. Guidelines have been prepared to standardize the approaches followed in estimating product prices and crop yields, in determining project costs, and in calculating risk allowances and probable salvage values for project items. Discount rates are set by a formula administered by the Water Resources Council. Agencies are also required to base their evaluations on conditions with and without the proposed projects rather than on before and after project assumptions.

Once the appropriate data on benefits and costs have been assembled and analyzed and their estimated totals discounted to provide a measure of their present values, determinations can be made of the economic feasibility of individual projects. Four different approaches can be used to indicate the relative desirability of single projects or permit a ranking of alternative project proposals.

As a first approach, one could subtract the total cost of each project from its benefits and evaluate projects according to their excess of benefits above costs. This approach ($B - C$)

measures the net economic benefit or return but gives no weight to the relative costs incurred in each case. It is unacceptable as a measure of benefit-cost relationships, because it gives the same weight to a $1,000,000 project that costs $999,000, as to an $8,000 project that costs $7,000.

A second approach involves measurement of the rate of net return on the expected total cost outlay. With this procedure, total costs are subtracted from the total benefits and the difference divided by total costs to get a percentage rate of return. This method ($B - C/C$) gives a rate of return on total costs with the project. Comparable answers are secured from a third approach under which the present value of the total expected benefits is divided by the present value of the expected costs (B/C) to provide a ratio of benefits to costs. This is the approach accepted by federal agencies in their benefit-cost analyses.

A fourth possible approach differentiates between project construction and investment costs and the operation and maintenance costs associated with the productive use of the developed project. With this approach, the present annual value of the expected operating costs is subtracted from the present annual value of the expected benefits, and the difference is divided by the annual value of the project investment costs ($B - OC/IC$) to provide a rate of return on project investment costs.

The (B/C) and ($B - OC/IC$) approaches yield comparable answers in many instances, but they can provide conflicting guidelines for the comparative priorities that might be assigned to alternative project proposals. Of the two, the (B/C) approach provides the better guide when emphasis is focused on allocation of limited construction funds and secondary concern is felt for future operation and maintenance costs. The ($B - OC/IC$) approach in turn provides the best measure of rates of return to initial construction costs over time.

Critique of Benefit-Cost Analysis

Several observations both pro and con can be made by way of critique of the benefit-cost approach to project evaluation. On the positive side, it may be argued that some method of project evaluation is definitely needed to guide the allocation of public and private investments, that benefit-cost analysis provides a logical and useful technique for this purpose, that its use over several years demonstrates that it has passed a test of time and that the resulting benefit-cost ratios are easily understood. Proponents of its use sometimes lament the fact that the federal government has limited application primarily to water and other comparable resource developments. They speculate about the values that could be attained if it were applied to enterprises, such as sending human crews to Mars or conducting wars in Vietnam or Iraq.

Critics have argued that the real decisions on whether or not to proceed with projects is a political responsibility; that at best benefit-cost analysis is a system of partial analysis; that the data used in its computations are often inadequate and incomplete with the result that benefits are sometimes understated and in other cases inflated. It is also charged that there has been a lack of consistency in the standards used by different agencies in the past, that the discount rates used with large public projects have been unrealistically low in some cases, and that significant impacts, such as the effects they may have on environmental resources and on prospects for local or regional area economic growth have been ignored.

Positive efforts have been made to tighten up the standards used and remedy many of its past flaws. The system still has its problems though. One of these lies is the fact that projects are evaluated on an individual project basis. Congress requires that project proposals have a positive benefit-cost ratio as a condition of approval. This practice discourages absurd projects, but it falls short of full maximization of investment returns. Projects are eligible for approval as long as they have positive B/C ratios and fall in the range between points A and D in Figure 7–2. Projects with positive overall ratios may also have separable features that cannot be justified on a marginal value productivity basis.

Another problem stems from the frequent disassociation of benefits and costs. The assumption that a project is eligible for funding if it has a positive benefit-cost ratio may be wholly justified if the same party pays the costs as receives the benefits. Complications arise when different parties are involved. Property owners in a small watershed area, for example, may oppose a project that has a positive overall ratio, because most of the benefits will be received by downstream residents while upstream owners are expected to bear much of the cost. Similar questions may arise when the residents of an industrial area are asked to bear the cost of preventing the air pollution that causes acid rain to fall hundreds of miles away or when local groups endorse federal "pork barrel" projects that are expected to provide positive benefits for local communities while the tax costs are spread over the entire nation.

One of the most critical issues associated with benefit-cost analysis centers in the selection of an appropriate interest rate for discounting the value of future benefits and costs back to the present. Significantly higher present values are secured with the use of low discount rates than with high rates. Proponents of public investments are often inclined to favor low rates, such as the yield rate on long-term government bonds, while critics of public investment programs argue for acceptance of the higher interest rates associated with the operation of commercial money markets. There are no absolute guidelines that indicate which choice is correct. Good reasons can be advanced for governments requiring favorable returns on the portion of their expenditures that go for resource investments. At the same time, however, creditable arguments can be advanced for governments using low social discount rates with these investments.

Thus far, benefit-cost analysis has been used primarily for the single purpose of determining the economic eligibility of proposed projects to qualify for Congressional funding. Little effort has been made to use it in assigning priorities to alternative investment opportunities. The final decision concerning project funding is, and probably should continue to be, a political one. Yet, insofar as emphasis is given to economic feasibility arguments, benefit-cost analysis can supply helpful guides to the rational allocation of limited public funds between competing alternative projects and programs.

Cost Effectiveness Analysis

Benefit-cost analysis was adopted during the 1950s as an appropriate process for determining the economic feasibility of land and water resource development projects, and was logically so-named, because the end product was a ratio of benefits to costs. A comparable process called cost-benefit analysis was highlighted in the writings of several economists a decade later for application in the valuation of other public projects. Like benefit-cost analysis, it encountered difficulties in quantifying costs and benefits. An alternative and simpler approach known as cost effectiveness analysis has emerged to take its place in those instances in which the expected benefits have high values that cannot easily be quantified in monetary terms.

When the goal of a project is to save human lives, protect public health, or provide needed research or higher levels of educational attainment, the desirability of project action can be assumed. With cost effectiveness analysis, the problem then becomes one of securing desired results at the least cost. This process involves comparisons of the costs associated with alternative approaches. Any proposed project should also be examined with regard to possible externalities, and if these externalities could be significant, efforts should be made to include them as potential costs or benefits. Cost effectiveness is a worthy complement to benefit-cost analysis in cases in which benefits are exogenously specified, and both could be used to advantage with a wider range of public policies than they now are.

Environmental Impact Assessments

Prior to 1970, environmental quality concerns received only minimal consideration in project evaluations. Recreational values, where they could be quantified, were considered in *B*/*C* analyses, but the impact projects might have on environmental conditions was largely overlooked. This situation changed when Congress passed the National Environmental Protection Act of 1970. This law called for creation of a Council on Environmental Quality, which was to draft regulations for a National Environmental Protection Agency (EPA), oversee its processing, and submit annual reports on the state of the nation's environment. The EPA was established with authority to establish quality standards for the nation's air, water, and land resources. It was also empowered to require the filing of environmental impact statements (EIS) with all federal projects that had discernible effects on the environment.

The filing of an EIS is not seen as a substitute for *B*/*C* or cost effectiveness analyses. Agencies can still be expected to use one of those approaches in seeking economic justification for their project plans. The basic purpose of EIS is that of ensuring complete disclosure of the effects projects could have on the environment and that these effects be considered before project plans are finalized.

A first formal step in the EIS process calls for determination by the developing agency whether a proposed project has environmental significance. Environmental assessments are usually conducted by agencies to guide them in making this determination. With this information, agencies can make a Finding of No Significance Impact, a decision that may be challenged in court. If projects are held to have environmental implications, that fact is published in the Federal Register. The agency then has to draft an environmental impact statement in which it examines all relevant impacts a project may have on the environment. Once drafted, copies of the EIS are circulated among federal, state and local governmental agencies and interested private parties for their review and comments. After its formal review, the agency prepares a final EIS for submission to the EPA, after the acceptance of which the agency can proceed with the proposed project.

About half of the states have enacted environment protection laws of their own for application to state and local public projects and in some cases to private developments. EIS reports are required by many of these laws. Thus far, they have had considerable success in getting federal and state agencies to reorient their thinking to emphasize environmental, as well as economic and other goals in their planning. They have also played an important role in getting agencies and developers to accept environmental assessment as a necessary step in the planning of resource developments.

The establishment of the EPA caught several agencies, such as the Department of Transportation and the Army Corps of Engineers, with numerous projects with which they were ready to start construction. The sudden requirement that they must complete EISs naturally caused problems as it meant that investments of time and money had to await a time-consuming EIS preparation and review process. Time also was needed for the courts to determine the nature and extent of the EPA's authority. These factors help explain why more than a 1,000 suits were filed against the EPA by plaintiffs during the first nine years of its operations. More than 11,000 EISs were filed with the EPA during this same time period. The volume of court challenges has declined significantly since 1980 though cases still occur as one might expect.

Overall, the EPA has rejected relatively few EISs. Examination of this record has caused John Rogers and P. Geoffrey Feiss (*People and the Earth*, 1998) to conclude that the social and political effectiveness of the EIS process can be questioned, because many affected agencies have tended to follow the form rather than the substance of the assessment process and the EPA "has favored economic interests over environmentalists." Though the filing of EISs may not have had as much positive impact on resource developments as some observers hoped, it has succeeded in getting developers to give more consideration to environmental responsibilities than otherwise would have been the case.

Chapter 8: Conservation – The When of Resource Use

"Conservation means the wise use of the earth and its resources for the lasting good of man."

~ Gifford Pinchot

The consideration resource managers give to the concepts of proportionality, maximization of economic returns, receipt of land rents, and minimizing production costs can in many respects be seen as the "how" of resource use. How well they affect the long-term management of different investment enterprises also depends on the decisions operators make concerning the timing of their activities.

With fragile resources, such as a wilderness or an endangered species, the principal goal may be that of protecting and perpetuating the resource base. With the development of water or solar power, the key question may involve choice of the optimum scale of operations and timing, that is choosing when to bring them into operation so that they will yield an optimum return. With farming, forestry, and the use of common properties, the goal may be to maintain productivity and profitable operations over time. With mining, concern may center on whether to start operations now or later, and on determination of an optimum rate of exploitation. With man-made resources, efforts may focus on extending the economic use lives of various developments. Decisions in each of these cases are affected by the relative values operators associate with their expected future flows of net returns and by comparisons of these values with those that could be secured from alternative investment opportunities.

Managers are expected to do what they think best for their enterprises. At the same time, they are expected to give appropriate heed to the ethical and moral considerations associated with the outcomes of their decisions. They live in a society that demands that they show respect for social, as well as economic goals. Accordingly, they find that they must weigh both sets of considerations when they make decisions concerning resource use over time. As a practical matter, they must often choose between practices that promise to maximize immediate returns but can deplete or undermine their future productive potentials and other approaches that emphasize the maintenance and saving of these resources for use over longer time periods.

Which of these approaches should the rational operator follow? What position should society take regarding these policy alternatives? These questions strike at the economic heart of the long-term management and conservation problem and provide the basis for the following discussion of the economics of conservation as it applies to land and other environmental resources.

The Meaning of Conservation

Conservation is a concept of many meanings. Environmentalists often visualize it as a moral issue tied up with man's responsibility to safeguard natural resources for the use of future generations. Technical workers sometimes identify it with the physical techniques they use to retard soil erosion, plant trees, or manage a deer herd. Sportsmen frequently think of it in terms of better fishing and hunting. Politicians often treat it as a political "sacred cow" closely tied to voter interests. Conservation evangelists regard it as a symbol of a better life, as an almost mystical means for securing what Charles R. Van Hise (*The Conservation of Natural Resources in the United States*, 1910) described as "the greatest good to the greatest number and that for the longest time."

Conservation can be defined in different ways. In a dictionary sense, it involves the preservation, guarding, protecting, or keeping of a thing in a safe or entire state. As Richard T. Ely, one of the first economists to write on the subject, noted (*The Foundations of National Prosperity*, 1918) this strict definition calls for *"the preservation in unimpaired efficiency of the resources of the earth, or in a condition so nearly unimpaired as the nature of the case or wise exhaustion will permit."*

The idea of preserving natural resources intact for future use has never gained much popular acceptance and certainly was not what the leaders of the Conservation of early 1900s advocated. To be sure, conservationists stress the need for wise use and for saving certain resources for a future use. But they favor maintenance and saving of natural resources only to the extent to which such a policy is consistent with programs for promoting their effective current use. Because of this rationale, much of the emphasis in conservation discussions is on the need for orderly and efficient resource use, elimination of economic and social waste, and maximization of social net returns over time.

From an economic and social point of view conservation may be defined quite simply as the wise or optimum use of resources over time. Wise use, viewed in an economic and social sense, includes uses that will permit operators and/or society to maximize the values associated with their expected net returns both now and in the future. Viewed in this context, conservation is concerned primarily with choices in the timing of resource use. It deals with public and private decisions regarding the allocation of resources between the present and the future, and with policies and actions that are designed to increase the future usable supplies of particular resources. It involves the when of resource use.

Conservation vs. Preservation

Since the beginning of the Conservation Movement during the early 1900s, conservationists have emphasized two goals in the use of natural resources: 1) They seek the constructive use of resources for beneficial purposes; and 2) seek the elimination of abusive and wasteful practices in their use. Their emphasis has generally been on the constructive use, not the nonuse of resources. Somewhat in contrast, another group, often called preservationists, has emerged with an agenda that calls for retaining particular resources in their existing state through protection from use.

While the two movements often stand in contrast to each other, both accept the thesis that natural resources should be subject to constructive uses to the point at which the economic and social values associated with their use no longer exceed the values associated with their nonuse. The differences between the two reflect subjective determinations of the points at which the values of use exceed or fall below those of nonuse.

With this formulation, conservationists have proceeded with extensive programs for developing land and water resources, for conserving soil, and protecting grazing lands and forests, while recognizing that particular sites or resources for reasons of age, singular and unique characteristics, or historical importance should be reserved from use. In the process of deciding which resources should be saved, it has generally been recognized that, while giant sequoias should be saved, because of their age and size, this rule does not provide protection for every large or old tree. Similarly, while a case can be made for protecting the site of George Washington's principal residence and his major victory, far weaker cases exist for commemorating every place where he ate or slept.

Many of the areas protectionists hope to preserve involve wilderness, unique ecosystems, or remote forested areas for which limited demand exists for development. Wide latitude has been expressed in honoring the protection of these areas. More significant conflicts of interest have arisen in cases, such as those in which protectionists have insisted on protection of stands of mature timber that business operators have argued should be cut both to sustain local industry and to open up areas for forest re-growth, while harvesting timber before its value is lost through fire or decay.

With the expected increase in demand for new developments more conflicts of this nature can be expected to emerge over time. Decisions will be needed as to whether particular building sites, water, forest and other resources should be retained in their current uses or be made available for development for other needed uses.

Classification of Resources

Although people often speak generally of the conservation of natural resources, it is more meaningful to speak of particular classes of resources. This situation exists, because of wide variations in natural resource characteristics. Some have longer use-lives, are more exhaustible, or can be more easily renewed than others. These differences call for a precise classification of resources for conservation purposes that distinguishes between fund resources, such as metals and mineral fuels that are non-renewable and relatively fixed in supply; flow resources, such as sunlight, precipitation, and changing climate, that come in a continuous or predictable flow over time; and certain composite groups of resources that have both fund and flow characteristics.[1]

Biological resources provide the leading example of the composite grouping. They include all forms of plant and animal life and have flow characteristics in that they are replaceable over time, provided care is taken to safeguard the seed stock needed for each new generation. Yet at any given time, they may also be treated as fund resources that could be used in a manner that will greatly reduce or even destroy their potential for future growth or reproduction. Unlike fund and flow resources, the productivity of biological resources may be increased, maintained at a constant level, or decreased as a result of human action.

[1] The definitions for fund and flow resources here differ from those used by Herman E. Daly and some other authors writing in fields associated with ecological economics. The definitions used in this book are consistent with the field of land resource economics.

Soil resources are unique in a sense in that they involve combinations of fund, flow, and biological characteristics. Farmers can exploit or destroy the fund of fertility stored over several centuries in their soils. They may also use their land in ways that draw only on an annual flow of fertility created by the action of plant roots, soil solutions, and organisms in releasing soil nutrients for plant use. They may also carry on soil-building programs (use of legumes, manure, green manure crops, and no-till farming practices) that enhance the action of plant roots and soil microorganisms in building up the productive capacity of soils. Soils lack the life-cycle characteristics of plants and animals. Except for peat soils, which are better treated as fund resources, they are comparable to biological resources in the sense that their productive capacities can be increased or decreased as a result of human action.

Man-made resources fall outside our definition of environmental resources. They frequently have important impacts on local environmental conditions though and fit within the composite conservation class of resources. Buildings and other man-made installations have predictable economic lives and can be treated over time in much the same way as soil resources. With good management and timely repairs, their long-run productivity can be definitely enhanced.

Use of Interest Rates in Conservation Decisions

Conservation decisions call for deliberate choices between the present and future use of resources. In this decision-making process, operators weigh the benefits expected from the holding of resources during given planning periods against the costs of holding them. On the benefit side they consider the expected value of their resources at the end of their planning periods together with the value of any expected flows of land rents they may secure during these periods. Their costs include the present investment value of their resources and any operation, holding, or resource-improvement costs that may arise during their planning periods. Strong cases can be made for adopting conservation practices when expected future values and benefits exceed their present values and expected holding costs. When expected benefits fall below their costs, conservation can usually be written off as economically impracticable.

This balancing of the value of a sum of expected benefits to be received at some future date (or of an expected flow of benefits to be received over a given planning period) and current investment outlays plus expected operating costs is complicated by interest rate considerations.

Operators who make investment commitments must think of interest charges on borrowed capital and of an opportunity cost return on their equity funds. Economic logic requires that they charge compound interest on the value of their fixed investments throughout the weeks, months, or years these investments must be held before the operators receive sufficient returns to recoup their costs. They can also be expected to place a higher value on the present possession or receipt of a given income than on promises of comparable income in the future. Operators accordingly find it logical to consider and compare the discounted present values of expected future returns and the discounted present values of expected costs when they make long-term investment decisions.

Most people are quite familiar with the workings of compound interest and of the increasing values one can expect if a given investment in a savings account is allowed to accumulate at compound interest without withdrawals for a period of several years. They see the need for charging interest on capital borrowed to pay for initial investments (buying land, constructing necessary buildings and improvements, and planting trees) and for operating costs incurred before a project starts to pay off. They also recognize that operators have a justifiable claim for an interest rate return on equity funds that otherwise could be earning a return in some alternative use. The concept of discounting, or of applying a discount rate to determine the present value of an expected future return, is equally valid but less understood.

Discount rates vary over a wide range. If an operator applies a discount rate of only two percent, an expected income of $10,000 50 years hence has a current value of $3,715. As Table 8–1 indicates, the same future income would have a current value of only $543 if discounted at six percent. The choice of the interest rate used in these calculations is a matter of strategic consequence in long-term investment decisions. As Lewis C. Gray ("The Economic Possibilities of Conservation, *Quarterly Journal of Economics*, 1913) noted *‘‘The primary problem of conservation . . . is the determination of the proper rate of discount on the future with respect to the utilization of our natural resources.’’*

Table 8–1. Present Value of an Income of $1,000 at Varying Numbers of Years in the Future When Discounted at Selected Rates of Interest

Discount Interest Rate	$1,000 in Income at the End of . . .			
	30 Years	40 Years	50 Years	80 Years
None	$1,000.00	$1,000.00	$1,000.00	$1,000.00
1 percent	$741.92	$671.65	$608.04	$451.12
2 percent	$552.07	$452.89	$371.53	$205.11
3 percent	$411.97	$306.56	$228.11	$93.98
4 percent	$308.32	$208.29	$140.71	$43.38
5 percent	$231.38	$142.05	$87.20	$20.18
6 percent	$174.11	$97.42	$54.29	$9.45

Source: Dr. Raleigh Barlowe, Michigan State University, 2012.

Under the conditions of perfect competition, operators are expected to use the interest rates prevailing in the current money market in discounting their expected future values and in compounding their cost outlays. Operators could thus be expected to use a six percent rate if this were the current market rate of interest. They would shift to a three percent rate (more favorable to conservation) or to a nine percent rate (definitely less favorable to conservation) if the going market rates shifted to either of these levels.

This assumption concerning operator acceptance of market-dictated discount and compound interest rates breaks down in practice. Factors, such as imperfect competition, lack of perfect knowledge and foresight, different institutional settings, capital rationing, ethical adherence to conservation objectives, and differences in operator goals have brought acceptance of a wide range of interest rates in conservation decisions. Some operators accept the going market rate, often with upward adjustments for the relative uncertainty of expected future incomes, in their calculations. Some use higher or lower rates. Still others act on the basis of hunches and subconsciously determined interest rates, which may be high or low depending on the operator's inclinations at the present moment.

The discount rates operators use in their conservation decisions ordinarily depend upon two important factors 1) the operator's time-preference rate, and 2) adjustments made for uncertainties. Of the two, <u>time-preference</u>—the relative weight one gives to the receipt of a given quantity of income or satisfactions at some future date as compared with receipt of the same quantities at the present time—is shown in Table 8–1. The present value of an income of $1,000 at varying numbers of years in the future when discounted at selected rates of interest is usually most important. Some people place high emphasis on enjoying the current use of their available resources—on a philosophy of "eat, drink, and be merry for tomorrow we die." Others may go to the opposite extreme in following a miserly policy of setting aside all of their income and resources above that needed for subsistence living as savings for a future rainy day that may never come.

Individual time-preference rates vary widely between these two extremes. They vary from person to person and from day to day for some operators, depending on the operator's immediate need for income, desire to put something aside for old age or one's heirs, pursuing a conservation "stewardship of the land" philosophy, and a general feeling of optimism or pessimism at the moment. Individuals may apply different rates over long planning periods as compared with short periods. They may use one rate in compounding the interest charged on current investment outlays and quite a different rate in determining the present values of expected future incomes. They may also shift from use of high discount rates while they are establishing their economic status to use of much lower rates once they feel financially secure.

The Social Time-Preference Rate

Many economists argue that the discount rates that governments and society use in calculations of the feasibility of long-term resource investments should correspond with those that apply with individuals. This means that there should be no distinction between individual and social time-preference rates. It may be noted, however, that the assumptions underlying the rates accepted in financial market places differ significantly from those that apply to society. Moreover, as Barry C. Field (*Natural Resource Economics*, p. 79, 2000) has noted, there is some evidence that the size of the discount rates people apply is inversely related to the length of the time periods they expect to wait.

Very few private business transactions concerning expected future incomes involve planning periods of more than 20 to 30 years. With them it is logical that operators be motivated by their human impatience in waiting for income and their uncertainty as to how long they will be alive. A different situation exists with social investments. Society can be expected to go on for thousands of years. It has no limited life span, and this factor deserves consideration when public investments are made in natural resource developments. As Steven C. Hackett (*Environmental* *and Natural Resource Economics*, p. 241, 1998) has observed, choice of the rate of time preference one accepts is a matter of "value judgment, and at the societal level there is no good ethical argument for using a pure rate of time preference other than zero."

Recognition of this difference between individuals and society has prompted several people to advocate acceptance of lower social time-preference rates than those accepted in the business marketplace. With this rationale, some operators, most particularly those who espouse a stewardship of the land philosophy, are often willing to accept social discount rates that are little above zero.

The case for accepting low time-preference rates rests on ethical rather than economic considerations. The stewardship concept has its beginnings in ethical and religious thought. Numerous operators accept interest rates, because they must in our commercial-oriented society. But many who do feel a basic uneasiness about this acceptance that goes back to their ethical desire to do what they regard as "the right thing." In this respect, it should be remembered that even though usury has been practiced since ancient times, payments of interest for the use of borrowed money was not accepted in the Western world as a justified practice until the beginnings of the Modern Age. It was condemned as unethical in the Christian world during the Middle Ages, as it still is in Muslim countries, and among the followers of Karl Marx.

Intergenerational Equity

Closely related to social time-preference rates is the matter of intergenerational equity. The stewardship philosophy holds that where possible we should pass the earth's natural resource base on to future generations with as much or more productive capacity as it had when we received it. This raises the question of how much do we really owe to future generations? Do we have a moral and ethical obligation to save resources from exploitation in their interests or should we give first attention to satisfying our desires and leave it to them to deal with the world as they find it?

Answers to this question vary from the opinion once expressed by a U.S. Senator on the floor of Congress that, "Future generations have done nothing for me and I do not favor doing much for them," to the view expressed in several cultures that roughly states, "The land is not ours; we have merely borrowed it from our children." Most of us feel that mankind bears a burden of responsibility to safeguard the interests of future generations, but we lack absolute standards that might indicate the limits of this duty. Some economists have developed theoretical models to provide answers, but real answers still remain elusive. Julian Simon and Herman Kahn (*The Resourceful Earth*, 1984) have argued that technological advances will enable future generations to enjoy levels of opulence not available to us and that we can, therefore, put questions of intergenerational equity aside. They could be right as we indeed do enjoy more access to the fruits of technology than did our fathers. Still, a great majority of us feel that our responsibilities to future generations should be taken seriously and not be left to chance.

Optimum Use of Resources over Time

The question of what constitutes conservation and the optimum or wise use of resources over time differs with the type of resource being considered. Conservation of fund resources calls for spreading the use of the relatively fixed supplies of these resources over extended time periods. A different situation exists with flow resources. Except for the storage of resources, such as water, there is no practical way to save these resources for future use. Good conservation practices call instead for elimination of the economic and social waste that comes with the nonuse of these resources and for their maximum practicable economic use under existing conditions. Wise use of biological and soil resources in turn calls for practices that yield the highest possible net return throughout one's planning period while maintaining, and if possible improving, their expected productive capacity.

Complications frequently affect decisions concerning the optimum rate and timing of the uses made of different classes of natural resources. Some of these are caused by the limited duration of operator planning periods, some because of their choice of interest rates, and some because of difficulties encountered in estimating expected costs and returns. Major problems also stem from the two-stage nature of conservation decisions: 1) the initial choices between developing a resource now or holding it for future development; and 2) determination now or later of the optimum timing of one's resource use activities.

Factors, such as expectations of sizable economic and social gains, high time-preference rates, high resource-holding costs, and uncertainties regarding future supply, demand, and price conditions, often favor the early development and use of resources. Other factors, such as operator inertia, lack of financial backing, insufficient market demand for the product, or expectations of higher future market prices or technological improvements, can have an opposite effect in favoring postponement of possible improvements. Decisions to utilize a resource now or to postpone its use until a future date call for an economic weighing of the values associated with immediate use as compared with the anticipated values expected with postponed use.

Fund resources are often saved and flow resources are lost or wasted simply because resource owners choose a policy of nonuse. Some owners follow nonuse policies, because of their social outlook, and their desire to hold certain resources for future use. Some maintain reserves for future business operations. Some speculate by holding resources in the hope that they can realize significantly higher returns by postponing their development to a later date. Others hold back, because they doubt that their contemplated developments will pay off.

A second-stage decision is made when operators decide to go ahead with the development of their resources. At this point planning decisions must be made concerning their optimum rate and timing of use. These decisions are geared to expectations concerning future costs and returns and the possible impacts interest rate considerations can have in dictating the optimum time periods over which operators should plan their activities. The resulting rationale can best be illustrated with examples involving the various classes of natural resources.

Flow Resources

Operators who visualize current opportunities for the successful and profitable use of flow resources have a definite incentive to proceed with the early development of their plans. Examples include the possible use of oceans and streams for commercial navigation, construction of hydroelectric and solar power facilities, and recreational and resort developments at sites that boast climatic attractions.

As long as a market demand exists for the product or service visualized, and the cost of providing the product or service is below its expected selling price, the development is economically feasible. Projects may be postponed for various reasons; but unless the delay is prompted by valid economic expectations of lower development costs in the near future or an emerging surge in market demand that will justify projects of larger scale than are now feasible, postponement ordinarily involves a loss of land rents and profits that could otherwise be realized.

Fund Resources

Developments that call for the exploitation, extraction, or mining of fund resources require a different rationale. Operators who utilize deposits of oil, coal, or iron ore, for example, must recognize the fixed and non-replaceable nature of their resources. They seldom have specific information concerning the exact quantities of their deposits, and they lack technical ability to extract and utilize all of the resources they control. They know, however, that once the resource is removed from the earth, it is no longer there and the supply will not be replenished.

Once they decide to proceed with a mining operation, operators could wish for the immediate recovery and sale of their entire supply of mineral deposits. This, of course, is not possible. Drilling and mining operations require installations and equipment, and time is needed for capturing and removing the resource. Operators with several oil wells, mining shafts, or units of mining equipment can exploit a given deposit of fund resources in far less time than if they operate with fewer mining units. The scale of operations thus bears an inverse relationship to conservation. Large-scale operations facilitate early and rapid exploitation, whereas smaller-scale operations are more conservation-oriented in that they spread the exploitation process over a longer time period. Optimum timing from an economic point of view requires choice of the scale of operations that can provide the highest present value of expected excess of future returns above operating costs.

The rationale associated with the optimum timing of the exploitation of a deposit of fund resource can be illustrated with the example of the quarrying of a large surface deposit of limestone assumed in Figure 8–1. Surveys indicate that the deposit contains three million tons of stone and that it can be mined at an average cost of $4 per ton. The mining operation can be handled by units of quarrying equipment, which are capable of handling 100 tons per day or 30,000 tons a year at an initial investment cost of $240,000 each. The quarrying equipment units have an assumed economic life of 15 years and limited salvage value if used for shorter periods. The operation also calls for an overhead investment outlay of $1 million for an office building and office equipment.

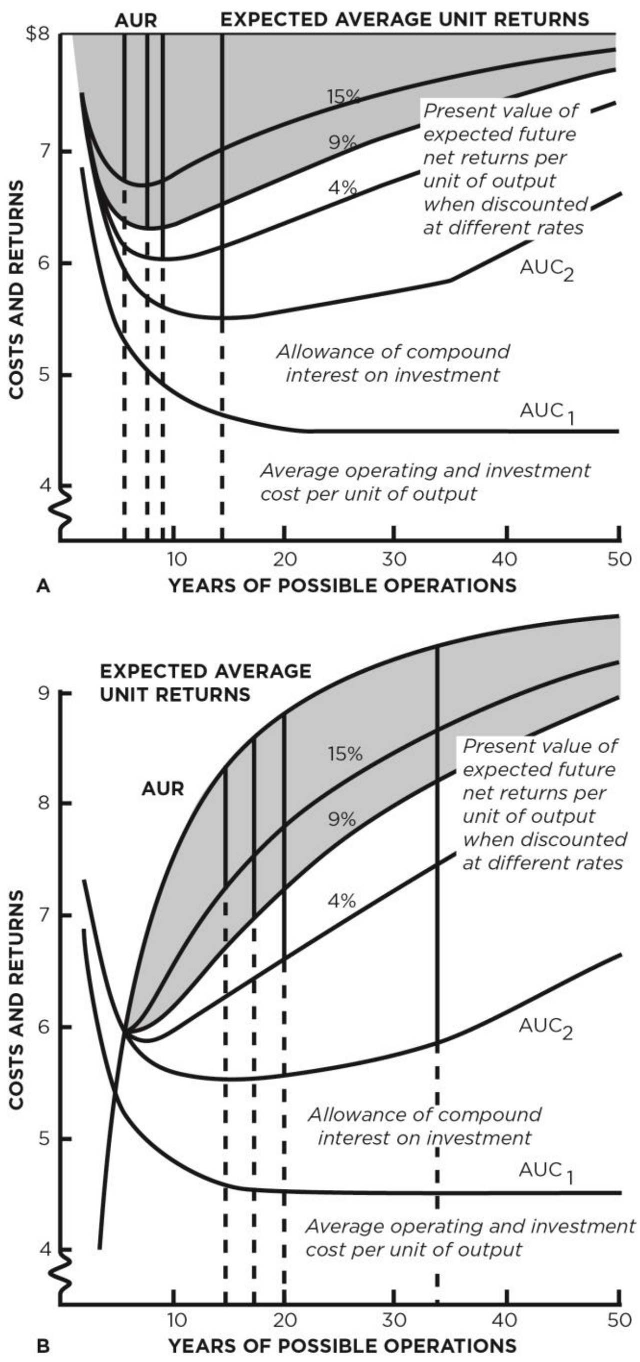


Figure 8–1. Use of Planning Models that Assume Expected Average Rates of Returns, Average Costs, and the Discounting to Their Present Values of Expected Average Net Returns per Unit of Output for Operations Scheduled over Alternative Time Periods to Indicate Optimum Duration of Extractive Production Periods

With these assumptions, the operator can choose between several rates and scales. Fifty quarrying units could be used to mine the entire deposit in a two-year period. Twenty units could be used for five years of operations, 10 for 10 years, and five for 20 years, and three for 33.3 years. As the diagram shown in Figure 8–1A indicates, the operator's lowest average unit costs (AUC1) could come with the use of only three quarrying equipment units over a 33.3 year period.

Most operators, however, would want a compound interest return on their initial investment outlay for the simple reason that this amount would be an operating cost if they operated with borrowed money. When compound interest is charged at an eight percent rate, the operator's lowest average unit cost (AUC2) requires use of seven quarrying units over a 14.3-year period. If the expected net return is then discounted at 10 percent, the optimum, operating arrangement will call for the use of nine quarrying units over an eight- to nine-year period.

The operator may feel that the assumption of a uniform average unit return is unrealistic; that dumping all or most of the limestone on the market within a short time period would depress average prices, and higher returns could be realized by marketing the product at a slower rate. With an assumption of a sliding scale of market prices starting at $10 a ton if only 30,000 tons are marketed annually and dropping three percent for each additional 30,000 tons offered for sale (Figure 8–1B) the highest average net return per unit of product marketed comes when operations are planned for 33.3-year period of operations. When compound interest is charged on the operator's fixed investment outlay and net economic returns are discounted at 10 percent the optimum scale calls for the use of seven quarrying units over a 14.3-year planning period.

Planning models, such as that assumed in Figure 8–1 can provide a helpful guide for operator decisions. They are never more accurate though than the assumptions on which they are based. Successful operators must always be ready to adjust to changing conditions and adjustments are needed whenever new or better planning data become available. When market prices increase or operating costs decrease, managers may extend their production periods and try to recover coal or ore that would otherwise would be too costly to mine. An increase in prices or drop in operating costs on the other hand could prompt decisions to cut back or even abandon further operations.

Biological Resources

Conservation and optimum use of biological resources calls for managerial practices that maximize the current values of one's net returns over time while maintaining or improving their potential for future production. The practices used to attain these ends vary with different resources. Some operators plant crops that mature in the space of a few months. Others deal with resources (grass, livestock, fish, and wildlife) that have life cycles that run for several months or years; and some work with resources, such as forests that have life spans covering several decades.

Some operators are concerned with the flows of products and services secured from resources, such as honey bees, draft animals, orchards, or scenery. Others deal with products (crops, forests, or meat animals) that involve the eventual taking of the resource itself. Some managerial practices call for complete harvesting of the resources found in given areas (field crops and rotation cutting of forests). Others maintain herds and forests with animals and trees of mixed ages from which selected animals are sold or trees cut while other young stock is always coming along.

A major concern in the management and conservation of biological resources centers in the optimum timing of harvest operations. Operators have little choice concerning the best time to harvest some resources. A wheat crop, for example, must be harvested when it is ripe. As Figure 8–2 indicates, the crop has little value before the grain is ready for harvest; it can be harvested to advantage only during a limited time period; and it loses most of its commercial value if it is not harvested during this period.

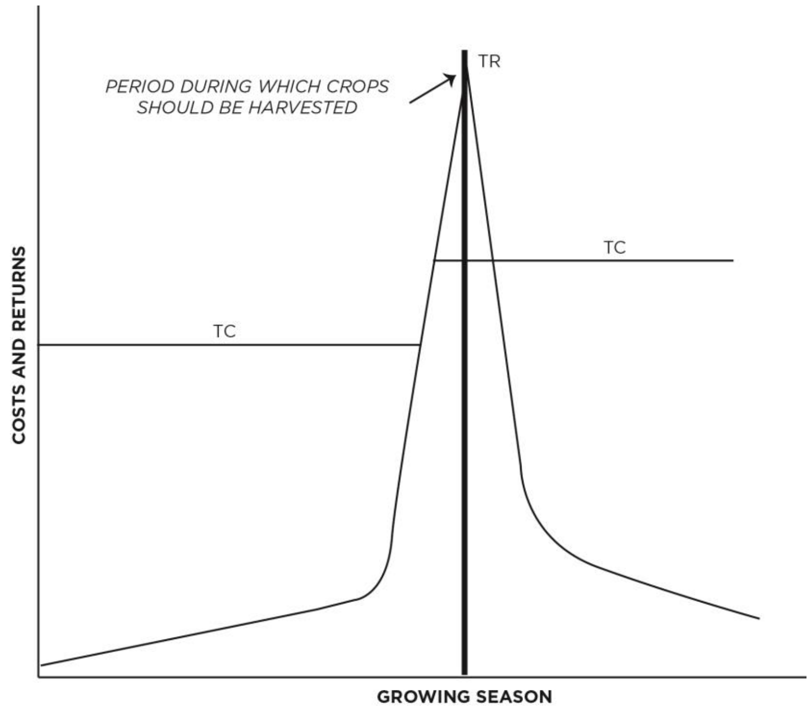


Figure 8–2. Typical Total Value Product and Total Factor Cost Relationships with a Crop, such as Wheat

A wider choice of timing is available with meat animals and forests. These resources can be harvested early, or they can be stored "on the hoof" or "on the stump" for later use. Thus a rancher may choose between selling cattle as veal, baby beef, or mature beef, and a forester between holding trees for sale as Christmas trees, posts, pulp logs, or sawlogs. Both operators will find it to their economic advantage to harvest their products before they reach a point of maximum growth and before they suffer from decadence or decay.

Optimum timing of harvest operations is a matter of economic arithmetic and may be illustrated with a planning model for a forestry enterprise, such as that depicted in Figure 8–3. This example assumes that an operator starts with a tract of essentially bare land that has been acquired and afforested at an initial cost of $100,000. Annual cost outlays for taxes and management are $1,000. The forest has little commercial value for the first 20 years. Thereafter, its value increases steadily until it reaches its highest economic value of $855,000 in its 70th year. This expected increase in total value product is shown by the two TVP curves in Figure 8–3.

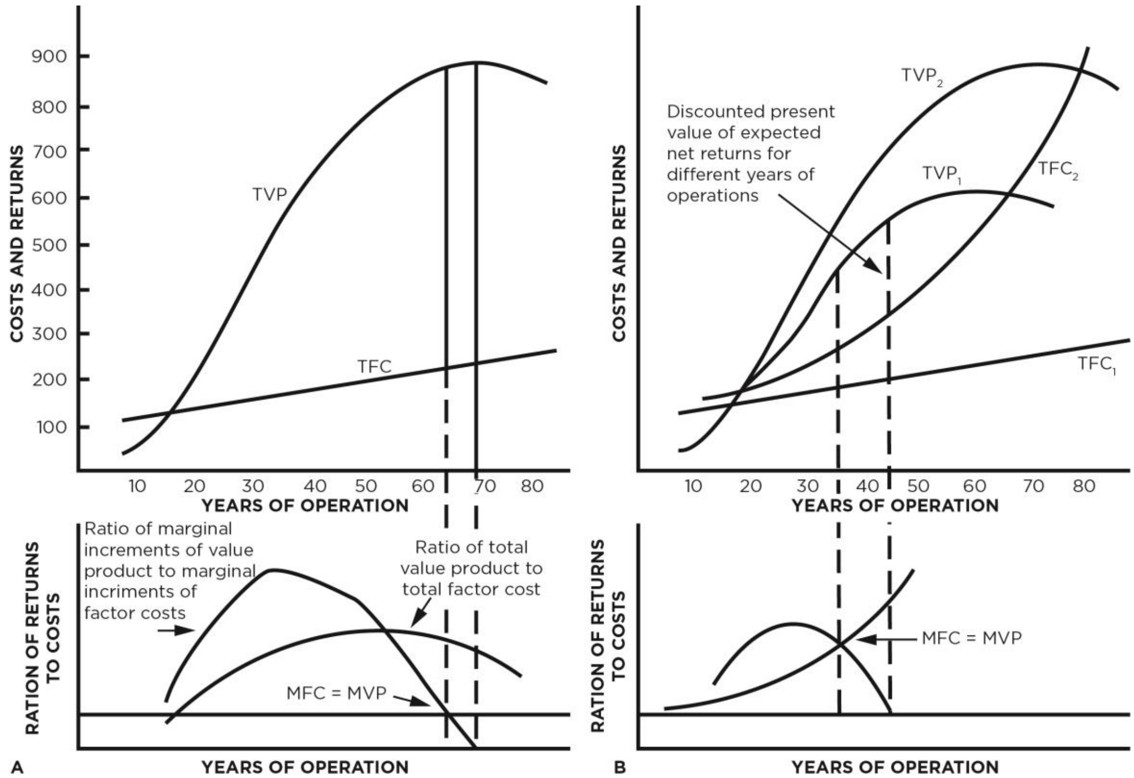


Figure 8–3. Use of Planning Models that Assume Rates of Total Value Appreciation, Total Cost Outlays, and Discounting of Expected Future Net Returns to Their Current Values to Determine Optimum Time of Harvesting for a Forest of Uniform Age

If the operator's cost calculations are limited to actual cash outlays for initial investment, plus annual management and taxes, the costs can be represented by the total factor cost curve (*TFC*) shown in Figure 8–3A. Maximization of net returns then calls for harvesting the forest in its 65^{th} year, that being the year in which the additional annual cost of holding the forest, its *MFC*, equals its *MVP*, the now declining annual value of net returns. This is the time of optimum spread between the *TFC* and *TVP* curves.

Discounting the expected value of the net returns as in Figure 8–3B shortens the optimum period of operations. The highest point on the TVP^2 curve now comes at around 55 years when a low rate of compound interest is charged on the accumulating operation costs (the TFC^2 curve), and the optimum time for harvesting drops back to around 35 years.

With situations, such as those assumed in Figure 8–3, questions can be raised as to why anyone invests in long-term forestry when more promising alternative investment opportunities are available. The simple truth is that few commercial operators start with isolated investments in raw land that they plant to trees and hold over long periods for eventual harvest. Many of those who have operated in this way have benefited from monetary inflation—their major investments were made when cost and interest rates were lower, and their harvested timber has had a higher value than they could have expected earlier. Others have received much of their compensation in the form of recreation or in the pleasure of working with nature and seeing otherwise underutilized areas of land shift into production.

A somewhat different rationale applies with commercial operations that involve the management of forests on either a selective-cutting or a rotation-cutting basis. Operators who periodically harvest mature, malformed, and diseased trees in their forests, while leaving young stock for continued growth, follow a pattern, such as that depicted in Figure 8–4A. With each cutting, the market value of the remaining forest declines and then gradually rises again as the time for the next selective cutting approaches. The operator's holding costs also rise; but by paying off all accumulated costs to date out of the proceeds of the timber harvested with each cutting, operators can realize a profit and not be as much concerned with the discounting of expected net returns as they would be if their calculations were tied to the life span of each individual tree.

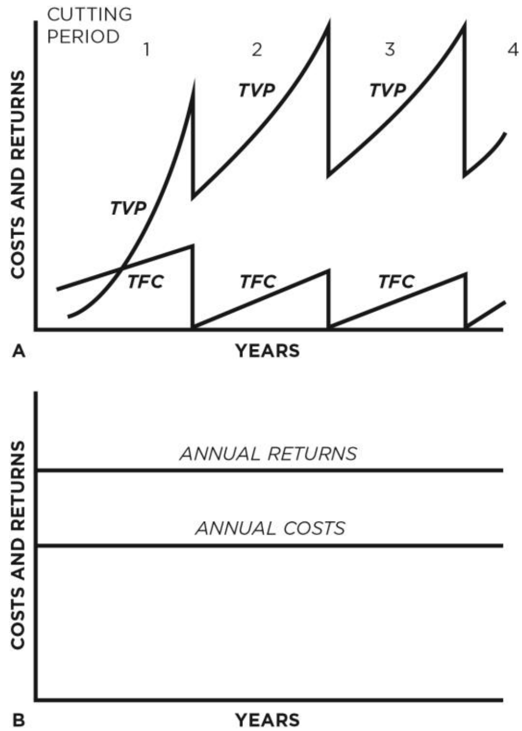


Figure 8–4. Interaction of Total Value Product and Total Factor Cost Considerations with Typical Selective Forest-Cutting and Rotation-Cutting Operations

A similar situation applies with operators who work with long-term cutting cycles. These operators normally control large forest acreages, which they manage as single-aged stands. To keep their crews and facilities operating, they plan to harvest one or more tracts each year and then move onto other tracts in succeeding years and eventually repeat the cycle. Meanwhile, the cutover areas are reseeded and managed so that they will be ready for harvest when the next cutting cycle begins. These operators follow the pattern suggested by Figure 8–4B, a planning model comparable to that used by farmers who grow crops for annual harvest.

Open-Access-for-Use Resources

The open-access-for-use resources that make up "the commons" pose unique problems for resource management and conservation. They include such varied examples as air, water in streams and lakes, oceans along with their fisheries, mineral deposits, public grazing areas, fish and wildlife resources, wilderness areas, public parks and recreation areas, and the radio spectrum. Some of these are flow resources, others are fund or biological resources. The characteristic that binds them together as a group is the fact that they are, or within recent time periods have been, treated as free goods that individuals could use at will.

With pure examples of the commons, every operator enjoys a right of access and use; no one can exercise proprietary ownership rights by excluding others from the right to use; no operator can lose rights through nonuse; and no one can benefit from transfers of previous exercised rights to others. In an ultimate sense, as Garrett Hardin indicated in his essay "The Tragedy of the Commons," all of the vast stock of the world's environmental resources can be viewed as resources that were given to mankind as parts of the commons. Rules have been developed to permit and govern the hopefully efficient private use of some of these resources; but increasing demands for their use by their present or additional users can lead to over-usage that will lessen and even destroy the value of the resource base for all users.

With operators exercising equal rights of access and use, conservation problems arise with the commons resources, because of their basic inability to support unlimited amounts of usage. Fragile resources, such as a wilderness can support only limited use efforts before they lose their wilderness characteristics. Overuse can easily bring the depletion of ocean fisheries, game hunting, and grazing resources. By exceeding carrying capacities, overuse and inappropriate uses can also destroy important values we associate with the radio spectrum, park and recreation areas, and air and water resources.

The conservation problem with commons resources can be illustrated with the example of free grazing on public lands, a situation that existed in the United States prior to 1934. Volume of grazing effort is shown on the base axis of Figure 8–5, and costs and returns are shown on vertical axis. Operator costs rise steadily as larger numbers of animals are grazed. The value of the sustainable yield of the range steadily rises until a point of maximum carrying capacity is reached. Usage beyond this point results in reduced carrying capacity and a reduction in total value product. Wise administration accordingly calls for limiting the grazing effort to the number of units that bring the maximum spread between total value of sustainable yield and total cost or to the point at which the declining ratio of marginal benefits to marginal costs drops to unity.

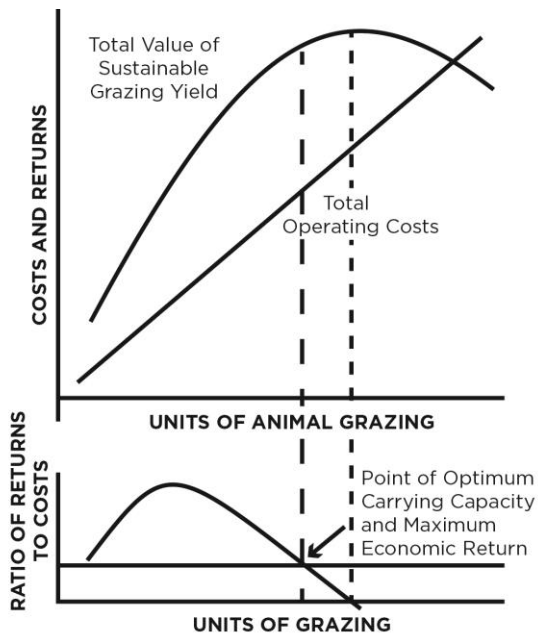


Figure 8–5. Determination of Optimum Level of Grazing in an Open-Access-to-Use Grazing Area

Without regulations that provide economic order by limiting the units of grazing effort to the carrying capacity of the range, problems involving disassociation of benefits and costs can arise. Individual ranchers find it personally advantageous to increase the size of their herds to gain larger shares of the available grazing resource. Those who operate from nearby headquarters or who benefit from better transportation facilities, superior livestock, or other technological advantages can enjoy higher benefits than others. Yet no one enjoys true security of their grazing expectations. No one has an economic incentive to improve or conserve the range. New graziers can invade the range used by others at any time. Feuding is common between graziers. Overgrazing leads to depletion of the range and a consequent reduction of its carrying capacity, and a dry summer or severe winter can bring death for many animals.

Analyses of this same order can be applied to the problems that arise with ocean fisheries, recreation and wilderness areas, the radio spectrum and other commons resources. In every case rules prescribed by governments or by collective private action are needed to specify conditions of entry for use of the resource and to prescribe how, when and where individual operators can use them. It is only by adherence to rules of this nature that the carrying capacity of commons resources can be conserved for optimum present and future use.

In recent years, the work of Elinor Ostrom (2009 Nobel Prize recipient in economics) and others has explored multiple ways humans can successfully manage the commons. They have advanced alternatives to the concepts of privatization or regulation by governmental agencies and shown that, given the opportunity, human beings living closest to the resource can often manage it best by working collectively.

Soil Resources

With proper management, most soils can be used and still retain their productive capacities over long periods of time. Their conservation does not require the saving of every particle of soil. New soil resources are formed every year; and although wide differences exist in soil loss tolerance levels, many soil conservationists agree that soils can retain their productive capacity if steps are taken to prevent their depletion and to limit average soil losses from erosion to maximum rates of four tons per acre per year. Others, however, stress the fact that the soils lost most often involve valuable humus that should, if possible, be retained to maintain soil quality.

People can quibble over the precise meaning of soil conservation. For our purposes, one can think of it as involving a system of managing soil resources that prevents diminution of their future capacity for production. With this simple definition, conservation is mostly a matter of good land use and management. Operators can usually choose from a variety of managerial practices. In so doing, they ordinarily try to maximize their returns and satisfactions both now and throughout their planning periods. Insofar as they understand the consequences of their actions, they consider the costs and returns expected with different practices, their distribution throughout their expected operating periods, and the effects of these practices on the productive value of their soil resource base.

Whether operators accept and use soil conservation practices depends on their understanding of the soil conservation problem; the urgency of their conservation needs, their calculations regarding the effects of proposed conservation programs on their income expectations both now and in the foreseeable future, their capital positions, their time-preference rates, and their general willingness to accept a conservation philosophy. Some of the major problems that arise in this regard are illustrated by the four problems situations depicted in Figure 8–6.

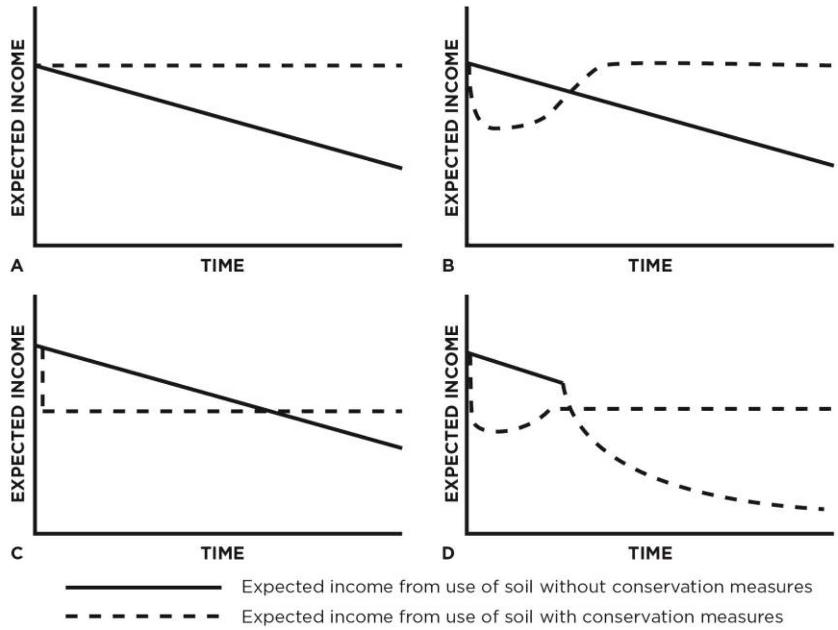


Figure 8–6. Use of Projection Curves Showing Incomes Expected from the Use of Soil Resources over a Period of Years with and without Conservation Measures to Illustrate Four Type-Situations Frequently Encountered in Conservation Decisions

Figure 8–6A pictures a situation in which operators can expect a gradual but steady decease in production and income from their soil resources. They can remedy this situation and stabilize expected crop yields and income by adopting conservation practices. Possible examples include applications of lime and fertilizers and adoption of strip-cropping or summer-fallowing practices. With these conditions, operators who are aware of their opportunities will shift to conservation practices with little prompting, while educational programs may be needed to acquaint the uninformed with their opportunities. Both groups can realize returns from their conservation investments almost immediately, and reluctance to adopt these practices may be regarded as a mark of poor or uninformed management.

A more perplexing situation arises with Figure 8–6B. With this example, operators who would use conservation practices to stabilize the income-producing capacity of their soil must first accept a period of reduced income while they invest in conservation practices or shift to a cropping system that emphasizes use of soil-building rather than soil-depleting crops. They may sacrifice income from cash crops while they use fields to grow crops that will be plowed under as green manure. They may give up income that would be available for other uses to build terraces and check dams or to provide better drainage conditions. They may also shift from primary dependence on row crops to the use of a forage crop and pasture program—a shift that often brings a period of reduced income, while they build up livestock enterprises capable of replacing income that could have been secured from sales of cash crops.

With Figure 8–6B, the big question centers on the operator's willingness to forego income in the immediate future in order to maximize expected returns over a longer future time period. The case for adopting conservation practices is not as clear cut as in Figure 8–6A. The line of action operators will pursue will reflect the duration of their planning periods, their current need for income, and their ability to secure credit to tide them over until the expected period of higher returns arrives.

An additional complication is introduced in Figure 8–6C. This example assumes that operators have small prospects for restoring the production capacity of their soil to levels that will maintain their present incomes. Long-run sustained use of the soil resources now calls for a permanent shift from soil-depleting crops to forage crops, grass, or trees. By delaying a shift to these uses, operators can enjoy higher annual returns for a few years. Delaying the needed shift, however, will lead to continued losses of top soil from sheet erosion. This would reduce the productive capacity of their soil for alternative uses and spell a prospect for greatly reduced net returns in the future.

Operators in Figure 8–6C may be reluctant to shift to a lower income-producing alternative for understandable reasons. Their willingness to shift, however, might be heightened if they face a situation, such as that pictured in Figure 8–6D. Operators in this case are aware of the declining productivity of their soil and also of the fact that sheet erosion has now taken all but a few inches of topsoil or that gullies are threatening to ruin their most productive fields. They recognize that they are fast approaching a critical danger point after which their soil resources will be so depleted as to be almost worthless for their present uses. With this prospect, they may be quite willing to employ conservation measures (terraces, check dams, or sodded waterways) and shift their fields to a lower use, because that may be the only practicable way for keeping them in productive use.

Discounting the value of expected future returns also has its impact on operator decisions on whether to accept soil conservation practices. Figure 8–7 provides an illustration of this situation. The operator in this case has a soil resource that currently provides a net return of \$20,000 a year. Accepting the assumptions of Figure 8–6A, the operator must anticipate the decreasing economic returns depicted by ERN_1 if no effort is made to shift to a soil conservation program. The operator understands, however, that the economic return level can be stabilized at the \$20,000 a year level if provisions are made for a substantial investment in soil conservation practices (the dip at the beginning of the ERC_1 line) during the next five years. With this situation and no discounting, the operator will need a planning period that extends long enough beyond the initial conservation practice investment period for the surplus of ERC_1 over ERN_1 to compensate for the cost of shifting to the conservation program.

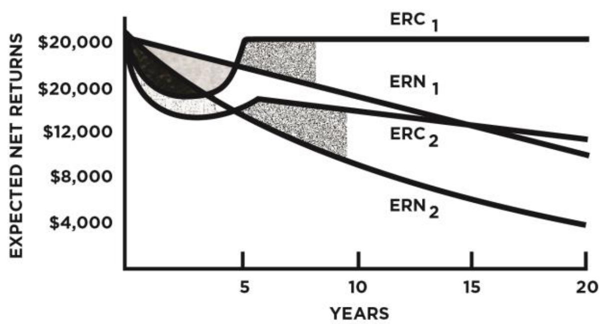


Figure 8–7. Illustration of the Effects Discounting of Values of Expected Future Returns Can Have on Operator Decisions to Choose between Use and Nonuse of Soil Conservation Measures

Should the operator discount the expected net returns (ERC_2) by six percent and the expected returns with no conservation (ERN_2) by five percent, the higher discount rate, including an allowance for uncertainty, it will take a planning period extending at least seven years beyond the investment period for the surplus of ERC_2 over ERN_2 to compensate for the five years of investment. Discounting has its impact here both in reducing the operator's calculation of expected net returns and also in influencing the duration of the planning periods needed to make conservation investments pay for their cost.

Some Conservation Issues

The discussion of conservation to this point has dealt with economic and social considerations that affect conservation decisions. Supplemental emphasis should be given to three additional matters: 1) The question of whether conservation pays; 2) the nature of society's interest in conservation; and 3) problems in overcoming obstacles to conservation.

Does Conservation Pay?

One of the first questions practical business operators ask concerning conservation is, “Does it pay?” As citizens, they approve of conservation in principle and endorse its objectives. As business operators though they are profit-conscious and have little interest in accepting practices that will not have short- or medium-term positive effects on their financial balance sheets. Managers of the environment must face this problem, and while they supposedly take a long-range view of resource use and are usually predisposed toward endorsement of conservation practices, they too must ask if its promise of returns justifies its costs.

Experience shows that conservation measures can and frequently do pay off, particularly when they represent economically sound uses of resources over time. There are instances though in which expected benefits are small or nonexistent. Over time benefits that have previously gone unrecognized may become apparent and measureable as in the case carbon sequestration and its relationship to global warming. Whether a conservation program will prove profitable depends primarily on its costs, the volume of expected benefits, the time periods that elapse before the benefits are realized, and the interest rates used in their valuation. Beyond these items, the question of whether conservation really pays depends on a miscellany of factors. Important among them are choice of discount rates, duration of one's planning period, the association of costs with benefits, investment and disinvestment considerations, choices between alternative conservation measures, and the effects conservation programs have on other resources.

Choice of Discount Rates

Operators who have low personal time-preference rates and who are willing to use low discount rates in valuing expected future returns often reap major satisfactions from investments that others with high-time preference rates and high discount rates would reject as uneconomic. No absolute standard exists for determining the discount rate one should use. One's choice is very much a personal matter with the result that the rates people use apply over a wide range. It is often argued that we should look to the prevailing rates accepted in the marketplace for guidance. In an opportunity cost sense, perhaps we should. But what rate should one choose?

Should it be the 1.5 percent rate banks pay on funds in one's checking account, the seven percent paid on mortgages, or the 15 percent charged on carried-over credit card charges? Interest rate returns at the three percent level were considered satisfactory during the early 1940s. Forty years later, investors wanted minimum returns at the 10 percent to 12 percent level. Accepting the inverse relationship between discount rates and the values placed on expected future incomes, this shift suggests that investors valued future incomes at a far lower level during the early 1980s than during the early 1940s. This clearly was not the case.

Duration of Planning Periods

Conservation decisions must be forward-looking. When operators decide to carry on conservation programs, they commit themselves, at least temporarily, to given lines of action. As a part of the commitment process, they ordinarily assume that their operations will continue over sufficient time periods for them to receive enough benefits to compensate for their conservation investments. Land owners often proceed with open-ended planning periods, with no specific dates in mind but with the assumption that their operations will continue long enough for them to enjoy a payoff from their investments. Problems with the duration of planning periods come when operators have short planning horizons that force them to think in terms of maximizing their short-run interests.

Association of Costs with Benefits

Conservation programs can easily involve disassociations of benefits and costs with some operators bearing inordinate shares of the cost of applying conservation measures while other benefit as free riders. Prime examples of the effect limited planning horizons have on conservation decisions occur with the case of tenants who operate with short-term leases. Tenants who operate with leases that must be renewed every year often have limited incentives for adopting conservation practices that require current investments of time, labor, and money for benefits that will be realized mostly in future years. Landlords can meet this problem by offering longer-term leases or by adding provisions to their leases that provide compensation to tenants for their contributions to unexhausted improvements.

Comparable disassociations exist when upstream users of water are asked to pay for conservation programs that are of primary benefit to downstream operators. Other examples occur when neighbors purse conservation programs that provide more benefits to one than the other and when forest owners are asked to follow conservation practices that will provide scenic or recreational benefits for the general public. Benefits in these cases may be cheerfully provided. When they are not, the cause of conservation may call for the provision of offset compensation arrangements.

Investment and Disinvestment Considerations

Many operators who practice conservation are not interested in simply having or storing resources for some vague future use. They expect their investments to pay off within definable planning periods and they also see their conservation programs as resource banking operations that allow them to build up resource reserves they can draw on in the future if need arises.

Ordinarily, it is assumed that operators should make a series of investments in conservation practices before they disinvest. In practice, operators sometimes find it both economically and socially expedient to draw on the investments made by nature or by previous operators. New owners of farms or forests, for example, can be excused for drawing on their stores of fertility or un-harvested timber for a few years to provide the capital they need for establishing themselves if they take later action to restore the resource values taken.

Settlers along the American frontier started with a rich soil, grass, forest, and mineral resource base that represented years of the accumulated investment. In their early development of this base, many followed disinvestment policies. Some of their practices had regrettable aspects. All things considered, however, their pursuit of this policy was desirable both for the average settler and for the nation. Disinvestment provided an early flow of capital that stimulated rapid economic growth.

The nation's conservation policies now emphasize the need for safeguarding and saving oil, mineral, forest, wildlife, and soil resources. Reasonable amounts of disinvestment are expected. Individuals may draw on their reserves to meet emergencies and meet family needs. The nation can justify disinvestment of investment reserves during periods of war and national emergencies. Over time though, surpluses of investments over disinvestments are needed to maintain the resource base. Good management calls for insistence that operators follow through with reinvestment programs if disinvestments are needed.

Alternative Program Choices

Operators are not limited to single choices when they pursue conservation programs. They often can choose between several combinations of practices that will permit them to attain their goals. Forest owners, for example, may follow inactive management programs under which forest growth is left entirely to nature. They may employ intensive management practices, such as tree planting, spraying, or selective thinning. They may follow sustained-yield harvesting approaches by cutting selected trees while leaving seed trees and young growth for future harvest; or they may clear-cut their forests and then either reseed or regenerate them by transplanting young seedlings.

Every case involving the need for soil conservation practices is different and in most cases a wide variety of practices, such as contour farming, strip cropping, terracing, spreading manure, and changing tillage methods can be used alone or in combination with others to attain desired levels of protection against soil loss. Similar ranges of choice are available with the conservation of wet lands, fisheries, wild game, fossil fuels and most other types of resources.

Effects on Other Resources

The question of whether conservation practices really pay cannot be answered in an ultimate sense until consideration is given to the impact they have on other resources. Operators frequently find it practicable to substitute one type of resource for another in their production programs. These adjustments reduce the use of the displaced resource and can lead to higher production or better products. They may also contribute to depletion of the substituted factor and thus have a negative or neutral overall conservation effect.

Whether resource substitution complicates or simplifies the overall conservation problem often depends on whether conservation is viewed in physical or economic terms. Physical conservation calls for limiting the use of exhaustible and non-renewable resources, for substituting flow for fund resources. These goals may be desirable; but little enthusiasm can be expected for shifts of this order as long as non-renewable resources can be used at lower costs than flow resources.

Substitutions of fund resources for biological and flow resources will continue as long as they provide cheaper or economically superior products. Once the more readily available supplies of these resources are used, however, the prices of the more critical of these resources can be expected to rise. This will favor more intensive mining practices and the treatment of these resources as limiting factors in production. It will also prompt the search for additional substitutes—a process that must eventually lead to the increased use of renewable and reusable resources.

Society's Interest in Conservation

Mention is often made in conservation discussions of the differences between the interests individuals and society have in conservation. Individuals are often assumed to have high time-preference rates and short planning periods. Society in turn supposedly has a longer planning horizon and uses lower discount rates, because of its interest in the welfare of future generations and its ability to borrow money at a lower rate of interest.

Realistic analysis of this supposed dichotomy of interests shows that the interests of society are not necessarily contrary to those of individuals. Society is made up of individuals, and its interests necessarily reflect those of its members. The real division comes between each individual's desire to maximize personal satisfactions and his or her desire to stress social and community interests. Business operators emphasize personal and firm goals and often find that they must pit their interests against those of other operators. The responsibilities we have and feel as members of society are another matter. What we can do in meeting them is often limited. Our short life spans dictate that we try to maximize such returns as we can during our lifetimes. Our responsibilities to society involve vastly longer time horizons. We meet them by delegating them to society with the hope that their achievement can be secured through collective action, through the marshaling of public opinion, the joint action of individuals in groups and organizations, and action by the state.

Rational individuals are always concerned with survival and the returns and satisfactions they can secure for themselves and their families. They are also interested to a greater or lesser degree in the future of the race, the welfare of their heirs, and the well-being of others. Every person has some combination of these sometimes complementary, sometimes conflicting, interests. These combinations make for a wide range of attitudes regarding conservation, varying from extreme conservation-mindedness to almost exclusive emphasis on policies of resource depletion or exploitation.

This range of interests in conservation also applies to business organizations and public agencies. Corporations, which are ordinarily assumed to have longer planning periods and lower interest rates than individuals, sometimes stress the conservation and sometimes rapid depletion of particular resources. The actions of governments show that they too have shown varying concerns for resource conservation. Most of us would agree with A. C. Pigou (The Foundations of Welfare, 1962) that:

> *"It is the clear duty of Government, which is the trustee for unborn generations, as well as for its present citizens, to watch over, and if need be, by legislative enactment, to defend the exhaustible natural resources of the country from rash and reckless exploitation. Yet on certain occasions, as during a war when the continued life of the nation is at stake, they may engage in resource-disinvestment polices that are every bit as exploitive as those of the self-seeking business operator."*

Important questions may be raised concerning the positions governments, and the societies they represent, should take respecting the long-term conservation of environmental resources. Should they emphasize current economic efficiency goals that call for maximization of current resource values, or do they have a moral obligation to work for intergenerational equity in the use of natural resources? If they stress economic efficiency, they may logically base their social rates of discount on the government's cost of borrowing money, which is somewhat less than the usual market rate. When elected officials focus their concerns more on intergenerational equity and the long-term needs of society, instead of just on what happens during their elected terms of office, justification can be found for accepting social discount rates that may be not much above zero.

Many conservationists feel that current short-run interest rates provide poor criteria for long-term resource management and conservation decisions that will affect the welfare and well-being of generations decades and centuries hence. As Alan Randall (*Resource Economics: An Economic Approach to Natural Resource and Environmental Policy*, 1981) has observed: "Present-value and expected-value concepts derived from traditional economics have proven to be of little use for the solution of decision problems involving very long time horizons, massive uncertainty, and/or irreversibility." With a continuing prospect of resource exploitation and with persistent uncertainties concerning the extent to which new technology can maintain and increase the productive capacity of the earth's limited land resource base, society has good reasons for insisting that governments sponsor and carry out resource conservation programs as a necessary form of social insurance against possible unwanted eventualities.

A clear case can be made for social action to promote conservation any time an operator's practices are regarded as detrimental to the nation's security and any time public programs are needed to facilitate desired resource developments. Social controls are justified when they are used to prevent individual property-use practices that contribute to neighborhood blight or that cause drainage, erosion, fire, siltation, or soil-drifting problems on other properties. Comparable action may also be needed at times to help individuals help themselves. As Arthur C. Bunce (*The Economics of Soil Conservation*, 1945) has indicated, public programs to advance conservation are desirable 1) when individuals fail to recognize that it would be in their economic best interests; 2) when it is in the best interests of society though not necessarily of the individual; and 3) when the needs of the majority in our society can be attained only through collective action.

A wide scope of tools can be used by governments to promote attainment of conservation goals. Educational programs can be used to acquaint people with their opportunities and responsibilities. Subsidies can be used to promote acceptance of conservation practices. Credit facilities can help operators finance and technical assistance can be provided to help operators launch conservation programs. Tax incentives can be used to foster a variety of resource conservation practices. Police power measures, such as forest-cutting restrictions and oil well-spacing regulation, can be used for similar purposes. Governments can also use their public spending, public ownership and eminent domain powers to attain resource conservation objectives.

Chapter 9: The Location Factor

"No matter how much transportation is perfected it can never become instantaneous, effortless, or costless. There will always be a cost of overcoming friction, gravitation, and loss of time in moving goods and people."

~ George S. Wehrwein

In the world of economic theory, it is common practice to ignore differences in spatial location. With the concept of perfect competition, it is ordinarily assumed that all buyers, sellers, and products in the market are perfectly mobile—that they are located at the site of the market or can be moved there instantaneously and without cost. This assumption has its place and value in theoretical analysis, but it does not match the conditions of real life. Most earth resources are fixed in location. This is a factor of major significance in the management of environmental resources because, except for air and wildlife, virtually every resource provided by nature finds its first use bound to the place where nature put it.

While substitutes may be found, natural wonders, such as Niagara Falls, the Matterhorn, and the forests of the Amazon, can be viewed only at the sites where they are found. Some other earth resources, such as a rich deposit of mineral ores can make it worth an operator's while to go to them wherever they may be found. With most environmental resources, however, it is the combination of its qualities for use and consideration of its distance from market centers and the costs associated with bringing capital and labor to it and of hauling its produce to market that determine the scope of the opportunities operators have for its use.

Most people would like to live in areas that boast a pleasant climate, low living costs, and opportunities for the satisfaction of their wants and desires. In deciding where they and their families will live, they are often torn between their desires as consumers and their needs as workers and producers. In deciding where they and their families will live, they have often been torn in the past between the counter-pull of their wants, and their need to locate near places that provide employment and that supply the resources they need in production.

Despite frequent complaints about the weather, most people are reasonably content with their present locations. This is particularly true if they have lived there all of their lives, if they have relatives and close friends nearby, and if they have come to regard these locations as home. Yet conflicts do exist between consumer and producer wants and goals. Retirees who are no longer tied to a specific place of employment often move to what they hope are more enjoyable environments, natural and/or social. Ambitious, energetic, and productive individuals also move to areas of greater economic opportunity and sometimes to places that offer them more amenities of living.

With the production of economic goods, operators and areas find it to their advantage to produce those goods or services for which they have their highest comparative advantage, the greatest opportunity for realizing surpluses in their trade with others. The discussion that follows logically begins with a brief examination of the concepts of economic specialization and comparative advantage. Consideration is then given to the impact location factors have on the various land uses and to the effect that changing location factors may have on management of the environment.

Economic Specialization and Comparative Advantage

Economic specialization is a common phenomenon in the present world. Workers tend to specialize and hopefully find employment doing the types of work they can do best. A similar specialization affects the uses made of land and other environmental resources. Every area could attempt to provide most of the products needed by its residents. The Midwest could try to provide its needs for cotton, coffee, and bananas. But even if it could produce adequate supplies of these products, the process would be both expensive and wasteful. It makes more economic sense for areas to concentrate on the production of those products for which they have natural or economic advantages and to trade their surpluses of these products for goods that can be better produced in other areas. By encouraging areas to specialize in the types of production for which they have high comparative advantage, we have been able to produce larger supplies of products and enjoy higher average qualities of life.

Principle of Comparative Advantage

Generally speaking, areas tend to produce those products for which they have the greatest ratios of advantage or the least ratios of disadvantage as compared with other areas. This concept is known as the principle of comparative advantage. The operation of this principle can best be illustrated by a few simple examples involving two areas and two products. Cases 1 through 4 compare the abilities of areas A and B to produce physical units of two products. To keep the comparison simple, it is assumed that both areas are able to produce the minimum needed supplies of either beans or rice for both areas, that each would prefer to concentrate on the production of one product and trade its surplus to the other for supplies of the second product and that consideration of market prices, market structures, transportation costs, and relative costs of production can be ignored.

With the first example (Case 1) in Table 9–1, it is assumed that areas A and B each produce all of the rice and beans they need. With this circumstance, neither area has a production advantage for either product. This same situation would hold true if the production in area B dropped to 30 and 45 units or increased to 50 and 75 units of rice and beans, respectively. In each case, both areas would have identical ratios between the units of rice and beans they could produce, and neither would find it to its advantage to specialize.

Table 9–1. Principle of Comparative Advantage – Case 1

Case 1		
Land Use	Area A	Area B
Rice	40	40
Beans	60	60

Source: Dr. R. Barlowe, Land Resource Economics, 1986.

If the production situation changed in area B as in Case 2, it immediately becomes profitable for each area to specialize (see Table 9–2). Area A finds its ratio of advantage is highest when it concentrates on beans, whereas area B finds it most profitable to concentrate on rice. In this case, each area has an absolute advantage in the production of one product.

Table 9–2. Principle of Comparative Advantage – Case 2

Case 2		
Land Use	Area A	Area B
Rice	40	50
Beans	60	40

Source: Dr. R. Barlowe, Land Resource Economics, 1986.

Under real-life conditions, some areas have an absolute advantage for more than one use, while most areas fail to enjoy an absolute advantage for any use. The disadvantaged areas in these instances do not go unused. Instead, they are ordinarily used for those purposes for which they have the least comparative disadvantage. In Case 3, area B has an absolute advantage for the production of both rice and beans (see Table 9–3). Yet since it lacks sufficient productive capacity to supply the assumed need of the two areas for both products, it will concentrate mostly on rice production—the use for which it has the highest comparative advantage, and area A will concentrate on beans—the use for which it has the least comparative disadvantage.

Table 9–3. Principle of Comparative Advantage – Case 3

Case 3		
Land Use	Area A	Area B
Rice	40	70
Beans	60	65

Source: Dr. R. Barlowe, Land Resource Economics, 1986.

To push the analysis further, it should be recognized that areas sometimes find it advantageous to concentrate on their second or third rather than their most productive use. In Case 4, for example, area B again has an absolute advantage in the production of both rice and beans. It concentrates upon beans, because this use has the highest comparative advantage (see Table 9–4). Area A, in turn, concentrates on production of the less productive of its two products, because with B exercising its comparative advantage for producing beans, the rice market is left to A more or less by default.

Table 9–4. Principle of Comparative Advantage – Case 4

Case 4		
Land Use	Area A	Area B
Rice	40	45
Beans	60	90

Source: Dr. R. Barlowe, Land Resource Economics, 1986.

The joint operation of these principles may be illustrated by the hypothetical situation assumed in Case 5 (see Table 9–5). This example assumes four separate producing areas and predictable estimates of the average levels of land rent associated with four alternative primary uses. For illustrative purposes, area A may be considered as representative of parts of the Lake States, area B of the Midwest, area C of some irrigated areas in the West, and area D of the non-irrigated dry farming areas of the western Great Plains.

Table 9–5. Principle of Comparative Advantage – Case 5

Case 5				
Land Use	Area A	Area B	Area C	Area D
Wheat	$10	$14	$11	$8
Corn	$19	$30	$20	$2
Potatoes	$18	$16	$17	-
Dairying	$25	$25	$10	$1

Source: Dr. R. Barlowe, Land Resource Economics, 1986.

Examination of the data in Case 5 shows that area B has an absolute advantage for the production of wheat and corn and that it can earn as high a net return in dairying as any other area. Its highest comparative advantage though lies in corn production, and a high proportion of its resources accordingly are used for this purpose. Area A has an absolute advantage in potato production, but its highest advantage lies in dairying. Areas C and D do not have an absolute advantage for any of the four uses. Area C could diversity and engage in any of the enterprises but would find its least comparative disadvantage in potato production. Area D has the lowest wheat yields of any area but would concentrate on wheat production, because of the limited nature of its alternatives.

Scope of Comparative Advantage

Comparative advantage is often associated with natural advantages, such as favorable climate, soils, and topography. Viewed in this manner, it is easy to assume static situations in which the successful use of certain areas for nature-favored purposes is more or less guaranteed. In practice, the concept of comparative advantage is far more dynamic and more all-inclusive. Some comparative advantage features stem from natural endowment factors. Others involve favorable combinations of production inputs, favorable location and transportation costs, favorable institutional arrangements, and desired amenity factors.

Natural Endowment

Comparative advantage frequently springs directly from differences in natural endowment, from differences in the quantity and quality of our earth-given resource base. Minerals must be available in economically attractive concentrations if commercial mining is to take place. Favorable climatic conditions and specific natural features, such as sandy beaches, good fishing waters, or ski slopes are a "must" for many types of recreation developments.

The relatively frost-free climates of southern Florida and the Rio Grande valley have favored the use of these areas for the production of citrus crops. The long growing season enjoyed by the South gives it an advantage for cotton production. Rich soils favor corn and soybean production in the Midwest. Level land and rolling fields provide distinct advantages for mechanized farming. Mountain valleys frequently provide excellent sites for reservoirs and power dams; and the presence of deep water harbors has favored the rise of commercial developments along the nation's coasts.

Favorable Production Combinations

Comparative advantage implies ability to realize an economic return from one's fixed inputs in the production of goods or services. It calls for favorable combinations of the inputs needed for production and also for markets for the products produced. A shortage of skilled management or a lack of adequate marketing or credit facilities may easily outweigh an area's natural advantages. The presence of skilled labor may provide a distinct advantage as may a firm's ability to cut costs by employing lower-cost labor. Operators must also consider the availability and cost of raw materials, water, power, and other utilities and the services provided by a community's developed infrastructure.

Operators who find it possible to work out low-cost combinations of their factors of production often enjoy comparative advantages over other producers. Their low-cost combinations may result from favorable raw material, climate, and other natural advantages or from superior management or utilization of the agglomeration economies associated with developed infrastructure and locations near established industries. Comparative advantage may also be created. With dynamic leadership, areas of limited natural advantage can develop their own supplies of skilled labor and management, capital, water and utilities, and even build up market areas that give them high comparative advantage.

Transportation Considerations

Business operators are always concerned about the distances they must ship raw materials and finished products. Local producers benefit from ability to move products to market at lower cost, in less time, and in fresher condition than more distant competitors. Savings in transportation costs can make it possible for local producers to compete favorably with producers who live in areas that boast stronger natural advantages for the production of particular products.

Transportation improvements have brought tremendous changes in the costs of moving people and goods. As late as 1816, the market price of flour in the United States did not justify its transportation for distances of more than 150 miles overland, and bulky and heavy articles could be shipped 3,000 miles across the Atlantic Ocean at about the same cost as 30 miles overland. Limited transport facilities and high shipping costs favored concentrations of land settlements along navigable streams. Distant overland transportation was limited primarily to objects with high value-to-weight ratios; and cities depended on immediate hinterland areas for much of their food, as well as for other products with low value-to-weight ratios.

The building of canals, railroads, highways, airports, and pipelines, and the introduction of improved modes of transportation have greatly relaxed the transportation constraints of the past. Products now move faster at far lower costs and, in the case of products shipped in refrigerated containers, sometimes fresher than many products produced at sites closer to consumers. Comparable advances in communication technology now make it possible to send instantaneous messages to people anywhere in the world, many of whom could not have been reached within months by mail, if at all, in times past.

Institutional Arrangements

Institutional arrangements also can be of strategic importance in determining the extent of an area's comparative advantage. Nations with histories of political stability offer greater attractions for investment than nations threatened with frequent revolutions. Tariff barriers and trade restrictions have long been used to shut off outside competition and augment the production advantages of domestic producers. Other institutional controls, such as quarantine restrictions, city milk market inspection requirements, and zoning ordinances can have similar impacts in favoring or discouraging particular land uses.

At an institutional level, economic, military, or political dominance can produce powerful advantages for favored nations. The OPEC nations have enjoyed considerable bargaining power since the 1970s, because of their potential for withholding much of the world's oil supply from market. Colonial powers, such as Great Britain in the past were often able to enhance their commercial interests by requiring that all products from their colonies be shipped in British ships.

Amenity Factors

Cultural and aesthetic attractions provide a fifth facet of comparative advantage. Amenity considerations are often ignored when significant economic advantages are associated with particular sites or when producers have no choice as to where they should operate as would be the case with opening a mine. But producers and workers are more conscious of amenity factors now than in the past. Moreover, choices of prospective operating sites can often be narrowed to several sites that offer quite comparable economic opportunities. When this situation exists, final decisions can be influenced by the general attractiveness of a community and the climate, cultural, education, recreational, and other opportunities it offers for potential residents. Other things being nearly equal, operators logically locate at places where they would like to be.

Interrelation of Comparative Advantage Factors

Operators must consider all of the above factors in their choices of where they should operate. Marked advantages associated with any one set of factors can be offset and neutralized by others. The interrelation of these factors can be illustrated by a hypothetical example of a Detroit industrialist who seeks a plentiful supply of a particular item needed for the manufacture of a given product. Suppliers at five different locations have submitted offers to produce the product at the prices indicated in Table 9–6.

Table 9–6. Hypothetical Example of Costs Associated with Delivered Prices Quoted for a Product Needed by a Detroit Industrialist

Site of Production	Cost per Unit of Product for . . .				
	Raw Materials	Production Costs	Shipment to	Customs Duty	Delivered Price per Unit
Hamburg	0.85	$2.00	0.65	0.50	$4.00
San Diego	0.95	$1.65	0.65	–	$3.70
Shanghai	0.95	$1.45	0.90	0.50	$3.80
Toledo	1.00	$2.45	0.25	–	$3.70
Windsor	1.00	$2.35	0.15	0.50	$4.00

Source: Dr. Raleigh Barlowe, Michigan State University, 2012.

Examination of these delivered prices shows that a prospective supplier in Hamburg, Germany, has the lowest costs for raw materials while the supplier in Shanghai, China, has the lowest costs for labor. The supplier from across the Detroit River in Windsor, Ontario, has the lowest transportation costs, and the domestic suppliers in Toledo and San Diego have the lowest quoted total prices. At this point, personal preferences and amenity considerations may dictate the industrialist's choice of a supplier. Should emphasis be placed on being close to the source of supply, the Toledo supplier would be favored. Should the industrialist want to spend occasional winter weekends in southern California, the contract may go to the San Diego supplier.

Comparative advantage involves ability to compete on favorable terms with alternative sites in the production of goods or services for a given market. Sites near metropolitan centers often enjoy high comparative advantages for many competing uses. Selection of the highest and best use involves the counter-bidding of the marketplace. Unless prevented from doing so by institutional constraints, individual uses tend to move to their highest and best economic uses. Uses that cannot pay top prices move to less favorable locations where they can become the highest and best uses of these sites even though they may represent uses of least comparative disadvantage for the operators involved. In this site selection process, it must be recognized, however, that high comparative advantage for particular uses does not guarantee that sites are available for those uses. Operators must face the fact that their preferred choices of sites may be occupied by other uses and that high supersession costs may be entailed in shifting them to new uses.

Spatial Relationships Affecting Land Use

Land-utilization patterns frequently reflect geographic differences in location with respect to markets. This is particularly true when one deals with land areas of like productive capacity located at different distances from market. Transportation cost is the key factor in these cases. Since these costs ordinarily increase with distance, sites near a market usually enjoy an element of comparative advantage over sites located farther away. Areas close to market accordingly receive higher net prices for their products, yield more land rent, and have higher capitalized values than areas located at greater distances.

Von Thunen's Model

Most of our theory regarding the effect of spatial location on land-utilization patterns stems from a model presented by Johann Heinrich von Thunen in his book *Der Isolierte Staat*, written in 1826. Von Thunen assumed the case of an isolated state (which freed his example from the impact of other economies and markets) with one central city located in the midst of a productive level plain surrounded by a wilderness area. He also assumed a village type settlement with families living in the central city rather than the open country, uniform climate and soils, uniform topography, and relatively uniform transportation facilities. With railroads and superhighways not yet known, he assumed that farm produce would be hauled to the central market on horse- or oxen-drawn wagons, carried by people, or driven in the case of livestock.

Except for location and distance to market, von Thunen's analysis held constant all of the natural factors affecting land use. Differences in land use could be attributed directly to variations in transportation costs. These in turn were dependent on distance to market, ease of transportation, and the bulk, weight, and perishability of the products sent to market. With these assumptions, von Thunen visualized a central city surrounded by a series of concentric land-use zones (Figure 9–1A). The zones closest to the city were utilized for intensive purposes and uses that involved highly perishable products or those that were heavy and hard to transport. The direct relationship between effort and time required for transportation favored utilization of the outlying zones by enterprises with low transportation costs.

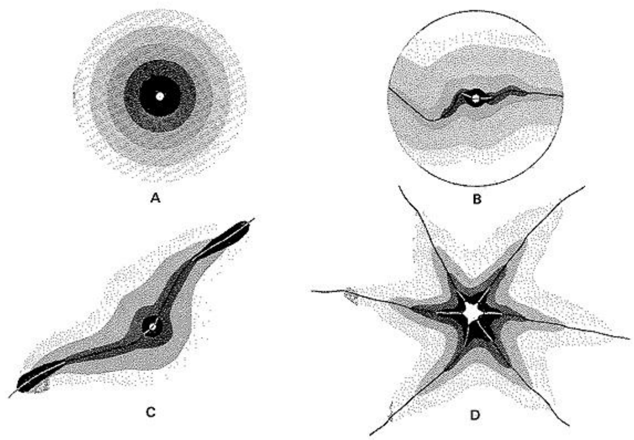


Figure 9–1. Modified Presentation of von Thunen's Theory of the Relationship between Resources Location and Land Utilization

Von Thunen assumed that the first concentric zone around the city was used for gardens, truck crops, and the facilities needed for stall-fed milk cows and laying hens. This use was logical as this area was subject to intensive use, was visited frequently, and most of its products were hand-carried to the city. The second zone was used to produce forest products. This use may seem unusual today, but it must be remembered that forest products provided both fuel and a source of building materials. And since this product is both bulky and heavy to haul, it seemed important that it be produced near the city.

Immediately beyond the forest zone land was used for the more intensively cultivated field crops—for bulky and heavy crops, such as potatoes, root crops, and hay, and for grain grown in rotation with these crops. The fourth zone was planted to cereal crops, which call for less intensive operations. The fifth zone was used for grazing purposes, with the cattle and sheep produced and fed in this area being driven to market. The surrounding wilderness area was a sixth zone used for hunting purposes.

Von Thunen's simple model can be modified by adjustments in its many assumptions. If one assumes that a navigable stream flows though the "isolated state," opportunities for water transportation may warrant changes in land utilization. With some series of uses, each zone could be expected to take on the elongated pattern suggested in Figure 9–1B. With the example described above, however, the market garden area associated with the first zone would probably remain unchanged, while it would become practicable to shift the areas used for forest production to sites along the navigable stream at greater distances from the city (Figure 9–1C).

The introduction of improved transportation routes, as in Figure 9–1D, would lead to star-shaped land-utilization patterns.

Importance of Transportation Costs

Von Thunen was primarily concerned with the role transportation costs play in allocating the land resources found at varying distances from market among competing agricultural users. His villagers used land as they did, because of their rational desire to minimize the effort, inconvenience, and loss of time associated with their use of various sites and the movement of their products to market. Their location decisions may be quantified in economic terms as in Table 8–2. Basic land rent levels may be assumed for each land use at the market; average transportation costs per mile can be calculated for the products associated with each use; and distance from the central market to the extensive or no-rent margin for each use can be computed by dividing the level of land rent at the market by the transportation cost per mile. Rent can be earned for each use until operations are carried on at its no-rent margin, but their zones of highest and best use occur only in the areas between their margins of transference with their next higher and next lower uses.

Land rent triangles can be drawn to depict the relationships reported with the four types of land use identified in Table 9–7. In Figure 9–2, the land rent triangle for use A starts with the $10.00 of land rent on its vertical axis and stretches horizontally for four miles. Use B is depicted by a land rent triangle that has a vertical apex at $7.00 and stretches out for 10 miles. The rent triangles for uses C and D start with land rent values of $4.50 and $2.00, and extend horizontally for 25 and 40 miles, respectively.

Table 9–7. Illustration of Effects of Transportation Costs on Allocation of Alternative Land Uses on Location around a Central Market

Land Use	Land Rent at the Market	Transportation Cost per Mile for Use	Distance to No-Rent Margin	Range of Zone of First Choice
A	$10.00	$2.50	4 Miles	0–1.7 Miles
B	$7.00	$0.70	10 Miles	1.7–5 Miles
C	$4.50	$0.18	25 Miles	5–19 Miles
D	$2.00	$0.05	40 Miles	19–40 Miles

Source: Dr. R. Barlowe, Land Resource Economic, 1986.

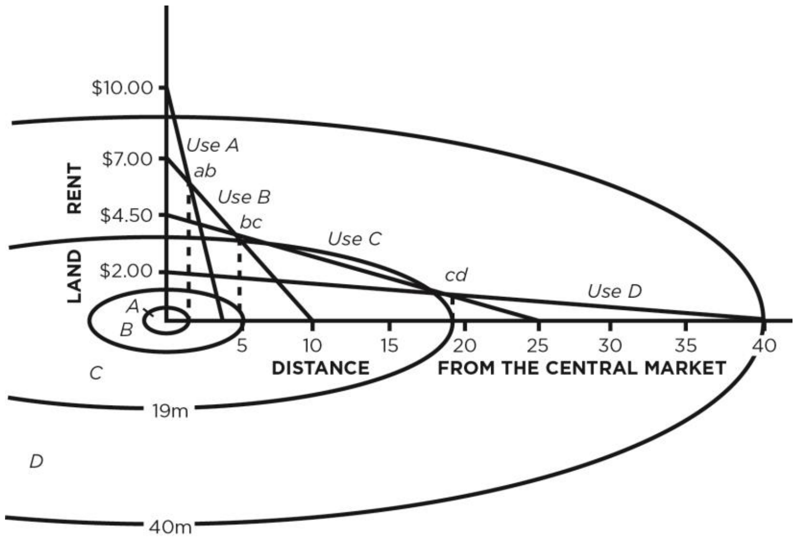


Figure 9–2. Example Illustrating Allocation of Land Uses around a Central City Market Assuming Four Competing Types of Land Use

When the four land rent triangles are brought together in a margin-of-transference diagram, such as in Figure 9–2, it appears that *use D* alone will be carried on to its extensive margin. *Use A* promises the highest land rent for the sites immediately adjacent to the city. It accordingly is the highest and best economic use for the concentric zone that extends out to transference margin ab, which occurs 1.7 miles from the city. *Use B* is most profitable in the zone that extends from ab to *bc*, or from 1.7 to 5 miles from the central market. *Use C* is the highest and best economic use between *bc* and transference margin *cd*, which is located 19 miles from the city. The margin-of-transference points for the overlapping rent triangles correspond with the respective boundaries of the concentric zones in the von Thunen model, Figure 9–2, uses land rent triangles to illustrate the margins of transference between competing land uses that can be found on one side of a central market. A third dimension can be added to von Thunen's model as in Figure 9–3. Land rent cones now rise above the concentric land-use zones and find their highest points at the central market. The surface of each overlapping cone depicts both the amount of land rent and the slope of the land rent function associated with the different uses at increasing distances from the central market.

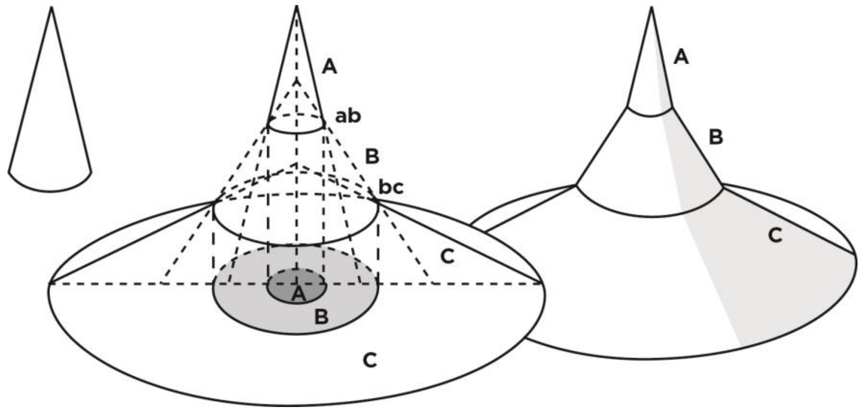


Figure 9–3. Use of Land Rent Cones to Illustrate Relative Levels of Land Rent or Land Values Associated with Highest and Best Uses of Sites Located at Different Distances from Central Markets

Von Thunen's basic concept, as depicted in Table 9–7 and Figure 9–2, illustrates the relationship of land rents to the cost of overcoming what Robert Murray Haig ("Toward an Understanding of the Metropolis," 1926) called the "friction of space." Transportation costs rise as products must be shipped greater distances to market. These costs explain the higher land rents associated with sites near the market; and, as offsets to land rent, they set the area limits within, which specific uses can be carried on to advantage. Locations of primary uses can often be explained in terms of their relative ability to produce land rents. Complementarity of uses, however, often favors intermixtures of uses in the various zones.

Differences in Land Quality

Relaxation of von Thunen's assumptions of uniform climate, fertility, and topography can also have significant effects on land-use patterns. If the land west of a city is fertile, level, and easy to work, while the areas to the east are handicapped by rough terrain, one can logically expect more expansion of the concentric use zones to the west than to the east. This situation results, because the higher productivity and lower unit production costs associated with the better lands provide larger economic surpluses that can be used in paying shipping costs. Crazy-quilt patterns of land use that only generally follow von Thunen's concentric zones occur when tracts of different fertility levels are scattered throughout the various zones. Central cities might also draw on production from areas outside the isolate state if these areas have particular advantages for production that exceed or are not shared by sites closer to the city.

Like the economist who uses the assumption of other things being equal to isolate economic principles, von Thunen's conclusions about location of agricultural land uses around his central city were based on rigid assumptions about the nature of conditions in his isolated state. None-the-less, his observations were realistic given specified control factors, and have general applications in location theory. It must be admitted, however, that their application in our 21st century world are greatly complicated and often clouded by other factors. Extremely important among these are the revolutionary changes in transportation technology that have evolved since the horse- and ox-borne economy. Also important are the facts that most farmers in our part of the world live on their farms not in a central village; that they often deal with a natural resource base that is far from homogeneous in nature; and that complementarily in farming practices often favors acceptance of combinations of land uses (such as planting a variety of crops and using some fields to pasture animals) rather than emphasize a single use of their land. Two other important modifications come when we admit the presence of other cities and when we consider the problems associated with the optimum location of non-agricultural uses.

Impact of Additional Urban Markets

Central cities are ordinarily surrounded by natural supply areas that they depend upon for supplies of agricultural and other materials. This pattern is complicated when two or more cities are located near each other. Several market centers then compete for the products of a single supply area, and the resulting land utilization patterns reflect the pull of the markets they serve. The impact of this pull of additional markets depends on the size and needs of the markets together with their location and transportation ties to the areas in question. When two cities of comparable size and function are located next to each other it is logical for them to divide their outlying areas with each city drawing on and servicing the areas closest to it. Complications may arise, because of differences in transportation facilities and urban functions. A highway or railroad connecting one city with the natural hinterland of a second city will often claim much of the area served by the facilities for the first city. Similarly, if one has the only furniture factory while the other has the only flour mill, considerable overlapping of supply and market areas can be expected.

When one or more smaller cities are located within the natural hinterland of a central city, the central city must compete with its satellites for the use of certain areas. The central city under these circumstances is still surrounded by a series of generalized land-use zones—uses that take the form of irregular bands rather than concentric circles, because of differences in transportation facilities, topography, and land productivity. Each of the smaller cities also has need for surrounding land areas and can ordinarily outbid the central city for particular sites as long as its uses have a higher economic or social priority than those of the central city (Figure 9–4). When the central city's uses have highest priority, the satellite cities must seek alternative use sites—usually at greater distances and away from the central city—where they can better compete with the prices offered by the central city.

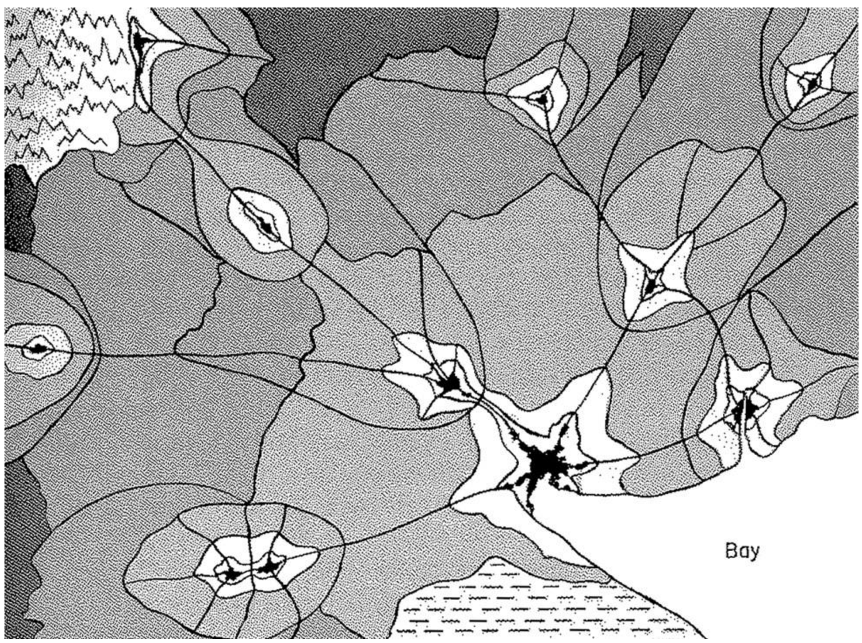


Figure 9–4. Illustration of the Effect Satellite Cities and Variations in Highway Facilities and Topographic Features Have on Land Utilization Patterns around a Central City

Product prices in satellite cities often reflect the cost of transporting goods to the larger market of the central city. As long as a surplus supply of a product is produced in the immediate area, its local price floor will represent the price offered in the larger city less the costs of transportation. For example, if milk is priced at $8 per cwt. (hundredweight) in the larger city and can be shipped from the satellite area for 60 cents per cwt., the minimum local cost will be $7.40 per cwt. If local producers are offered lower prices, they have the option of shipping to the larger market. In actual practice, satellite cities often pay more than this minimum. This situation may exist, because of less desirable or less stable local market conditions or, because of need to attract supplies from areas lying between or beyond the satellite cities and the central market.

Prices in satellite city markets are sometimes higher than in the central market. This is particularly true when a satellite area does not produce all of its own supplies or when the products grown in the area must go to the central market for processing. In meat-producing areas, for example, local livestock and meat prices may reflect the major packinghouse center price less freight. If an area is dependent on Omaha packers for part of its meat supply, however, local prices are more apt to represent Omaha prices plus shipping costs.

Figure 9–4 illustrates the effect of satellite cities and variations in transportation facilities along with differences in land quality on the generalized land-use zones found around a central city. The impact of these land-use patterns on land rents and property values is shown with rent value profiles in Figure 9–5. They can also be depicted on three-dimensional topographic maps of rent and value levels on which the land rents associated with the higher and better uses rise like mountain peaks, ridges, and hilltops above the surrounding plains and valleys.

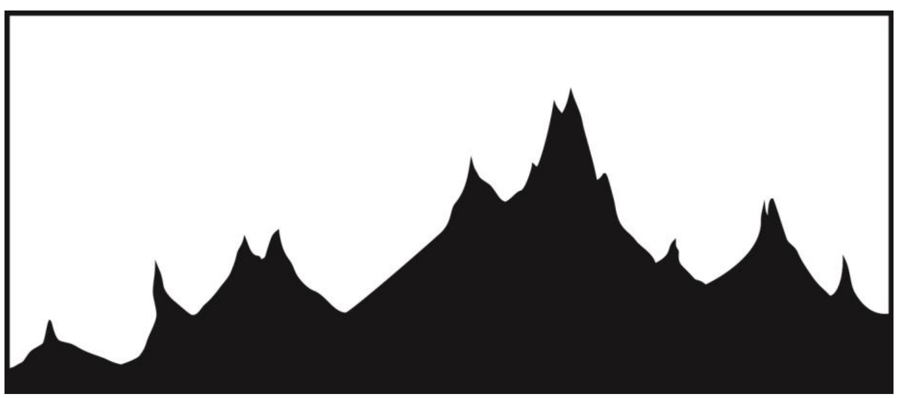


Figure 9–5. Profiles of Land Rents and Land Values Associated with the Example Depicted in Figure 9–4

Competition for market areas

Cities compete not only for the raw materials and supplies they secure from their hinterland areas but also for markets for the goods they produce. When two or more producers compete for the same market, price competition and even price wars may develop. But cutthroat competition is not likely to occur as long as producers refuse to sell at less than their actual costs of production plus transportation.

When producers of heavy or bulky goods who operate in different areas quote prices based on production costs plus their shipping costs to their customers, their actions can have an automatic effect in dividing and allocating market areas. As long as the producers hold to these prices and as long as one assumes uniform transportation costs, it is easy to determine the areas within which each producer can undersell the other two. Differences in transportation costs, and the fact that markets equidistant from any given city seldom enjoy equal transportation costs, complicates the drawing of boundaries between market areas. Market distribution is also affected by the willingness of firms to absorb portions of their transportation costs to distant markets for such varied reasons as desire to sell their products nationwide at a uniform price or willingness to absorb transportation costs for overall economies of scale benefits.

Weber's Approach

Von Thunen's model provides a meaningful basis for explaining the market-oriented relationships between spatial location and several types of land utilization. Its focus on the land use patterns associated with a single central market, however, ignored the counter effect that concentrations of given production resources at given sites have on the location of industries. An important contribution dealing with this material-oriented aspect of location theory stems from the work of Alfred Weber (1868–1958).

Like von Thunen, Weber started his analysis with basic assumptions about climate, topography, and the location of basic resources. He visualized several cities scattered over a region and noted that 1) some inputs in the manufacturing process are ubiquitous, available almost anywhere, whereas others are found only at particular sites; and 2) cities can have both agglomerating attractions that draw industries to them and deglomerating features that have an opposite effect. With these factors in mind, he asked where an industry should locate if deposits of its chief raw material are found at a single site (point B in Figure 9–6A) and the principal market for the product is at point C. If all other inputs in the manufacturing process are ubiquitous and no loss of product bulk or weight takes place as the raw materials are processed, processing can logically take place at A, B, C, or some site in between. If the raw material from B is such that considerable weight is lost in the manufacturing process, transportation cost savings would favor location of this phase of the production process at B.

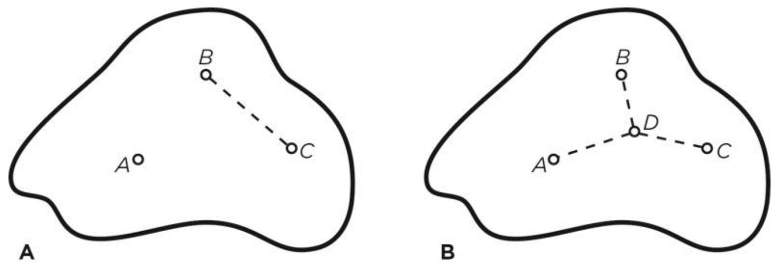


Figure 9–6. Illustration of Weber's Location of Industry Model

Weber went on to ask how decisions concerning industrial site location might be affected if a second necessary ingredient is found only at point *A*. If the ingredient is a necessary supply of water power, as in the days before electricity, the manufacturing process would have to move to the fixed location of *A*. If the raw materials found at *A* and *B* are bulky or heavy and lose all or part of their bulk or weight in the manufacturing process, transportation costs could be minimized by locating the processing plant at some intermediate site, such as at point *D* (Figure 9–6B).

Precise calculations to determine the optimum location for a processing plant call for detailed information on transportation and other costs. If transportation cost is the only variable, an operator's calculations can be depicted diagramatically by drawing a series of isotim curves around each of the three sites. The bands between the concentric isotim curves depicted in Figure 9–7A represent the distances each of the raw materials can be shipped at a cost of say $100 to a processing site. With this assumption, and the assumption that all other costs are equal, the optimum processing site will be somewhere in the *ABC* triangle. Its location can be determined by adding the costs indicated by the isotims around *A*, *B*, and *C* for the different sites and them selecting the site with the lowest sum of the three costs. Point *D* with a transportation cost of $10.40 per unit, represents the site with the lowest total transportation costs.

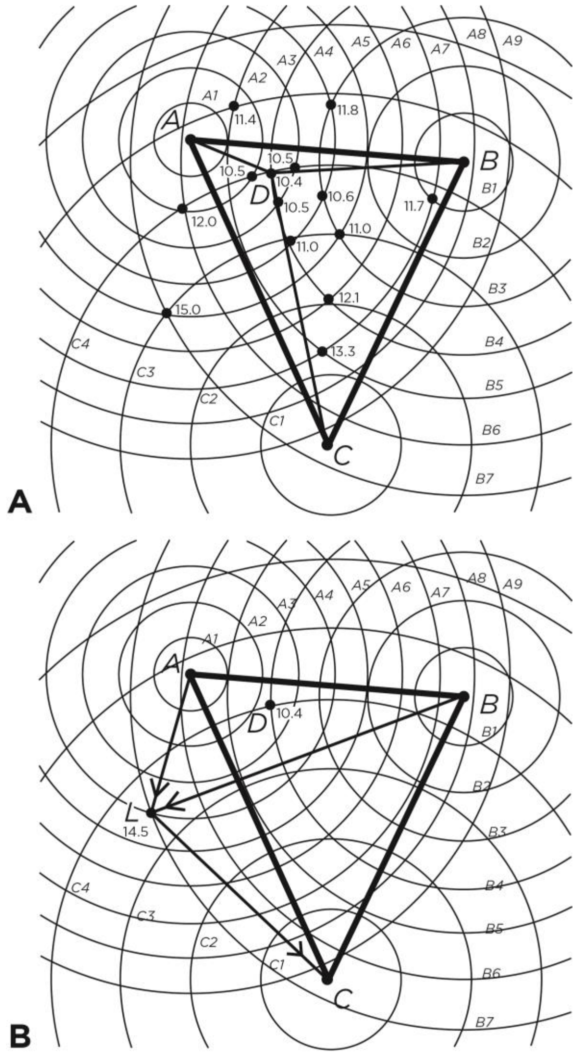


Figure 9–7. Use of Isotims to Illustrate Weber's Assumptions on Optimum Location of Industries

Weber's analysis gave particular weight to transportation costs. Other costs, such as the cost of labor, can be equally if not more important in today's world. If one assumes, as in Figure 9–8B that the labor cost for producing the product is $25.00 per unit for all sites within the *ABC* triangle but is $20.00 at site *L*, it would be economically advisable to move the processing plant to *L*, because the operator's combined costs for transportation and labor would be $34.50 a unit at that site as compared with $35.40 at *D*.

Changing Impacts of Location over Time

A dynamic dimension is added to the von Thunen and Weberian models when consideration is given to the effects changing supply and market conditions and new technology have on the location of economic activities over time. History provides numerous examples of cities that existed primarily as agricultural trade centers, expanded as their rulers used military power to command trade and tributes from others, and then lapsed back to their earlier status. The development of new trade routes, new transport facilities, and the rise of new industries have also caused thriving cities to spring up at sites where few people lived before.

Excellent examples of the changes that come with new trade and industrial arrangements are provided by the cities of East Asia. Prior to 1600, the major cities of this world region were almost always located at interior sites. Cities and villages were largely dependent on agricultural hinterlands, although some enjoyed additional attractions as military, government, or trade centers. Port cities were virtually nonexistent until the arrival of European traders brought the establishment of bases at sites, such as Bombay, Calcutta, Jakarta, Manila, Singapore, Hong Kong, and Shanghai. With international trade, the new cities grew, industrialization processes were introduced, and new metropolitan centers emerged, while many of the older cities remained as they were.

New technological developments also have brought notable changes. Many settlers along the American frontier minimized transportation costs by locating along navigable streams. Where this was not possible, they looked to furs, livestock, and whiskey with their high value-to-weight ratios as their primary cash products. The development of canals and railroads between 1840 and 1890 opened up new empires. Railroads made it feasible for farmers in the Midwest to sell their products in the industrial centers of the East and for wheat growers on the Great Plains to produce for world markets. Land-utilization practices that were not profitable more than a few miles from cities in von Thunen's day are now carried on thousands of miles away. Lumber from the Pacific Northwest is used in faraway building operations; truck crops are shipped from Central America to New England kitchens; fruit from South Africa, New Zealand butter, and Argentine beef are standard commodities in British markets; and far-off attractions have become the playground of world tourists. Some of the most significant effects of new technological developments are occurring with the impact they are having on the location and growth of cities.

Urban Land Uses

Urbanization with is congregation of large numbers of people in specific areas has given rise to numerous problems in addition to competition for the possession and use of particular sites. Air and water quality problems, traffic congestion, noise, sanitation and public health concerns, the need to provide fire and police protection, and satisfaction of demands for cultural, educational, and recreational opportunities have become matters of environmental significance. Modern cities seek to maximize social and economic benefits while simultaneously maintaining a clean and healthy environment with recreational opportunities.

The Rise of Cities

Cities have existed almost since the dawn of civilization. Much of their basis is found in the gregarious nature of mankind and in the cultural, economic, and political advantages that stem from the agglomeration or clustering together of people. Many early cities started as religious centers, the home of a royal court, or as fortified areas; but they also benefited from the opportunities they provided for trade and labor specialization. Throughout the modern era, the presence or potential development of a strong economic base has been a prime requisite for urban growth. Cities need to produce goods or services that can be exchanged to provide a flow of wealth from outside sources if they are to grow and thrive. This does not mean that all or even most of their workers must be engaged in marketable production activities. Larger and larger proportions of our urban residents now live by providing services to each other, or as some have observed *"by taking in each other's laundry."*

With the opening up of much of the American public domain for settlement, few locations offered more advantages for the creation of towns than others. Townsites were occasionally chosen by community decision. More often, towns sprang up when some entrepreneur built a store or tavern at a particular site and others followed by erecting houses and establishing service facilities nearby.

The towns established in this manner became service centers for their surrounding areas. Some were closer together than others and some had overlapping services areas that led to competition and the development of rivalries between them. Some grew faster than others and some, frequently county seats, emerged as civic centers that could provide governmental, legal, banking, medical and other services for surrounding basic service centers. With the addition of manufacturing activities to their service function, many towns became cities, which offered employment opportunities, as well as specialized services to surrounding service areas. The further growth and clustering together of these centers brought the emergence of huge metropolitan agglomerations in some areas that provide a wide range of services to hierarchies of smaller surrounding service areas.

Hierarchical service patterns of town and city location are found in many areas of relatively homogeneous terrain. Other factors, such as the presence of mountains or wetlands, opportunities to exploit mineral deposits, and the location of highways and railroads, however, also have significant impacts on choices for urban locations. When adjustments are made for these considerations, the overall pattern or town and city growth shifts to that depicted in Figures 9–8A and 9–8B.

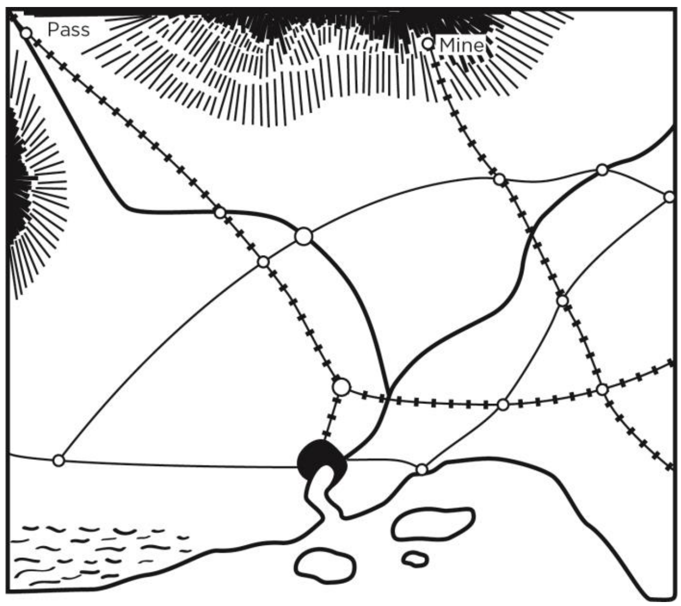


Figure 9–8A. Illustration of Effect Differences in Land Use Patterns and Differences in Transportation Facilities Have on Location of Cities

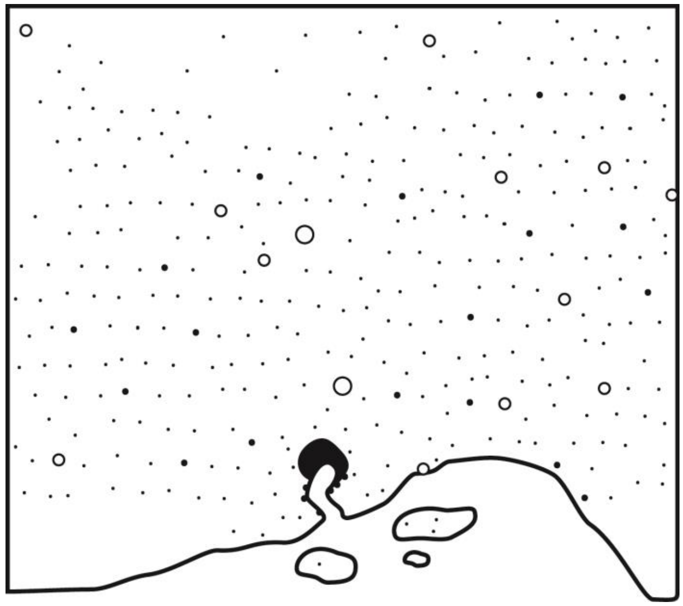


Figure 9–8B. Illustration of Added Effect Need Local and Regional Service Centers Have on Location of Urban Centers

Urban Land Use Patterns

Very few cities started as planned developments with neat allocations of given areas to commercial, industrial, residential and other uses. Instead the average city began as a village and gradually expanded. This growth process was often haphazard, poorly planned and frequently expensive. As cities grew, they usually sprawled outward. Business districts spilled over into surrounding residential areas. This expansion sometimes had a relatively uniform effect on all the blocks that surrounded the original 100 percent spots. Sometimes it was all in one direction or followed a single street; and in some instances, business districts migrated with their 100 percent spots to new locations. Industrial areas also were affected by this growth process. Original industrial sites that were ordinarily located near the outskirts of cities were often engulfed by the growing city and frequently cut off from contiguous areas that could be used for plant expansion purposes.

Of the various land uses affected by the squeeze of urban growth, the residential areas located around the commercial core of the original city were usually the first to give way. With the encroachment of commercial establishments and light industries on this area, new higher valued residential districts usually shifted in the direction of the city's outskirts. This movement has brought a succession of lower-valued residential uses in the transitional zones surrounding the city's heart and frequently resulted in blighted neighborhoods. Timely redevelopment or redesigning of the transition areas could have contributed (and sometimes did) to the vigor and vitality of the urban economy. But when the succession process brought lower uses faster than properties were redeveloped, blight often heralded the emergence of slums.

No two cities have grown and expanded in the same way. Variations in the succession of their land use patterns reflect commercial and industrial trends, local business conditions, city leadership, the attention given to urban planning efforts, and frequently most important, the activities and imagination of urban land developers.

Hoyt's Sector Theory

An insightful explanation of the growth patterns found in America's cities of the 1930 period is provided by Homer Hoyt's sector theory of urban growth. (<u>The Structure and Growth of Residential Neighborhoods in American Cities</u>, 1939). Hoyt saw the average city as starting with a central business district and numerous sectors or slices extending out from a central business district to the city's outskirts. He then argued a theory of axial development in which the land uses found in the various sectors tended to expand outward usually along the same axis, along principal transportation routes, and along the lines of least resistance. This theory provides a logical explanation for string-street developments and for the tendency of commercial districts to expand along important streets and to sometimes jump several blocks and then reappear along the same street. Where possible, factory and industrial districts tended to continue their expansion along railroads, waterways, and sometimes principal streets.

The sector theory assumed urban growth with succession in land uses in already developed areas and in new developments around the fringe of the city. Commercial areas were usually contained by surrounding areas devoted to other uses and could be expanded only through the acquisition and redevelopment of neighboring uses. Properties in high-value residential areas filtered down to lower-cost residential uses as their occupants shifted to newer, high-prestige locations. Some intermediate- and low-cost housing resulted from the filtering-down process, but a high proportion of the housing occupied by low- and intermediate-income groups was built on new ground as urban growth caused the sectors used for these purposes to expand outward and beyond the city's outskirts. The sector theory still explains many urban land-use developments, but changing conditions have made it a less meaningful explanation than it once was.

Adjustments for Multiple Nuclei

Hoyt's sector pattern was a product of a society that was affected to a far greater extent by transportation constraints than are today's cities. Several important developments have conditioned his conclusions. Our cities are much larger both in population and in land area now than they were. The downtown areas that were once served by streetcars are now served by superhighways, express buses, and underground rail systems. The superhighways that were designed to bring produce and buyers into the city are used just as much by urban workers to live outside the central cities. Industries that were once bound to downtown locations by their need for locations near railroad facilities have found that they can operate with trucks at more distant sites where they have room to expand. Commercial operators and service workers have followed the exurbanites and moved away from downtown centers to be near the residences of their principal customers.

The combination of these factors has brought changes in the structural layout of cities. Downtown areas that were once the hubs of commercial activity and the points to which major portions of a city's street traffic often seemed to flow have retained many of their functions but no longer provide the single pinnacles of commercial rent-supplied property values they once did. Space in downtown areas is still used for financial institutions, corporate headquarters, huge office buildings, major hotels, and entertainment centers but many of their commercial uses have migrated to other areas in the city. Instead of the rent-derived land values of the central city rising like a single mountain peak on a topographic map and then tapering off toward the outskirts of the city, our larger cities now have several peaks of varying height that represent the presence of numerous urban nuclei.

Central business districts are no longer the only places at which one expects to see multistoried structures. Huge office buildings, hotels, and intensive commercial developments line the major streets. Grocery stores with their need for parking spaces led the shift away from the urban core to places where they could better serve the needs of local residents. With the rise of shopping centers during the late 1900s, department stores, apparel shops, and other service-oriented businesses were quick to follow the move to suburban locations. Industries that have been considered as fixed to particular sites now feel free to relocate to completely new sites that offer them more space for expansion or parking. Provision of sites for parks, playgrounds, schools, and churches also called for urbanization of nearby rural areas.

The areas used for housing followed much the same trend as in earlier years with wealthier residents tending to move away from older settled areas and leaving their houses to be trickled down to lower-income residents. Many wealthy residents moved to outlying sites that offered special amenity attractions, such as lakes, golf courses, and considerable open space. Middle income families often moved to outlying suburban neighborhoods that were enclosed on four sides by major streets, which were soon lined with commercial developments.

Considerable private renewal took place in some cities where older housing in and near prestige neighborhoods was torn down to provide space for newer and larger homes. Gated communities were established in some areas to protect and enhance residential property values. Multistoried condominiums located in and near the downtown heart of cities also became common phenomena as developers recognized the desire of numerous families to live close to downtown attractions.

With the growth and outward expansion of urban areas, the traditional concept of a city lost much of its meaning. Cities no longer stood alone. Even the smaller cities were soon surrounded by clusters of towns and suburbs. The larger clusters took on a new designation as standard metropolitan areas (SMAs). Cities within the SMAs still retain their political boundaries and are governed by their own officials. But they share common economic and social problems with each other that call for joint efforts both in planning their future and in providing services for their residents.

Most of the older cities that provide the economic hubs for their SMAs face complicated problems in choosing approaches that can bring the needed rejuvenation of worn-out and deteriorating past developments. Efforts are needed to update aging urban infrastructure and for replacing or putting a new face on older structures. Well-orchestrated planning and renewal efforts are needed to bring brownfield areas back into productive use, to both acquire and make properties "shovel-ready" for redevelopment, and at the same time respect the concerns of the people who now live in the downtrodden areas.

New Directions in Urban Development

Ability to produce and sell products and services to outside areas has long been recognized as a prime requisite for urban growth. Throughout the 1800s and most of the 1900s, material-orientation, favorable location relative to sources of raw material supplies for manufacturing, or transshipment points for materials accessibility, provided a leading explanation for the growth of the nation's larger cities. Heavy industries prospered, because of their favorable locations, and once they offered opportunities for employment, workers came to them.

Two new trends have brought an important change in this situation. Heavy industries are no longer the all-important part of the nation's economic equation they once were. There has been a relative increase in the number of "footloose" industries, such as the electronic, pharmaceutical, and information technology industries, which are free to locate almost anywhere, because their locations are not tied to particular sources of raw material supplies. Furthermore, technological improvements, such as the pelletizing of iron ore and the increased recycling of iron products, and transportation improvements, such as increased reliance on truck rather than rail deliveries, have made many once heavy industries more "footloose" in their location decisions.

A second major development has come with the increasing importance of service sector employment as compared with jobs in manufacturing and agriculture in our national economy. This means that fewer of the nation’s workers need to live near sites tied to fertile ground or manufacturing centers. More people can now live where they want to and entrepreneurs who need higher skilled workers find it advantageous to locate in places rich in natural resources and amenities. Service sector jobs follow as these same knowledge workers are willing to pay for quality-of-life services.

A third major development of increasing consequence is the phenomena known as outsourcing. Globalization has opened up world markets for trade and provided opportunities for operators to shift large segments of the labor costs of manufacturing their products to low cost labor areas in less developed countries. This situation can be expected to continue as long as producers find they can operate with lower labor, energy, and shipping costs, and with less concern for dealing with institutional regulations and restraints than their former sites. With globalization and outsourcing it is now possible for producers to profit while selling their products at lower prices. This trend also has the regrettable feature of displacing workers who have no replacement for the lost income. Significant charges of unfair competition can be raised if the employment of low cost workers involves child labor, working under unsafe or unhealthy conditions, or with disregard for negative environmental externalities like low cost (or free) waste disposal into the natural environment at the high cost of human or environmental health. Meanwhile, outsourcing provides major problems for displaced workers who often have a difficult time locating another job, especially if overall job openings have shrunk or disappeared.

The challenge of finding needed employment opportunities is one of the most significant issues society must face. Viewed in an economic support and demand context, we must recognize that on the supply side we are facing problems in finding suitable work opportunities for an increasing labor force. Growth in the U.S.'s work force from population increase has increased more than three fold in the last century. In 1900, thousands of workers labored for 10 to 12 hours a day to supply work needed by society. By 1940, the average work week had been reduced to 40 hours, a standard that has largely been unchanged.

In 1915, more than half of the U.S. work force was still living on farms. That percentage dropped to about two percent in 2000, which marked a radical shift to the urban environment. Millions of women joined the urban workforce following WWII and, by 2010, it was normal for couples to both have a paying job outside the home. While more workers are available, technological developments have impacted the picture by making it possible for machines to do jobs that were once done by human labor. By any measure the productive potential of the U.S. work force has increased exponentially during the last century with the resulting challenge of fully utilizing that potential.

The increased size of the work force, primarily located in urban settings, presents the problem of inability to purchase and consume without jobs that provide for a moderate income level. Excessive unemployment in the urban workforce is a matter of worldwide concern, not primarily because of shortages, but because of a lack of demand for products due to the inability to purchase. This stands in stark contrast with the movement to urban centers and associated increased buying power during past, more prosperous, economic times.

People generally prefer living at sites that offer rewarding opportunities to enjoy economic, cultural and educational advantages, places where they can enjoy the amenities of pleasant and wholesome environments, places where they can have fun and expand their prospects for living and enjoying productive lives. Communities that offer these amenities now enjoy the best prospects for growth. With them the old rule of jobs attracting people has changed to *"provide the living environment people want and the jobs will follow"* (Soji Adelaja, "Making Strategic Growth Happen").

Environmental Impacts

Where economic activity takes place can have pervasive effects on how the environment and its resources are viewed. Transportation improvements have a great potential for enriching our lives by giving us access to more materials and allowing us to travel faster and farther than ever before. Insofar as they contribute to exploitive uses of the earth's resource base and to its pollution, they have adverse effects on the environment. The growth of cities has provided many families with opportunities to earn higher incomes and live at higher levels than they otherwise might. At the same time, the burgeoning growth experienced by major cities in several developing nations has brought undesirable environmental consequences by magnifying the problems many cities face in feeding and housing people under conditions of high un- and underemployment.

Traffic conditions have worsened as have substandard living conditions with the ballooning of urban populations. With high levels of unemployment for unskilled workers, thousands of prospective workers, many of whom have come to the cities to escape bleak rural poverty, have merely moved from areas where their plight could go unnoticed to places where its festering can lead to mass disorder.

In areas, such as the United States, adjustments in location factors have freed industries, commercial operations, and workers from much of the tyranny of site that bound them to more central locations. This situation has had both good and bad environmental effects. Relaxation of transportation constraints has made it possible for thousands of urban workers to live and work at locations where they enjoy the use of more space. Their outward movement from central cities, however, has often generated traffic and air pollution problems and deprived the cities of needed tax revenues.

Freedom from need to locate at water power sites made it possible for textile mills to move away from the millponds of New England to a warmer climate in the South. Further advances in communication and transportation technology have since made it profitable for corporations to outsource their production to factories at low-labor cost sites in other parts of the world. Whether this has been better for the environment depends upon how the areas are affected and the point of view of the person impacted by these changes. When new enterprises have provided displaced workers with comparable or better employment opportunities, the movement of industries to new locations has had a minimal effect on local environments. When this has not been the case, local economies have sometimes been devastated as workers have been left without jobs, industrial and commercial facilities have fallen into disuse, and local governments have been left with inadequate tax revenues to provide needed public services.

Movement to new industrial and commercial sites often means that workers at the new sites benefit from better work opportunities and ability to use new equipment and facilities. But when industries move to reduce labor costs, their action can bring a narrowing of the economic opportunities available to workers in the areas left behind if commensurate employment opportunities are not provided.

Maintaining a Level Playing Field

Most economists agree that products should be produced at the sites for which they have greatest comparative advantage. This assumption can be challenged, however, on ethical, moral, and environmental grounds when the comparative advantage springs from lower wage rates, unsatisfactory working conditions, and/or environmental abuses that would not be tolerated in the domestic markets where products are sold. A level playing field for competition between producing areas cannot exist when production is outsourced to countries that subsidize their exports or that pay lower wages for labor, operate with less safe working conditions or with less regard for maintenance of environmental protection standards than those legally sanctioned in the areas where goods are marketed.

It may be argued that outsourcing is desirable, because it is a needed feature of globalization, and because it can provide goods and services at lower costs for consumers while securing profits for their promoters. Proponents of this view argue that the displaced workers can find employment in better jobs. This can be true if factors, such as the provision of an attractive living environment or measures to upgrade worker skills attract replacement enterprises. It must be noted, however, that wage rates are generally higher for workers in manufacturing and productive enterprises than for service workers and that opportunities for employment in most of the more developed nations is becoming increasingly service-oriented.

Outsourcing of good paying jobs to other areas can lead to gradual improvements in working conditions in those areas. Without an increase in alternative work opportunities for the displaced workers, however, the outsourcing process can have a depressing impact on the opportunities thousands of workers have for securing sources of income that will allow them to live above the poverty line.

Chapter 10: Resource Use in the New Economy

"Don't think out of the box: there is no box."
~ Soji Adelaja (2008)

The earlier segments of Part Two dealt specifically with economic considerations in natural resource use. Key assumptions, laws and concepts in economics were presented. Underlying these concepts is the neoclassical theory of economics, which focuses on the input/output relationships in production to explain the roles of markets in allocating resources. Production and markets are critical elements of the neoclassical economy, which relies largely on rational behavior on the part of producers and consumers. However, neoclassical theory has limitations and does not fully explain emerging economic phenomena in society. Therefore, it may not be an appropriate framework for management decisions related to natural resources, land and the environment in general.

Chapter 5 presents the rudiments of supply and demand, highlighting the usual input/output relationships in production, the law of diminishing returns, the three stages of production, declining average cost curves and increasing marginal cost curves. These concepts highlight the tendency in economics to use assumptions to create a convenient framework for analysis. Whether or not the assumptions are realistic and the analysis appropriate depends upon how closely neoclassical theories capture the reality of today's society.

Chapter 6 delves into the nature of land, highlighting the concept of rent, treated as an economic surplus, as a return on investment, and as an unearned increment. It also explains the value of land and applies the concepts to resource development decisions. In Chapter 7, the costs and costing of a project are discussed. That chapter explores concepts, such as economies of scale, externalities, cost evaluation, benefit-cost analysis, and development issues. Chapter 8 leverages the earlier chapters in looking at conservation related issues.

Chapter 9 puts all of the above in the context of location, showing how production, consumption, allocation, market, and other concepts work in the context of a given location. It addresses issues, such as comparative advantage, spatial relations, the treatment of quality differentials and space, the structure of urban markets, and the temporal dimension of space. In other words, it ties economic principles to land and place resources, highlighting such things as the roles of cities, suburban land use patterns, emerging land use issues, environmental impact and inter-location equity.

The five chapters that comprise Part Two represent key rudimentary material for a solid understanding of traditional thinking in land and natural resource economics. However, by ignoring some of the fundamental changes that have occurred in the nature and structure of the economy in recent decades, they fall short of providing an adequate explanation of the present day landscape for optimal resource management. In the rest of this chapter, we introduce the New Economy concept, a theme that is rapidly emerging as a new paradigm. This chapter will highlight the implications of the New Economy and how it impacts the way we look at resource management.

The term "Old Economy" was coined to describe the prevalent industrial and manufacturing-based economy that dominated much of the 20th century. This was the economy within which most advances in land and resource management and policy were accomplished. The term "New Economy" was coined to describe the economy that emerged in the 1990s following the advent of new information technology, new communications, the Internet, and the subsequent emerging global trends. The term "New Economy" evolved out of the recognition that information and communications technology so radically changed the world that the paradigm for the successes of people, businesses, industries, and places changed radically as well.

What is the Old Economy?

The Old Economy refers to the industrial economy that dominated many parts of the United States and the industrial world for almost 200 years. This made the U.S. economy one of the most prosperous in the world. Economic prosperity boomed in areas that were rich in natural resources, such as timber, minerals and agricultural resources. During the 19th and early 20th centuries, industries developed in the places where these resources were found. Generally speaking, fossil fuel-powered machinery transformed raw materials into manufactured goods for household and business consumption. Logging, flour milling, brewing, and distillation industries are familiar examples. Communities and regions were defined by the goods they produced, such as steel (Pittsburgh, PA) and automobiles (Detroit, MI). The neoclassical model of the economy certainly explained the rudiments of the economy during the industrial age.

In the most general way, a basic premise of the Old Economy was that profits could be generated once a competitive manufacturing advantage was achieved. An advantage might be a better manufacturing process, better access to natural resources, a more productive or skillful labor pool, or lower costs. Development of these manufacturing facilities required huge capital outlays and long-term planning. In order to remain competitive, manufacturing facilities located in low tax and low wage communities to reduce their operating costs.

Cities and population centers were molded by geography and transportation routes. Many places with ports proudly shipped goods and materials worldwide. The Old Economy industrial model was very successful, generating an extraordinary amount of wealth in the 19^{th} and 20^{th} centuries, and enabling the construction of magnificent urban settings. Equally as important, this wealth funded the development of highly respected and prestigious institutions, such as colleges and universities, museums, and hospitals.

The industrial success also created unprecedented wealth and opportunities for workers. For the most part, the labor markets were regional. Communities competed for manufacturers by offering incentives to develop facilities there. The talent market was largely regional. Manufacturing created the jobs and people followed. In return, laborers demanded and received higher wages, comprehensive health care, job security, and generous retirement benefits. Under these labor contracts, workers could graduate from high school, enter the middle class, and comfortably retire two or more decades later. This was a life path that had never before been open to unskilled labor**.** In return, companies enjoyed a labor supply that was generally loyal to the company.

Our great manufacturing centers and industrialized nations developed into such prosperous places because they became cost competitive. They became cost competitive by developing technological innovations, by increasing labor productivity through training, and most importantly, by managing the risks associated with large investments. Successful companies effectively combined and managed capital and equipment, skilled labor, and abundant raw materials. Places with these successful companies flourished.

While people in many parts of the world had not figured out how to make these key elements of prosperity work for them, the United States did, and consequently thrived. It created a well-paid middle class that could afford the very goods that they produced as skilled workers. With a growing and increasingly prosperous middle class, economic growth and prosperity were almost guaranteed. Uncertainties were few and small. Risk was low. This economy attracted the wealth of other nations, which in turn, further fueled the American economy. By this process, America leveraged global capital and gained easy access to credit. As a result, the working class was able to buy homes, cars, television sets, and an unprecedented amount of services previously not achievable.

Most American communities are built on the Old Economy paradigm, which no longer works. Old Economy towns most often feature heavy manufacturing infrastructure. The currency for growth and development was found in attracting manufacturing companies with significant plant capacity. People followed jobs, which were concentrated in places that already had them. Because of the huge capital outlay and long-term planning involved in establishing a manufacturing facility, communities could usually keep whatever economic activity they had for a long time. Based on its agglomeration of manufacturing infrastructure in a growing post-WWII economy, the U.S. captured a stable and steady portion of global growth. All that American cities and communities had to do was to position themselves to capture a healthy portion of that growth. Of course, it is easy to see from the above summary how natural resources came to be viewed largely as inputs into the production process, not as outcomes that society wished to maximize. The New Economy framework allows this paradigm to shift in the treatment of natural resources.

Post 1990s Global Economy

This economic model was prosperous until the 1990s, when information technologies, telecommunications, and a global economic network revolutionized the way business is done. Goods are still manufactured today, but greater economic value is created through information technology, telecommunications and the global economic network. A whole new set of high-valued services are now available outside of the manufacturing or goods production domain. The creative ideas that go into product development, design, and distribution, not the production of the product itself, are what lead to the emergence of high-wage advanced industries. Think of the Dell Computer Company as one example. It allows consumers to go online and design their own computer, instead of buying a ready-made model.

Successful industries of the Old Economy created jobs where there were natural resources and quality labor to leverage for economic opportunities. People migrated to these places to find employment. In the New Economy, the old industrial centers have become vulnerable. Jobs are no longer tied to particular manufacturing locations; jobs now tend to follow people. People and capital are migrating to knowledge centers (such as university towns) or other desirable places. One example of this is Silicone Valley, which has exceptional "entrepreneurial spirit." There are other desirable places, which have become centers because of the quality of life they offer.

What is the New Economy?

The New Economy refers to a global, entrepreneurial, and knowledge-based economy. Businesses are now succeeding by incorporating knowledge, technology, creativity, and innovation in their products and services. A good example is the purchase of a high-end Microsoft software product, which can cost up to $400, but the manufactured component could be as low as $2 (the blank CD and the packaging). Even the instructions now have to be downloaded. The ability to produce high-valued products, based largely on human knowledge capital and not natural resources, and through a production process that is essentially virtual and creativity dependent, raises questions about the direction of our dependence on natural resources as inputs into quality-of-life products. This paradigm shift is also affecting how we view capital.

Increasingly, as a larger percentage of our economy has become knowledge dependent, the nature of needed capital has changed, and venture capital has become more critical to business development and job creation than it was in the past. New forms of capital are flowing to businesses and places where knowledge and creativity are highly valued and abundant. Although rising rapidly, employment in New Economy industries is not yet large enough to offset the losses of manufacturing jobs. However, New Economy jobs have the potential to become a strong foundation for continuing, future and sustainable economic development.

While this book is not about the New Economy, it covers just enough to make the reader comfortable with the concept and with the needed changes in our viewpoint to be able to benefit from the knowledge of the New Economy in resource management. To this effect, we provide a summary of the five features that characterize the New Economy: 1) It is global, 2) knowledge-dependent, 3) rooted in information and communications technologies (ICT), 4) driven by innovation, and 5) is entrepreneurial in nature. Each of these characteristics is reviewed below.

The New Economy is Global

"Global" has a much larger and different meaning today than it did even 25 years ago. Many more nations are part of the global marketplace than ever before. Since 1980, global trade has grown 2.5 times faster than global Gross Domestic Product (GDP) (Adkinson and Andes, 2008). The reader may recall that GDP is the total cost of all finished goods and services produced by a country in a year. Manufacturing is also now highly interconnected in a global supply web. Manufacturers, their suppliers, their shippers, and everybody connected with the production and delivery of their goods are globally integrated through advanced information technologies. Nearly 20 percent of world GDP is in exports (Ibid).

The New Economy essentially means that each national or place economy is no longer a simple closed system whereby resources are constrained geographically. Countries have become more reliant on natural resources from other countries, especially in the cases where markets exist to facilitate trade. In fact, the world is witnessing heightened cross-county dependence and possibly even monopolies of resources in some countries by other countries. One illustrative example of this is the growing global concern over China's interests in rare earth minerals and their willingness to provide financial aid to countries with critical natural resources that China needs back home (Bradsher, 2010). The expansion of trade opportunities not only opens access to foreign natural resources, which, in the context of the resource dependent nation, have less impact on the environmental resource base. In this regard one can no longer view the resource management challenge of society as a closed system that will guarantee optimal resource allocation to meet the needs of society. The concept of input substitution becomes more nebulous. Therefore, globalization has changed the natural resource management problem significantly enough to warrant a revisiting of the concepts laid out in chapters five through nine.

The New Economy is Knowledge-Dependent

Skilled workers and managers have always been important to the economy, but the importance of knowledge and creativity has grown enormously in the global New Economy relative to natural resources. As creative professionals who more readily can integrate information and communications technology into goods and services, knowledge workers capture high shares of the values of today's goods and services. One key implication for resource management is that natural resources used to be viewed as relatively abundant while human capital and creativity were considered more rare and scarce. The emerging New Economy recognizes that the quality of human capital (the value of a mental capacity to think, create and innovate) now represents a larger share of what drives economic performance and development. So, places that are rich in creative and innovative human capital can thrive without significant reliance on natural resources as inputs into the production process. The emerging New Economy also recognizes that natural resources are attractive to a wide variety of population segments, especially those whose presence in a community can add significant economic value. One important implication of this is that the range of factors that explain society's objective function has expanded. Another is that human capital now enables indirect resource management through lesser reliance on the consumption of resource-depleting products that once dominated the economic landscape.

In 1979, "knowledge workers" comprised 22 percent of total employment in the U.S. By the 1990s, these workers became the largest occupational category. By 2003, they were 34.8 percent of total employment; while only seven percent (one in fourteen!) was employed as a production worker in manufacturing (Ibid). And now even these workers must constantly expand their knowledge and skills. Unlike the Old Economy, it is now very difficult for high school graduates to find a good paying job that will last them through retirement. Instead, the jobs that are being created today require education, computer skills, and an entrepreneurial spirit. This is very different from the world according to neoclassical economics, which laid the foundation for this book.

The New Economy is Based on Information and Telecommunication Technology

The impact that computers and telecommunications have had on our lives should not be underestimated as computers have become so powerful, fast, inexpensive, and pervasive. Personal computers and computer networks are now used almost everywhere and everyday but before the 1990s they were practically nonexistent. Information technology allows industry to produce, manipulate, store, communicate, and distribute information much more efficiently than ever before. Information technology has increased productivity, improved product quality, driven innovation and eliminated major classes of employment, which were previously very relevant.

One obvious area of significant payoff is the ability to produce value without consuming exorbitant amounts of natural resources. For example, only a few years ago a professor often had to use a significant amount of copied materials, overhead slides, chalk, and a large classroom to accomplish his undergraduate course. Today, online courses are possible, the use of PowerPoint (or similar products) allows electronic presentations beyond the classroom, reference materials can be downloaded from the internet, and key relevant materials can be made available to a large number of students electronically. Of course similar changes can be found across the board, and the resource use reduction implications of these technological advances are tremendous and there is significant promise of a much less natural resource-dependent society in the future.

The widespread availability of information technology has also revolutionized the way business is conducted. The vast majority of economic growth is attributable to high tech, new tech, and clean tech companies, while traditional industries are shedding jobs. Information can now be shared instantaneously and globally, creating significant value through products that do not have to travel on roads and bridges, through ports and customs, or through traditional warehouses, storage facilities and retail stores. Customers and business now speak and think in "24/7," and in a mode that is less natural resource dependent, changing the value generation process in ways that significantly reduce natural resource reliance.

The New Economy is Driven by Innovation

The instantaneous availability of information has encouraged the development of new business models, new products, and new production methods. In part, this growth in innovation resulted from businesses competition all over the world and the development of global supply networks. Individuals and businesses now have access to so much more information and so many more opportunities that new ideas can be generated and tested at a much higher rate than before. For example, since 1984, the number of patents has increased by over 160 percent (Adkinson and Andes, 2008).

The Old Economy paradigm treated technology and innovation as slow and deliberate processes whose impacts on the production process were minimal in the short-run. Technology was viewed largely as extraneous to the optimization of resource use and one where major changes were few and far between. The range of new ideas and technologies has made it necessary to treat technology and innovation as direct inputs in production, not as factors that we assume to be constant as we think through the resource management problem. For example, since major new advancements in the technology and policy environments are imminent, increasingly resource management professionals will be expected to consider these in the decisions they make.

The New Economy is Innovative and Entrepreneurial

Perhaps, because individuals have access to so much information, the New Economy is sparked by a wave of creative individuals who see new opportunities and are able to implement them. To be sure, innovation and invention were very important to the Old Economy. Many of our industrial advances sprang from early ingenuity. But in the New Economy the influence of entrepreneurs is far greater. An entire sector of the economy has developed to incubate new businesses and to provide start-up capital. The impact of these new companies on the American economy has been remarkable. Between 1917 and 1977, it took approximately 30 years to replace one-half of the 100 largest public companies. Between 1977 and 1998, it took approximately 12 years. Between 1980 and 2001, virtually all net U.S. job growth was from firms less than five years old (Ibid).

The relevance of this aspect of the New Economy lies in what we can do to promote an innovative environment and an entrepreneurial community. For example, more and more governments are choosing economic gardening (supporting local entrepreneurs) over economic hunting (attracting companies from other places, especially manufacturers). Evidence suggests that local firms with the potential to benefit from economic gardening are less resource dependent and have tended to generate greater benefits than traditional companies who rely on economic hunting. Emerging economic clusters to which economic gardening strategies tend to target typically include biomedical, life sciences, financial, and other private sector segments, which have less significant environmental and natural resource footprints.

Comparing the Old to the New Economy: A Resource Perspective

The above suggests a drastic enough change in the structure of the global economy that we have to revisit the basic principles of economics as they relate to people, businesses, and places. Table 10–1 below illustrates the key difference between the Old Economy and the New Economy, particularly focusing on the roles of amenities and natural resources in industry and places. As shown in the Table 10–1, one can summarize the New Economy as one where talented and knowledgeable people are attracted to places with a quality of life that includes green and recreational amenities, and economic activity follows them. This involves a radical change in the view of amenities, natural resources, and environmental factors.

Table 10–1. Comparison of the Old Economy and the New Economy with Respect to Place

Key Feature	Old Economy Paradigm	New Economy Paradigm for Companies	New Economy Paradigm for Places
Prime Location	Companies chose inexpensive places to do business and people followed.	Companies choose places that are rich in talent and that promote great ideas.	Places need to attract talent and promote great ideas.
Prime Economic Driver	Attracting industries was key, especially manufacturers.	Companies are attracted to places rich in human capital.	Places need to attract and retain educated people.
Amenities and Natural Resources	A high-quality physical environment often stood in the way of attracting cost-conscious businesses.	Companies attracted to places with talented knowledge workers who value natural resources and amenities for quality of life.	Places need to preserve and enhance natural resources and amenities.
Competitive Advantage	Based on existing natural resources for production and the skill levels of labor.	Based on the ability of companies and workers to learn, adapt, network and connect.	Places need to be flexible and promote lifelong learning.
Economic Development	Government-led (large government meant good services)	Companies seek out places that promote shared leadership by private, civic and government sectors.	Places need to promote shared leadership by private, civic and government sectors.
Specialization and Diversification	Industrial sector (manufacturing) focus.	Companies seek sectorally diverse places and clusters with related activities.	Places need to promote sector diversification and the clustering of related sectors.
Energy	Fossil fuel dependent manufacturing.	New Economy companies seek places with diversified energy supply.	Places seek reliable sources of renewable energy and seek to expand their ICT infrastructure.
Population/ jobs Dynamic	People followed jobs.	Companies follow educated people who seek places rich in amenities and quality of life.	Talented, well-educated people tend to choose location first, then look for or create a job.
Access to Raw Materials and Transportation	Location mattered (esp. relative to transportation and raw materials).	Companies are more interested in knowledge infrastructure. Natural resources are amenities and create places with high quality of life.	Places should invest more in things that enhance quality of life, including natural resources as amenities.
Green Economy and Environmental Stewardship	Dirty, ugly, and a poor quality environment were common outcomes that did not prevent growth.	Companies interested in clean/green environments, proximity to open space and quality recreational opportunities, because people do.	Investing in clean, green environment, proximity to open space and quality recreational opportunities are critical.
Globalization	Connection to global opportunities not essential.	Companies value the global connectivity of a place and cluster around globally connected companies.	Connection to emerging global opportunities is critical for government.

Source: Dr. Soji Adelaja, Land Policy Institute, Michigan State University, 2011.

The table above provides some useful insights about how significant the transition from the Old Economy to the New Economy has been. Not only does it suggest a different role for natural resource-based amenities, it explains the dynamic relationships between people, companies, natural resources and specific locations. Natural resource use is place sensitive, as places feature varying natural resource assets. Traditional places with significant natural resource endowment historically tried to leverage such endowment for economic advantage. It appears that a prime driver today it is not so much the abundance of a natural resource asset that is useful in production, but rather what communities have done to highlight and enhance the amenity benefits of their natural resource endowments.

A good example of the challenge implied by the shift from Old Economy to New Economy models can be found in the views and perspectives of people and communities about trails. In the distant past, in a significantly industrial-oriented community, trails constructed to connect critical green places across town had practically zero economic value. In fact, the channeling of an unnecessary trail could cut down on land productivity, in this case, by taking land out of production that would otherwise be used to enhance agricultural production. Similarly, because few developers and their customers were appreciative of the aesthetic value of trails, most new housing did not end up near man-made trails, but near rural artifacts for those who valued and enjoyed camping and other activities in the woods. But today, in recognition of the growing desire of the knowledge and creative classes of our population to live in places where they have easy access to trails, bike paths and other man-made natural amenities, developers are integrating well-defined trail networks and correspondingly housing demand in these areas is rising. So, in some cases, the amenity value of trails gets incorporated into the value of homes through the amenity benefits that people receive through greater access.

Knowledge workers are particularly known to be natural resource dependent. According to research by Adelaja et al. at the Land Policy Institute (2009b), citizens entering the post-college phases of their lives and senior citizens are particularly drawn to a variety of what they have termed “green infrastructure.” The authors further argue that the effects of green infrastructure accrue to a community through enhanced job opportunities, enhanced incomes, population attraction, and a higher tax base. How does one account for these using the traditional production-centric neoclassical explanations of rent and wages? What is rapidly emerging is the notion that even the production process has evolved so rapidly that the traditional arguments made that natural resource management must be addressed in the context of a production economy (with labor, capital, and raw materials as key inputs), is no longer valid in many cases. The production functions presented in chapters five through nine were based on a limited set of production factors. As instructed by recent economic studies within the endogenous growth literature, the list of relevant factors in production or in the representation of how places utilize natural resources must now include explanations of key elements such as:

- Human capital—not just skills but knowledge, the ability to create, and the ability to innovate as with the creative class (Lucas, 1988; Mathur, 1999; Rauch, 1993; Glaeser and Saiz, 2003).
- Knowledge infrastructure—educational and social institutions have been shown to contribute significantly to the income potential of communities around them (Peck, 2005; Friedman, 2002; McGranahan and Wojan, 2007; Sassen, 1994; Howkins, 2002; Castells, 1989; Wu, 2005; Etzkowitz et al, 2000).
- IT infrastructure—including broadband (Kellerman, 2000 and 2002; Webster, 2006; Castells, 2000).
- Museums, cultural and social amenities (Clark, 2004; Florida, 2000 and 2005; Gottlieb, 2003).
- Parks, trails, green space and other green infrastructure (Deller et al., 2001; McGranahan, 1999; Scott, 2000).
- Rivers, lakes, ponds and other blue infrastructure (Deller et al., 2001; McGranahan and Wojan, 2007; Clark, 2004)
- Weather and climate (not just warm and sunny) (Barro and Sala-i-Martin, 1991).
- Regional strategies and interrelationships (Weinert, 2002; Bartik and Bingham, 1997; Santos, 1998; Alderman, 1998; Azfar et al, 2000).
- Economic gardening and entrepreneurship (Hackler, 2003; Lichtenstein and Lyons, 2006; Goetz and Freshwater, 2001).
- Formation of interlinked economic clusters and agglomeration (Feser and Bergman, 2000; Potter and Watts, 2010; Sadler, 2004).

The above suggests that if one were to try and use a neoclassical approach the equation would be unmanageably complex to fully explain the role of natural resources and amenities. Endogenous growth theory has recently emerged as an appropriate framework for representing the economies of places. This approach does not make the usual limiting assumptions inherent in neoclassical theories of the economy.

A more contemporary theory of place, place performance and prosperity and, therefore, of what a place has to do to be successful in the New Economy, can be captured in a new simplified model of growth. This model builds on the old neoclassical economic growth models, but the requirements for place performance exceed capital (*K*), skilled labor (*L*), management (*M*), and natural resource base and accessibility (*N*). The contemporary model includes such new factors as venture capital (*VC*), talent (*TA*), innovative capacity (*IC*), entrepreneurial capacity (*EC*), natural amenities (*NA*), urban amenities (*UA*), social capital (*SC*), digital communication capacity (*DC*), creativity (*CR*) and others. This contemporary Place model features a long list of factors that a community can now target in order to achieve prosperity.

From the above, the Old Economy model of production from which natural resource demand derives can be depicted as follows:

(1) $Q = f(K,L,M,N,t)$,

where Q is income, employment, population or any combination thereof that depict prosperity, *f* connotes function, and *t* represents the intangibles. The New Economy equivalent is:

(2) $Q = f(K,L,M,N,t, \mid VC,TA,IC,EC,NA,UA,SC,DC,CR,P)$,

where the two letter variables are listed in the paragraph above, and *P* is the symbol for Place. It is important to note that the inclusion of the place factor (*P*) is intended to capture the synergistic effects of the many factors that endogenous growth theory suggests give a location its unique signature, which makes it attractive for economic activity. A company equivalent of *P* would be such things as good will, reputation, and brand recognition. The endogenous growth model of economic activity, therefore, implies not only that natural resources are not necessarily plundered in creating economic value, but in and of themselves add value by increasing the productivities of other inputs in the production process. In Equation (2), place, which includes the natural assets of a location, and output, which captures the economic performance of a place, are directly related. The primary paradigm shift that makes Equation (2) realistic is the slowdown of the production or industrial economy and the relevance of a new economic paradigm where amenities and natural resources attract people and attract companies, thereby resulting in economic development. This stands in contrast to natural resources being used up in a production process in order to get to greater economic output that complements labor, capital and management.

It is also important to note from Equation (2) that relevance is shifting to the previously intangible factors. It is reasonable to conclude that locations have the attributes to also attract the new precursors of performance, such as venture capital and talent, because these are more mobile in the New Economy as prosperity is not tied to the traditional old production places. Since virtually all of the factors that are dominant in economic performance ultimately add to the place element, Equation (2) can be reduced to the following:

(3) $Q = f(P, a)$,

where a represents those drivers of performance that are not directly tied to Place or placemaking, such as a government facilities, schools, libraries, etc.

So Place and placemaking not only involve more options in terms of what places can do to achieve prosperity, but include elements that were not relevant in the past. These new elements represent opportunities to make significant advancements in place performance. So what is a Place? In this context, *a Place is a particular physical location characterized by a strong concentration of relevant (many formerly intangible) factors or amenities (based on the authentic assets of the location) that are assembled at, constructed in or attracted to that location in order for it to be more successful in the global New Economy*. More discussions about place, placemaking, economic activity and the role of natural resources can be found in several writings from the Land Policy Institute (Adelaja et al., *Chasing the Past or Investing in our Future*, 2009).

Why is the New Economy Important for Resource Management?

The manufacturing dependence in the Old Economy exerted significant pressure on natural resources. As mentioned in Chapter 4, the primary role of natural resources in a production economy was to feed the production process as an exhaustible resource. Waste was a byproduct of the process that was either returned back to nature as a pollutant or in an altered state from its original form as a raw material. In an environment of scarce natural resources, the big management issue was how to optimize resource use while guaranteeing prosperity.

The New Economy allows the creation of significant value without a production pass through. Also, in the New Economy, natural resources serve a role as a direct element of quality of life. This means that rather than treating raw materials as exhaustible resources, the waste from which diminishes the environment, they can be preserved or optimized in society's interest. So, in essence, the world has changed and the paradigm of resource management has changed as well.

The New Economy Paradigm and its Implications for Land Use Policy

The paradigm shift from the Old Economy to the New implies that the way we look at the role of land needs to change, and that this opens up new opportunities for land use professionals and decision makers to play a strong role in defining prosperity in their domains. In the New Economy, the connections between land use strategies and economic development are more direct, with greater implications for the future prosperity of places and regions. In the Old Economy, land use decisions and policies were largely reactive, effected in an attempt to maintain or enhance quality of life in light of the onslaught of growth pressures (decline pressures in distressed places) that were known with certainty to the land use decision maker, but were largely exogenous.

In the New Economy, growth is not guaranteed as a phenomenon tied to a place. Growth and prosperity are endogenous to a new set of drivers, knowledge workers and companies for example, whose choices of location are driven by quality of place. Prosperity is the result of how a community manages the precursors to growth. In the New Economy, an important goal of land use is to enhance place-quality so as to attract sustainable economic development. A community can "*placemake*" for the type of growth it wants. So, where land use strategies were aimed largely at managing the negative effects of growth, today such strategies are needed to attract good growth.

Part Three:

Institutional Considerations

Chapter 11: Property in Environmental Resources

"Property is the fruit of labor; property is desirable;
it is a positive good in the world."

~Abraham Lincoln

The natural resources we commonly associate with the environment fall into two classes. Some, such as the air we breathe, a view of rippling water, or of a gorgeous sunset, are free goods to which humans share rights of access. A somewhat larger second class, which includes land, minerals, and in many instances water, involves use-rights and competition among humans to secure those rights. In most cases rights of ownership have been assigned by social institutions to allocate possession and use. In this context institutions can be thought of as “the rules of the game” and it must be recognized that there are both informal and formal institutions that create and enforce what is called property.

Our behavior as individuals and as members of families, groups, communities and society is shaped by the recognized rights we have to use resources. These rights are allocated by cultural attitudes, legal arrangements, government programs, religious beliefs, household considerations, and other manifestations of the legal social system or of our cultural backgrounds.

Of all of these institutional factors, the rights we hold for using the earth's resources are of greatest significance in management of the environment. People covet and want land resources for their personal use and satisfaction. To secure this end, institutional arrangements have been devised that permit individuals and groups to exercise the privilege of owning, possessing, and utilizing specified resources while excluding others from exercise of these same rights. The system of rights represented by these arrangements provides the basis for the concept of property.

Property rights play an ever-present role in determining what people may or may not do with environmental resources. Understanding these rights, and how these rights are allocated, is essential if one is to comprehend human behavior and conduct with respect to land and water.

The discussion that follows focuses on the rights individuals and groups hold with respect to the earth's resources. It starts with a general commentary on the nature, characteristics, and scope of property rights and then proceeds to a more detailed examination of the various interests individuals and society have in real property, in water, in air, and in subsurface resources.

Nature of Property Rights

Property is a complicated legal concept. People often think of it as objects they can own and possess. In a legal sense, however, it consists not of objects but rather of the rights one might hold with respect to a material object. One court has defined it (McKeon v. Bisbee, 9 Calif. 137, 1858) as "the exclusive right of possessing, enjoying, and disposing of a thing." In truth though, it is more a person to person than a person to thing relationship. As A. Allan Schmid (Property, Power and Public Choice, p. 5, 1987) has observed: "Property rights describe the relationship of one person to another with respect to a resource or line of action."

As these definitions suggest, property can be seen as encompassing all of the rights a full owner claims or be limited to specific rights, such as those held under a lease or an easement. In more eloquent terms, Walton H. Hamilton and Irene Till wrote about property ("Property" in Encyclopedia of the Social Sciences, XII p.528–9, 1934) and noted that:

> *". . . property is a euphonious collocation of letters, which serves as a general term for a miscellany of equities that persons hold in the commonwealth. A coin, a lance, a tapestry, a monastic vow, a yoke of oxen, a female slave, an award of alimony, a homestead, a first mortgage, a railroad system, a preferred list and a right of contract are all to be discovered within the catholic category. Each of these terms, meaningless in itself, is a token or focus of a scheme of relationships; each has its support in sanction and repute; each is an aspect of an enveloping culture. A Maori claiming his share of the potato crop, a Semitic patriarch tending his flock, a devout abbot lording it vicariously over fertile acres, a Yankee captain homeward bound with black cargo, an amateur general swaggering a commission he has bought, an adventurous speculator selling futures in a grain he has never seen and a commissar clothed with high office in a communistic state are all men of property. In fact, property is as heterogeneous as the societies within which it is found, in idea, it is as cosmopolitan as the system of thought by which it is explained."*

Attributes and Characteristics

Property has many important characteristics. It is an attribute of human beings, not of chattels. It can be held by individuals, groups of people, or by governments as public property. It involves rights to the use of material things, not personal rights or liberties. It differs from free goods in the sense that it involves only appropriable objects of value that people can possess. Furthermore, it is an exclusive, not an absolute, right. Individuals can hold property rights alone or share them with others to the exclusion of all other persons. Their rights of use include the rights of access to use, manage, and develop, to hold rights in continuity or alienate them by transferring them, in part, or entirely to others and to coerce others by withholding privileges with respect to property that others may want to enjoy.

The rights one holds in property are always subject to the supervision, as well as the protection of a sovereign power. In our society, the existence of property rights presupposes the presence of 1) an owner together with other persons to be excluded from the exercise of property rights; 2) a property object that can be held in private or public possession; and 3) a sovereign power that will sanction, and if necessary protect, the property rights vested in individuals or groups.

Property involves exclusive rights. These rights obviously cannot exist until there is both an owner to possess rights to use the object in question and other interested persons who can be excluded from possession and use. Property, as we know it, simply does not exist in areas where there is no population and no outside claimants. Nor does it exist in those isolated instances in which a single user, such as Robinson Crusoe, may be present. Property rights come into existence only when two or more people compete for the possession and use of some object and need develops for the allocation of recognized rights between them. In this sense, the concept of property involves more than a simple relationship between persons and things. It involves relationships among people regarding their rights to use and to exclude others from the use of particular objects.

Before property can exist there must be a property object. These objects usually involve material things, though they may involve quasi-material items, such as franchises, patents, copyrights, industrial good will, or rights held under contracts. Two additional attributes of property objects are their appropriability and value. Before anything can be classed as a property object, it must be capable of appropriation. The lands beneath the deeper portions of the ocean and on the face of the moon are not property, because they have not yet been appropriated for human use. Free goods, such as air and ocean water can be appropriated. But in their natural state, they cannot be considered as property unless they are contained for a person's exclusive possession.

Our supply of property objects has come from two primary sources; the capture of free goods and the creation of new goods through the processing of existing resources. People ordinarily try to capture, develop, or produce things that have value. By accident, or as a byproduct of their activities, they sometime produce things of negative value, such as slag from mines. They may also continue to hold objects that have lost their value. But as a general rule, property objects have value. Otherwise, owners would have little incentive for the continued retention of their property rights.

As a final requirement, the existence of property implies the assent or sanction of a sovereign power vested with both authority and ability to protect the rights of its subjects. People have been able on various occasions to acquire and hold objects they desire through cunningness or sheer force. By these means they can acquire possession but they do not acquire property rights unless a sovereign power recognizes their claims. Property rights, and with them the right to exclude others from the possession and use of an object, arise only when a sovereign authority—the family, clan, tribe, or the state-recognizes and enforces one's exclusive right of possession.

The dependence of the property concept on the protection afforded by sovereign powers is best illustrated by examples of what happens when this power is weak or destroyed. Children often appropriate the toys of others. Lawlessness sometimes breaks out when the enforcement powers of government appear weak or ineffective. Pillaging frequently follows natural disasters. Similarly with the breakdown of authority that comes with armed conquest, personnel of conquering armies often feel free to "liberate" private possessions of the vanquished.

Bundle of Rights

Property involves several distinct interests or rights, which can be held separately and which when taken together represent a "bundle of rights." The largest bundle of rights a private owner can hold in landed property is known as complete ownership or as ownership in <u>fee</u>

simple. Fee simple owners hold what might be envisaged as separate sticks or rights, such as those shown in Figure 11–1. They have the right to possess, use, and within reason exploit, abuse, and even destroy their land resources. They can sell land with or without deed restrictions that affect its future use. They can give it away, trade it for other things, or devise it in any of a number of ways to heirs. They can lease use rights to others; mortgage their property or permit liens to be established against it; subdivide their holdings or grant easements for particular uses; enter into contractual arrangements involving its development, use, or disposition and exercise these rights, as long as they have not disposed of them to the exclusion of all other persons.

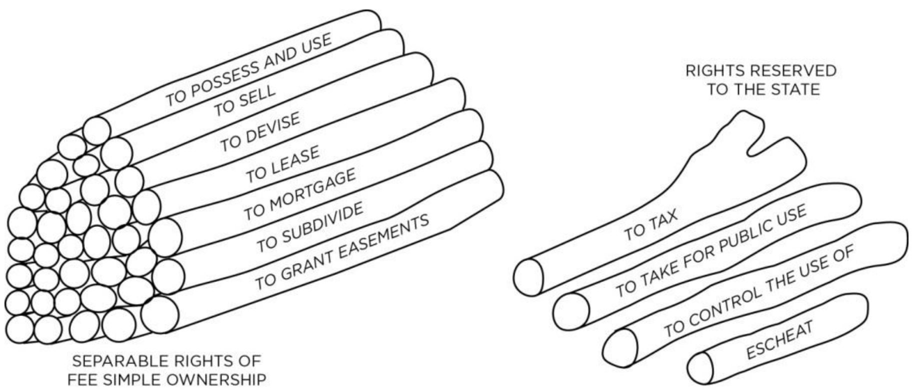


Figure 11–1. The Bundle of Rights in Property

Fee simple ownership is one of the broadest and most complete concepts of property ownership yet developed. Yet it must be recognized that the fee simple owner holds exclusive, not absolute, rights. Ownership rights are always limited and conditioned by the overall interests of society administered by the state. Because of their public nature four important sticks are never included in the fee simple bundle of rights. These include the public rights of regulation, taxation, taking for public use, and escheat.

The nearest approach to absolute ownership in our system is found with the land holdings of the state and national governments. Since these owners exercise the powers of government, it may be argued that they possess absolute ownership. The rights they hold, however, are limited by public opinion, and by various reservations of public economic and social policy.

Qualified Property

Property rights can be asserted only over those objects that individuals or groups can appropriate to exclusive possession. This means that most objects can be classified as either free goods or property. An intermediate classification applies to those free goods that can under certain circumstances be reduced to private ownership. These objects, often described as "qualified property," include such items as household pets, wild game, fish, wild fur-bearing animals, and water.

Wild creatures, such as birds, deer, and fish ordinarily have the status of free goods. As Justice Oliver Wendell Holmes (Missouri v. Holland, 252 U.S. 416, 1920) observed:

> *"Wild birds are not in possession of anyone; and possession is the beginning of ownership. The whole foundation of the states' rights is presence within their jurisdiction of birds that yesterday had not arrived, tomorrow may be in another state, and in a week a thousand miles away."*

Most states now have laws declaring these creatures the property of the state. Their proprietary interest, however, is asserted for the purpose of regulating and controlling the private taking of these resources, not for their exploitation or use as public property. Individuals can acquire property rights for these creatures if they kill, catch, or capture them in compliance with the licensing provisions and other regulations set up by individual states. Wild animals valued for their fur are often treated in much the same way as game and fish. They exist as free goods in nature but can be trapped or captured subject to public regulations.

A similar rule applies with the water found in natural streams, lakes, and the ocean. As a New York court (City of Syracuse v. Stacey, 169 N.Y. 245, 1901) has observed:

> *"Water, when reduced to possession, is property, and may be bought and sold, and have market value, but it must be in actual possession, subject to control and management. Running water in natural streams is not property, and never was."*

Contention over water rights is extremely complex since water often extends to touch the shores of several sovereign political entities. Rivers frequently divide nations, and within nations, create boundaries for states, counties, townships, or even cities. The presence of many stakeholders increases the need for communication and the capacity to enforce rules across legal boundaries.

Institutional arrangements to deal with water rights are dynamic and changing. Management at the level of the watershed is an expanding field that uses a blend of formal (legal) and informal (social) institutions to allocate property rights. As useable water becomes increasingly scarce, pressure will mount to reallocate property rights and seek new ways decide who will benefit from use of water.

The Commons

A broad general concept known as "the commons" has been used by Garrett Hardin and others to describe the sum total of the earth's supply of natural resources that are available for human use. As much of this bounty is now subject to private or public ownership, the concept is also used in a more limited sense to describe the remaining supplies of resources, such as air, water, grazing areas and ocean fisheries that are still freely available for anyone's use. Examples of the commons are sometimes called common property. This characterization, however, is a misnomer because, except for being subject to governmental sovereignty, these resources are not subject to anyone's exclusive possession. Common property calls for co-ownership by two or more owners.

The class of resources properly classified as the commons have three key characteristics: 1) They are used in common by members of communities and society; 2) individuals and groups have historically exercised free and unlimited rights of entry for their use; and 3) no user enjoys the privilege of excluding others from their use. High values are associated with many of these resources. But unrestrained rights of entry and increasing competition between users can easily result in over utilization and exploitation. Public regulations have accordingly been accepted in many instances to limit their utilization to levels at which their resource values can be regenerated and maintained.

With public and private ownership now being exercised over major portions of the world's resource base, the remaining segments that can be identified as being parts of *"the commons"* fall into two classes. One group involves the community-use areas designated as commons in many early American settlements, certain mountain pastures in Switzerland, the Mexican ejidos, and some areas within Indian reservations. Although no one has exclusive property rights to these resources, they are available for use by members of local communities in accordance with mutually accepted understandings. A second more general class of open-access-for-use resources, such as air, involves what Daniel Bromley (Economic Interests and Institutions, p. 202, 1989) has described as *non-property*.

Basis for Property

Concepts of property rights have been accepted as part of the social order since the beginnings of settlement. Most authorities agree that the concepts we now accept are an outgrowth of long periods of evolutionary development. Among the primitive and nomadic societies from which our culture sprang, land resources were at first regarded as free goods to be used at will.

Group ownership rights were gradually recognized for particular types of land, such as burial grounds, sites of religious significance, salt and mineral deposits, and springs and watering holes. Communal and tribal ownership was asserted over these resources and gradually gave way as groups shifted from a gathering to an agricultural economy and to recognition of the advantages that could be realized if individuals held recognized use rights for the tillage of specified areas. This process of resources shifting from their original non-rivalous status to private property is still going on as pressures are exerted to privatize various resources now managed as public goods.

Development of Fee Simple Ownership

The concept of fee simple ownership now accepted in most English-speaking countries evolved from the village and feudal tenure systems found in Western Europe during the Middle Ages. Most of the nomadic native tribes in these areas settled down to a village economy during Roman times. The residents of these villages were primarily dependent on agricultural pursuits. Ordinarily they used an open field system for tilling the lands around villages. Under this system, all of the land was usually held in common ownership, at least at first, and each family shared a portion of each field.

With the rise of feudalism, most villages came under the political and military control of overlords who frequently converted them into manorial or feudal estates. Actual ownership of the land in these estates was vested in an overlord who in turn was subject to a king who in theory had a proprietary interest in all the lands within his realm. Usufructuary rights, rights to use land, were retained by the villagers and serfs. The extent of these rights varied with users in some areas having more rights than users in other areas. But most fields were operated by villeins, who were born to their status and who exercised tillage rights subject both to customary obligations to the lord and to his arbitrary will.

A trend toward freer tenure conditions in England began with the gradual weakening of the feudal system during the 13th and 14th centuries. Required military service, homage and other incidents of feudalism were relaxed as a condition of proprietorship. Operators gradually acquired the privilege of selling or passing their holdings to their heirs without the required approval and payment of dues to an overlord. Overlords also acquired the right to exclude landless villagers from the use of land, a development that precipitated the "enclosure movement." These events brought an end to villeinage tenure in many parts of England during the 15th century and its complete extinction by the 17th century. With these changes, land operators became owners or tenants, and landless villagers had to find other types of employment.

Developments in Other Areas

England gave up the feudal system gradually at an early date. Different patterns were experienced in other areas. France retained its feudal system until the French Revolution, and vestiges of feudalism remained in many parts of Central and Eastern Europe until the uprisings of 1848, emancipation of the Russian serfs in 1862, and the Armistice of 1918. Similar practices persisted in many other parts of the world until they were ended by land reform programs after World War II.

Wide variations exist between the property rights concepts accepted in different parts of the world. Most countries have relatively complete concepts of ownership. However, many of the world's people have had little experience with this concept. Some still hold to semi-feudalistic practices that have much of the land held by a few large often absentee owners. Still others have emphasized communal ownership and forms of state and collective ownership.

Interests in Landed Property

Property can be classified in many different ways. From a physical standpoint, property objects may be seen as mobile or immobile, tangible or intangible, or as types of objects, such as a student's books, clothes, furniture, and car. In an economic sense they can be divided into production goods and consumer goods. They may also be classified as real property and personal property; as public and private properties; or as properties held by individuals, partnerships, and corporations.

Some of the most important classifications of property interests involve the distribution and sharing of the bundle of rights people hold in land. With this approach, emphasis may be focused on the 1) types of interests people may hold in land, 2) layers of rights, 3) number of owners, 4) conditions of holding, 5) duration of interests, and 6) time of enjoyment. Emphasis is focused here on the leading types of estates people hold in land, after which brief attention is given to the other five classifications and to the general nature of the interests society has in landed property.

Leading Types of Estates

The rights and interests one holds in the ownership, possession, or control of property are often described as one's estate. Estates vary in scope from fee simple ownership to estates of remote or negligible importance. The most important estates involve the interests held by owner-operators, holders of life and remainder estates, landlords and tenants, mortgagors and mortgagees, and the givers and holders of land contracts. Lawyers ordinarily give detailed consideration to the nature, characteristics, rights, and responsibilities associated with each of these estates. It is sufficient here, however, to briefly identify each of the leading types of property interests.

Complete or fee simple ownership represents the highest combination of rights a person can hold in landed property. Most owner-operated properties are considered as held in fee simple. This is true even though many are affected by minor subtractions of rights, such as a power line easement or a deed restriction or covenant.

Easements involve rights held by others to use one's land for specific purposes. A utility company may hold an easement that permits it to run its utility lines above or beneath the surface of one's property and gives its workers a right of access for servicing these lines. Easements can involve a wide variety of privileges, such as the right to encroach on one's air space, cross and transport goods across one's property, drain water across one's land, or compel a property owner to maintain a share of a common driveway. Easements can be created by oral or written agreement or sometimes by implication. They can be acquired by purchase, deed reservation, gift, condemnation, or adverse use and possession throughout the prescriptive period recognized by law. They *"run with the land"* when properties are transferred to new owners and they cannot be revoked except by sale, release, abandonment, or condemnation.

Property owners are frequently affected by specific provisions in their deeds, which limit the scope of their ownership rights. Sometimes these provisions involve deed restrictions that reserve mineral rights, timber-cutting rights, rights-of-way for travel, or other comparable privileges to the grantor. Reservations of this type create easements against the property. Deed restrictions and covenants are used to impose private controls over the future use of land. Building lots in most residential subdivisions have deed restrictions and covenants that stipulate that the sites must be used for single-family residential purposes and may specify set back, size, or architectural style standards for the houses built. Deed restrictions have been used for other purposes, such as forbidding future use of the premises for particular purposes, such as the sale of alcoholic beverages.

Deed restrictions and covenants may run indefinitely, for definite periods, or they may be limited by statute. Ordinarily, they are legally enforceable as long as they do not run counter to public policy. Restrictive covenants can be enforced by court order or injunctions issued against persons who would violate the covenants or by personal actions for damages against violators. Unlike covenants, deed restrictions usually contain reversion clauses that provide for the forfeiture of properties and their reversion to the original grantors should the restrictions be violated. Thus, if owners grant a site for a church or sell a commercial site with the provision that it be developed for a specific use, the ownership would revert to them, their heirs, or assignees if the site were diverted to another use. The ownership rights retained by grantors in these cases are called determinable, base, or qualified fee estates.

Another type of limitation on the rights of ownership occurs with the entailment of estates. This practice has been discontinued. Yet in some American colonies and for a long period in England, property owners were free to entail their estates by specifying that they could be handed down only to "heirs of the body.” Under this system of fee tail estates, the owner in each succeeded generation (usually the eldest son of the previous owner) had the right to possess and enjoy the property but could not sell nor dispose of it to persons other than the heir next in line of succession.

In contrast to estates held in fee, many properties are held as life estates. With this arrangement, life tenants can enjoy, possess, and use properties throughout their lifetimes. They can lease their estates to others; and assuming they can find someone willing to risk such a venture, they can mortgage or sell their interest for the duration of their lifetimes. But these rights exist only for the duration of their lives. At their death, the estates revert to the grantors, their heirs, or assignees, or to designated remainder men. A comparable arrangement know as an estate pur autre vie exists when one's rights are limited to the lifetime of some other person or persons. A son-in-law, for example, can hold an estate of this type during the lifetime of his wife.

Life estates ordinarily fall into two classes: 1) Conventional life estates created by deeds, wills, and other contracts; and 2) legal life estates authorized by law. Some life estates are set up during the lifetime of the donor with the donor holding a reversion interest. Most conventional life estates, however, are established by will, as when a man leaves his widow a life estate in his property with the provision that their children hold a remainder interest, which will vest them with the estate at her death. The principal legal life estates involve the rights of dower, curtsey, and homestead.

Closely analogous to life estates are the rights involved in trusts. Trusts involve contractual arrangements under which properties are held and administered by trustees for the benefit of specific beneficiaries. As is the case with estates, a living trust can be established during a property owner's lifetime, while a testamentary trust can be provided by will. Business trusts are sometimes established and operated for investment and other business purposes, and land trusts are occasionally used by operators as a means of concealing property ownership while they benefit from the acquisition or control of properties.

Twenty-two states recognize the dower right of a widow to a life estate in one-third of a husband's property at the time of his death. A comparable right of dower is held by widowers in a few states. Twelve other states give a surviving husband a courtesy right, which is analogous to dower except that it usually applies to all rather than merely a third of the wife's property. Another arrangement exists in the eight community property states of the West and Southwest. Husbands and wives in these states can hold property separately or together as community property. When either party dies, the community property is divided into halves and the survivor receives his or her share plus one-half of the deceased spouse's share. This share passes in fee simple rather than as a life estate.

Most states also recognize a concept known as homestead that provides families with a basic right to retain a small area of limited value, which is exempted from forced sale for payment of debts. The right was established mostly to protect widows and their children who might be victims of adversity. Homestead rights cannot be sold, but they can be lost through remarriage of a widow or abandonment.

Most people are familiar with the division of rights that takes place with the leasing of properties. A <u>lease</u> is the relationship created by a contract that gives a tenant or lessee the right to possess and use the property held or owned by a landlord or lessor. Leases can run for given periods of time or continue indefinitely by mutual consent. Rent or some other consideration is normally paid by the tenant to the landlord or his or her agent as a condition of the lease. At the expiration of the lease, tenants are obligated to return the premises to their lessors less normal wear and tear or any damage caused by the elements. Throughout the period of the lease, the landlord normally has no right to enter upon the property without the tenant's permission and has no right to interfere with the tenant's use of the property unless these rights are reserved to the landlord in the lease. Under a leasing arrangement, a tenant is said to have a <u>leasehold</u> estate, while the landlord retains a reversion interest.

A <u>mortgage</u> represents a conveyance of landed property by a borrower (mortgagor) to a lender (mortgagee) as security for payment of a debt, with the provision that the conveyance becomes void if the debt is paid in the manner and period prescribed. In early England, the term <u>mortgage</u> meant death pledge. Mortgagors turned properties over to their mortgagees; and the latter not only enjoyed the use and income from these properties throughout the mortgage periods but also acquired full ownership rights if mortgagors failed to repay their debts on the due date. Mortgagors now retain their properties throughout their mortgage periods; and if they default in their payments, they can remain in possession during specific redemption periods while mortgagees initiate foreclosure proceedings. Also if a mortgage is foreclosed, the mortgagee has a valid claim only to the outstanding value of the loan plus interest, not to the entire property.

<u>Land or purchase contract</u> arrangements are accepted in some areas as a popular means by which buyers with limited capital may acquire rights in property. These contracts resemble mortgages but they differ in the types of estates created. Givers of land contracts can gradually build up their equities to a point at which they can convert them into mortgages or even become full owners. However, as long as they operate under a land contract, the titles to these properties

remain with the holders of the contracts. Buyers under these conditions have a right to possess properties; but this right, together with their equities in the properties, can be forfeited without need for foreclosure proceedings if they default on their payments.

Another rights-sharing arrangement involves the use of liens. A lien is a right enjoyed by certain classes of creditors (including mortgagees) to require, if necessary, the sale of a debtor's property to satisfy payment of a debt or charge; three principal types of liens can affect property ownerships. They include: 1) Mechanic's liens for charges associated with the use of labor and building materials; 2) tax liens for the payment of delinquent property, income, gift, or inheritance taxes; and 3) judgment liens that result from court actions. A properly filed lien always poses a threat to an owner's continued use of property. It places a cloud on the title that affects one's ability to sell or secure mortgage financing; and as long as it stands, legal action can be taken to force foreclosure of a property to pay the claims against it.

Other Classifications of Interests

It is often convenient to classify property rights as layers of rights; surface, suprasurface or air rights, and subsurface rights. Most discussions of property deal primarily with rights regarding surface land, but the rights one holds in surface waters, air and the space above surface holdings, minerals and other subsurface resources, represent significant aspects of the property concept. These rights, which are discussed later in this chapter, can be and often are separated from the bundle of surface rights in land.

Other criteria are also used in classifications of the legal interests individuals hold in landed property. Important among these are the classification of estates by number of owners, conditions of holding, duration, and time of enjoyment.

Number of owners. Estates in landed property can be classified by number of owners into three general groups: 1) The commons in which all members of a community hold use rights; 2) properties held as undivided interests by two or more co-owners; and 3) properties held in severalty by single owners.

With the commons, every individual and family in the community has a right to use the resource, but no single user has a recognized ownership right that can be leased, mortgaged, sold, or devised to others. This system of ownership has for the most part broken down; and most properties once held as parts of the commons are now held in severalty—that is, in separate individual ownerships.

Properties held by two or more persons in undivided ownerships are normally held under one of four arrangements: tenancy-in-common, joint tenancy, tenancy-by-the-entireties, or community property. When ownership interests are held under tenancy-in-common, each party owns an undivided share of the property. An owner may sell this undivided interest or devise it by will; otherwise it passes to his or her legal heirs.

Properties can be held by two or more owners as joint tenants but joint tenancies cannot be created without the inclusion of an express statement to this effect in the deed that confers title. Whenever deeds are made out to two or more persons (not husband and wife) without stipulations concerning the type of tenancy created, the grantees acquire title as tenants-in-common. Some states do not recognize a right of survivorship unless a deed specifies that the title has passed to "joint tenants with right of survivorship.” Joint tenancies can be dissolved by mutual consent of the owners or by the action of a single tenant should he or she request court partition of the property. They also are broken and become tenancies-in-common when a tenant sells his or her undivided interest. This situation stems from a legal rule that requires joint tenants to share the same interest, acquired at the same time and in the same deed, and held throughout in the same undivided possession.

Twenty-nine states treat husbands and wives as legally the same person in matters involving co-ownership of property. A husband and wife in these states cannot hold property as tenants-in-common or as joint tenants; instead, they hold their ownership rights as tenants-by-the-entireties. This co-ownership arrangement is similar to joint tenancy, except that neither party can break it without the other's consent. And when either party dies, the surviving spouse takes the entire ownership, not by right of survivorship, but under the terms of the original title.

In community property states, husbands and wives can hold any property owned at the time of their marriage or acquired by gift, will, or inheritance during marriage as separate property. All other property acquired during marriage is shared equally as community property. With this doctrine, both parties share in the ownership of real property acquired during a marriage regardless of whether the deed is made out to the husband, wife, or both.

Conditions of holding an estate. Most estates are held in fee simple absolute without conditions as to holding. When conditions are specified, they fall into two categories: 1) Conditions precedent that involves requirements that must be met or events that must occur before an estate will vest; and 2) conditions subsequent, which involve events or types of actions the non-performance of which will defeat estates already vested.

Conditions precedents are involved when a will provides that a property shall vest with a given heir on a specified birthday, or on the death of a life tenant. Another example exists with the agreement of a holder of a land contract to exchange the contract for a mortgage once buyers build their equities up to a given level. Estates granted subject to conditions subsequent continue only until the happening of certain events or "during," "while," or "so long as" the grantee complies with certain conditions. A will, for example, may provide that an heir shall enjoy an estate for life, or perhaps only "until John becomes of age" while a leasehold to rented property continues only so long as rent is paid.

Duration of estates. From the standpoint of duration, estates can be classified into six groups: estates in fee, for life, for years, from year to year, at will, and at sufferance. Estates held in fee simple are not limited as to duration. Owners can select their successors in ownership and use deed or other restrictions to qualify the interests they sell, devise, or otherwise convey to others. Life estates involve a period of shorter duration, because they are limited to the holder's lifetime. Both of these types involve freehold estates.

The other four classes involve types of leaseholds. A tenancy for years is created when the lease specifies the time period during which it operates. If a tenant stays on with the owner's permission at the end of a specific leasing period or if no time limit is originally specified, a tenancy from year to year (from month to month with most residential tenancies) is created. A tenancy at will exists when tenancies continue for indefinite periods subject to termination by landlord or tenant on short notice. Holdover tenants who continue to occupy a landlord's premises after the expiration or in the absence of a lease are tenants at sufferance. As long as a landlord does not consent to their continued occupancy and does not accept rent, they can be evicted as trespassers and can be held liable for paying penalty rent.

Time of enjoyment. Estates can be enjoyed either now or in the future. Those that are enjoyed at the present time must be held in current possession. Examples include estates in fee, life estates, and leaseholds held by tenants. In contrast to these types of estates, reversion, remainder, and executory interests cannot be enjoyed until some future date.

Owners retain an estate in remainder whenever they grant interests in property to others with the provision that the interest will revert to them at the expiration of a grant. Landlords retain this interest when they lease their premises to tenants. People who give life estates may retain a reversion interest. Much the same situation exists with grants of determinable fee estates though the uncertainty of reversion normally gives them only a possibility of reversion.

Estates in remainder are created when interests are conveyed to a person to take effect on the termination of a prior estate. This situation is typical with life estates created by a will. A husband may leave a life estate in his property to his widow with the provision that it goes to a nephew upon her death.

Future interests that vest after a given period of time or after the happening of some particular event are known as executory interests. These interests are similar to remainder rights except that they need not follow the termination of some prior estate.

Protection of Property Rights

Property rights would be of questionable value if operators lacked means for protecting their rights. It is a major responsibility of the state to provide this needed protection. Governments provide military and police protection to maintain law and order and protect the day to day rights of their citizens. In addition to these protections, individuals and groups may also seek court injunctions to prevent undesired actions or sue for damages if they find that acts of others have injurious effects on their interests.

The concept of torts, which involves one's legal right to secure civil court action to curtail and prevent wrongful practices by others and to secure payments for damages caused, provides an important legal tool that can be used to protect environmental property values. The torts remedy has been used to sue manufacturers for marketing products, such as tobacco, pharmaceutical products, and mechanical equipment that have known injurious effects on their users. It can also be used in combination with the laws of trespass or nuisance to protect rights of environmental concern.

Operators may seek legal action under the law of trespass to prevent illegal entry, poaching, and attempts to appropriate or take products from one's property. They can request court action under the law of nuisances to rule against general offenses, such as obstruction of traffic, disorderly conduct, generation of excessive noise, keeping hogs in the city, clogged sewers, sale of infected or unsanitary food, or storing dangerous chemicals within residential neighborhoods.

Courts can issue injunctions, orders for abatement, and consider suits for damages. Court action was often hard to secure in the past, because of a rule that plaintiffs had to have legal standing before the court to sue. Many suits were thrown out on the ground that the plaintiff's interest was too small to warrant court action. This system was changed with authorization of class action suits, which allow groups of individuals to pool their claims in suits for injunctions and damages.

A somewhat different protection of property rights occurs with the rules on adverse possession. Property owners are sometimes lax in allowing others to use their properties without periodically exerting their rights of exclusive possession. When a neighbor has been allowed to use one's property or the general public has made a path across a portion of one's lake property to get to a beach, situations can arise in which the neighbor or the public can claim rights to these continued uses under the law of adverse possession. Acquisition calls for use of the property openly and in defiance of the owner for a prescriptive period specified by law. Owners can prevent loss of their rights by closing off the use permanently or periodically during the prescriptive period. The law offers protection for an owner's interests. It can also operate in the interests of the using parties if need exists for their continued trespass and owners take no action to prevent it. Acquisition of ownership rights through adverse possession may also be used as a means for clearing title to abandoned properties.

Rights in Water

Water rights were identified as an important legal concern in the arid farming areas of the Middle East at an early date. Availability of plentiful supplies of water relative to demand in other parts of the world, however, favored the widespread treatment of water as a free good until long after surface ownership rights were defined in land. This situation has changed during the last two centuries as increasing competition and conflicts of interest have called for specific working rules concerning the who, when, and where of water rights.

Different legal doctrines now apply regarding the rights individuals have in the use of water from different sources. For discussion purposes, these sources can be classified into four principal groups: 1) Ocean waters; 2) diffused surface waters (from rain, melting snow, or possible waste water from irrigation works) found standing in natural depressions, bogs, or marshes, or flowing vagrantly over land while enroute to some watercourse, lake, or pond; 3) surface waters found in lakes, ponds, rivers, streams, and springs; and 4) subsurface or ground waters, which occur either as flowing water in subterranean channels or as diffused percolating waters.

Ocean waters have generally been treated as free goods that individuals can use for navigation, fishing, recreation, and other purposes subject to certain national and international regulations. New problems, however, are arising with the fencing off of ocean water for commercial fish farming. Among the countries and states that accept the English system of law, diffused surface waters, together with water in the soil, are normally regarded as the property of the landowners. The principal water-rights problem with this resource concerns drainage of unwanted waters. More complicated water-rights issues are associated with the use of surface and ground waters. Surface water rights are governed by the riparian doctrine in most of the more humid areas of the United States. In the more arid regions of the West, constitutional and statutory provisions require application of either an appropriation or a modified riparian doctrine. Comparable differences occur in the doctrines that govern the allocation and use of ground waters.

Water rights concepts similar to the American riparian and appropriation doctrines are accepted in several other nations. Most nations, however, emphasize administrative arrangements, which permit governments to exercise varying powers to grant, revoke, and withhold water-use permits and concessions. Acceptance of reciprocal obligations is often associated with the receipt of use permits.

Riparian Doctrine

With the common law riparian doctrine, all landowners whose properties are bounded or traversed by a river, stream, spring, or natural body of water have riparian rights. Owners have rights to use waters to which they are riparian for domestic and household purposes, for watering their livestock, for navigation, for generation of power, for fishing and recreation, and for certain other uses.

Strictly interpreted, the riparian doctrine grants riparian owners a right to have water flow by or through their lands undiminished in quantity, unchanged in quality, and undisturbed in time of flow except for its use by upper riparian owners for domestic purposes and the watering of livestock. As this statement suggests, riparian owners have usufructuary but not proprietary rights in the water that flows by their land. They can use the water for a variety of purposes. But except for domestic and stock watering purposes, they have no right to divert or take more water from a stream or lake than they can return to it.

Few state courts now hold to the strict "natural flow" doctrine. Most of them have substituted acceptance of a reasonable use doctrine that permits diversion for uses that may involve consumption of part or all of the water taken. With this modification, riparian waters can be used for municipal, industrial, irrigation and other uses as long as an adequate supply of water remains available to meet the natural needs of other riparian owners.

Riparian rights are limited to owners of riparian land. Non-riparian owners hold no rights except as members of society to use public waters, beaches, and fishing sites. Riparian owners enjoy comparable use rights regardless of the extent of their property frontages along streams or lakes. When riparian waters are used in connection with land (as with irrigation), the right of use extends only to holdings that are contiguous to the lake or stream and are located within its watershed. In many jurisdictions, the riparian right also extends only to areas with the smallest legal descriptions in the chain of title leading to the present owners. This limits use of riparian rights to lands that have always held these rights.

Riparian owners ordinarily have the right to change their points of use and diversion and also the right to use dams to retain water if their exercise of these rights does not cause injury to others. They can reserve or separate the riparian right when land titles are granted to others. As a rule, riparian rights pass with conveyances of riparian land. They can be reserved, however, as would be the case if owners with frontage on a lake wanted to retain their riparian rights of access to the lake while they conveyed rights-of-way for building a road between their houses and the lake.

Appropriation Doctrine

With the settlement of the arid lands of the American West, it soon became apparent that water is a strategic resource and that its most beneficial use sometimes calls for outright appropriation. This situation was clearly recognized by the Mormon pioneers who appropriated surface water without regard for riparian rights when they started their irrigation of the Great Salt Lake valley in 1847. Similar practices were soon applied on a larger scale by the early gold miners in California. An appropriation doctrine was accepted in both areas as a matter of expediency, primarily because the riparian doctrine did not serve the best interests of the settlers.

With the appropriation doctrine, both riparian and non-riparian owners can file claims to divert water from streams or other bodies of water as long as their claims do not conflict with prior claims on water from the same source. As successive claims are filed, a system of priorities develops. This system vests each claimant with a recognized exclusive right to take water up to the amount of his or her claim for beneficial use, provided there is sufficient water to satisfy all claims of higher priority.

The appropriation doctrine has five distinct features: 1) It vests an exclusive right in the first appropriator and allocates rights to later claimants in the order in which claims are filed; 2) all rights are conditioned on beneficial use; 3) water may be used on non-riparian, as well as on riparian lands; 4) water can be diverted from a stream to the extent of one's rights regardless of its effect in diminution of a stream; and 5) continuation of the right depends upon beneficial use and may be lost though nonuse.

The essence of the prior-appropriation doctrine is aptly summarized by the catchphrase "first in time, first in right.” As this maxim suggests, the key feature of the doctrine involves recognition of priorities in appropriative rights. The operation of these priorities can be illustrated by an example of a stream, such as that depicted in Figure 11–2, along which several claims for water have been filed.

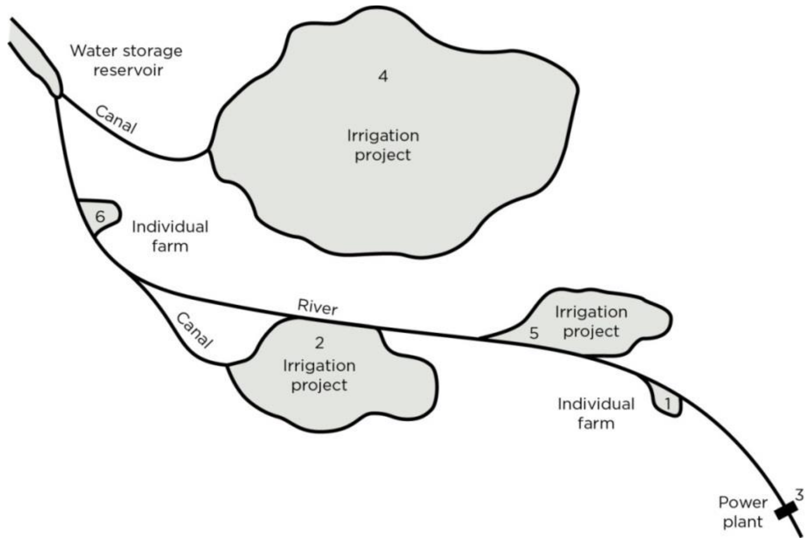


Figure 11–2. Example of Priorities Held in Appropriation Rights under Appropriation Doctrine

The first and the sixth claimants in the example are riparian owners who take water to irrigate relatively small acreages. The claims with the second and the fifth priorities involve irrigation projects along the stream but serve several irrigators who do not hold riparian rights. The fourth priority is held by a large irrigation enterprise located some miles away from the stream, and the third priority is held by a downstream hydroelectric power plant, which claims a definite minimum flow of the stream at all times.

Regardless of their locations along the stream, the six claimants can enjoy exercise of their rights only in accordance with their priorities. The first and second claimants may expect to take water up to the full amount of their claims every year. After them, the power company's claim can call for all of the remaining flow during critical low-flow times of the year. The nature of this claim can cut off the claims of the remaining claimants at the times of their greatest need for water to irrigate their crops. Their situation can be remedied by building an upstream reservoir that will hold seasonal flood waters back for release at later dates when water is needed to fulfill their claims. To push the example farther, later claimants located upstream from the reservoir or at points downstream from the reservoir could receive water if a second reservoir were located on a tributary stream to provide a trade-off reserve of water to meet their claims.

The appropriation doctrine is accepted in 18 western states. The eight intermountain states and Alaska have completely abrogated the riparian doctrine in favor of the appropriation doctrine. Oregon also accepts it except for a few early cases in which riparian rights were established for beneficial uses. These states are sometimes said to adhere to the Colorado doctrine, so-named because exclusive appropriation was prescribed in its constitution when it was admitted to statehood in 1876. The eight remaining western states—California and Washington on the Pacific Coast, and North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and Texas on the eastern fringe of the arid, and the semiarid West—accept a <u>modified riparian doctrine</u> that permits appropriation where it is needed, while still giving primary recognition to riparian rights.

Some eastern states have modified their interpretations of the riparian doctrine to allow the taking of water for supplemental irrigation and other beneficial uses. Problems involving conflicts of interests between these users and riparian owners sometimes arise. In one such case, the court in Oklahoma (Franco-American v. Water Resources Board, No. 58310, 1990) held that though water can be appropriated for legitimate uses, riparian owners cannot be deprived of their riparian rights without payment of just compensation.

Use of Ground Waters

Wells have been used as a source of domestic water supplies since the beginnings of history. Throughout this period rights for the use of ground waters has usually been taken for granted. The increased taking of this resource in recent decades for domestic, municipal, industrial irrigation, and other uses has given rise to important questions concerning both ground-water rights and ground-water conservation.

From a legal standpoint, ground waters may be divided into two groups: underground streams and percolating waters. Most courts apply the same water-rights doctrine to underground streams that they apply to surface waters. Thus if an underground stream is found in a riparian-doctrine area, its waters are normally subject to the riparian rights recognized in that state. Likewise, if the underground stream is located in an appropriation or modified riparian doctrine state, its waters in most cases are available for appropriation.

Percolating waters—those waters below the surface that are not confined to any channel—are affected by four legal doctrines; the doctrines of 1) absolute ownership, 2) reasonable use, 3) correlative rights, and 4) prior appropriation rights. The first of these, the common-law rule of absolute ownership, was originally accepted in most areas that accept

English law. This doctrine recognizes a landowner's right to all the water on or under the surface of one's surface land as long as it is not part of a definite stream. As one court has complained, (Schenk v. City of Ann Arbor, 196 Michigan 82, 1917) this doctrine "affirms the right of the owner of land to sink wells thereon, and use the water therefore, supplied by percolation, in any way he chooses to use it, to allow it to flow away, even though he thereby diminishes the water in his neighbor's wells or dries them entirely, and even though in so doing he is actuated by malice."

The obvious lack of justice associated with unreasonable withdrawals of ground water under the absolute ownership rule has caused the courts in most states to qualify this rule. Out of these actions has come the American doctrine of reasonable use. This doctrine recognizes that landowners hold joint rights in the use of common groundwaters. Individual owners are permitted considerable freedom in their use of percolating groundwaters on overlying lands, but the rule of reasonable use may be interpreted to prevent wasteful, malicious, or otherwise unreasonable uses of water, particularly if these uses have a harmful or injurious effect on others. Owners who suffer injuries from groundwater depletion can in some cases secure legal action to prevent the pumping of ground waters for sale or for use on non-overlying land. Under some circumstances, they may also seek and secure damages from persons whose pumping activities cause them injury.

The doctrine of correlative rights applied in California and some other Western areas is an outgrowth of the rule of reasonable use. With this doctrine, landowners who are drawing water from a defined ground water basin have coequal rights with other users. Their rights can be limited to an equitable proportion of the total supply any time the supply of water in the groundwater basin is found to be inadequate to supply the needs of all of its users. Thus if it is determined that the overall supply of ground water is being recharged at a 25 percent lower rate than it is being used, all users can be required to reduce their consumption by 25 percent.

A few states in the West apply a prior-appropriation doctrine to percolating groundwaters. This doctrine permits use of groundwater on a first-come, first served basis. It also allows holders of groundwater appropriation rights to use the water they pump on lands that do not overlie the source of groundwater. Problems have arisen with this approach, because of the practical difficulties associated with its administration.

Drainage Rights

Too much water can be as much a problem to operators as too little. We cannot legislate against torrential rainstorms or the flood conditions that often follow. Dikes and levees can and have been built to hold back expected high waters, but even they are inadequate to provide complete protection from damage caused by hurricanes and violent acts of nature. With flood conditions, our primary concern is with saving lives and property with secondary emphasis being given to disposal of the surplus water. A very different situation exists under more normal conditions when the problem of dealing with excess water involves drainage rights.

Most states have legal arrangements for establishing drainage or levee districts that can manage the construction and maintenance of needed drainage facilities. In addition to these provisions, most of the more humid states have legal provisions covering drainage problems. These laws tend to follow one or the other of two legal patterns. They accept either the common-law, or so-called common enemy rule, or follow the civil law rule.

The common-law rule treats both flood waters and unwanted runoff water as a common enemy against which landowners have a recognized right to protect their lands. Some courts have modified this rule to permit drainage from upper lands on to lower lands if no appreciable damage occurs. Owners of upper lands, however, have no lawful right to drain unwanted waters onto lower lands or to use tile, drainage ditches, or other man-made means to discharge drainage waters into a natural stream if their actions cause injury to lower owners.

Unlike the common-enemy rule, the civil-law rules recognize the right of upper landowners to have flood and runoff water flow naturally to lower lands. Lower owners cannot obstruct or refuse to receive the natural runoff from upper land. But they can object whenever upper landowners hold back water for later release, use terraces or dikes to concentrate the runoff in given locations, or use ditches to facilitate faster runoff.

Both rules allow upper owners to acquire drainage rights over the lands of lower owners through the use of easements or by maintaining adverse uses over an authorized prescriptive period. They also recognize that different situations exist whenever drainage or levee districts are created. Landowners living within drainage districts, for example, have a lawful right to use tile, ditches, and other man-made devices when they discharge drainage waters into artificial water courses, that is, into public drains or natural watercourses that have been improved for drainage purposes. Owners of lower lands can usually claim damages from upper owners for just cause. In many jurisdictions, they can also secure injunctions against future uses of artificial drainage measures by upper owners if the expected extra water flow caused by these measures threatens injury or damage to the lower owners.

Public Interests in Water

Important powers concerning water are also held by the federal and state governments. The federal Constitution clothes Congress with the power "to regulate commerce with foreign nations and among the several states" and with the power "to dispose of and make needful regulations respecting government property." These two grants of power, commonly referred to as the "commerce power" and the "property clause," underlie most of the interest the federal government has in water resources. But important powers affecting the administration, use, and development of water resources may also be implied from the authority vested in Congress "to provide for the common defense," "to provide for the general welfare," and to pass on interstate compacts. Other federal powers over water are associated with the government's treaty-making power and the exclusive jurisdiction the Supreme Court has over controversies between states.

Under the commerce power, Congress is responsible for the control of navigation and has full jurisdiction over navigable rivers. Because of the scope this power, considerable importance is attached to the meaning of "navigable waters." English common law limits the legal concept to navigable ocean waters and to inland waters affected by the ebb and flow of tides. This doctrine was accepted for a while in the United States and then expanded to include waters that are navigable in fact. It was later expanded to include all rivers and lakes that are used, are susceptible of being or with reasonable improvements can be used in interstate commerce.

In its exercise of power over commerce and navigation, Congress has passed legislation affecting the erection of dams, bridges, dikes, causeways, wharves, and others structures; the operation of drawbridges, the removal of sunken vessels and deposits of refuse, and the dumping of oil in coastal waters. The federal government has licensed private power plants on navigable waters, required the removal of unauthorized structures regarded as obstacles to navigation, built storage dams and locks, deepened channels, improved harbors, developed its own water transportation facilities, and taken measures to restore beaches. Going farther, Congress has declared it national policy to work to the end that the nation may "fulfill the responsibilities of each generation as trustees of the environment for succeeding generations" and "assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings." In so doing, it has broadened the interpretation of the commerce and navigation powers to give the federal government constitutional authority to work with the states on programs for protecting, maintaining, and enhancing the quality of air and water resources.

In addition to its commerce power, the federal government has used its proprietary power under the "property clause" to undertake resource development programs, such as those carried on under the Reclamation Act of 1902. With this power the federal government can acquire and condemn property rights; it can build multipurpose dams and generate and sell electrical power as an incident of ownership.

Broad powers concerning water also are exercised by the states. Every state can set its own rules that govern the use of surface and ground waters within its boundaries. Some have exerted a proprietary interest by declaring their ownership of these waters. States can engage in water resource developments and they can exercise their police powers to control water pollution, to regulate the provision and treatment of municipal water supplies, control the pumping of ground waters, and authorize flood control measures.

Every state has a perpetual and inalienable responsibility for safeguarding the rights of its citizens in the use of public waters. The full nature of these rights is subject to court interpretation, but most courts agree that these public rights include the privilege individuals have to use public waters for such purposes as navigation, fishing, fowling, bathing, skating, and the enjoyment of scenic beauty. How far the states may go in protecting these rights depends on court interpretations of what constitutes "public waters" or waters subject to state regulation.

State courts frequently use state definitions of "navigability" as the criteria for determining whether a lake or stream is a "public water" that is subject to state regulation. Some of the Atlantic Coastal states hold to a saltwater test, which treats only those waters affected by the ebb and flow of tides as navigable. Some others use a sawlog test, which holds that streams that can or have floated a log or boat are navigable. Mississippi has specified that a navigable stream must be capable for any 30 consecutive days to float a steamboat large enough to carry 200 bales of cotton.

Some of the most important differences in definitions concerning "public waters" relate to the distinction between public and private lakes and ponds. Lakes or ponds connected with navigable streams are ordinarily regarded as public waters. They may also be so regarded if they cover more than a prescribed area, if they were meandered in the original public survey, or if owners have consented to the public planting of fish in what was their private water.

Two problems occasionally arise with the exercise of public rights to public waters. The first involves the ownership of the ground underlying public waters; the second concerns rights of access. Most states have retained public ownership of the land beneath their public waters. With those that have surrendered this right to riparian owners, questions sometimes arise as to the rights anglers and others have to use waters that flow over the private bottomlands of others. In a leading case on this point, one state court (Collins v. Gerhardt, 237 Michigan 38, 211 N.W, 115, 1926) has held that anglers can wade upstream, fishing as they go and, contrary to the posted warnings of the riparian owner of the bottomland, without being guilty of trespass as long as they do not go on the owner's upland.

Lack of access rights keep many people from exercising their rights to the use of public waters. Several states have recognized this situation by taking steps to acquire riparian frontage that gives the general public rights of access to public waters for fishing, boating and other recreational uses.

Growing concerns during recent decades over public health issues related to water use, the declining quality of the nation's water supplies, and the need to institute and enforce pollution control measures have opened up an extremely important area of public responsibility for dealing with water resource issues. Detailed consideration will be given to this topic in Chapter 18.

Air Rights

The rights individuals have in land are sometimes visualized as an inverted pyramid that starts at the center of the earth and extends upward through the surface boundaries of one's property to the highest heavens. As this concept suggests, land property rights can be divided into layers of rights; air rights, surface land rights, and subsurface rights. From a legal standpoint, each of these layers can be held separately from the others and each has its particular characteristics.

Prior to the development of air travel, it was an accepted principle of law that land owners held all the rights to use the column of airspace above their surface holdings. The right of the public to use air space for travel was recognized once air travel became practical. But individual owners were left with the exclusive right to use all the airspace above their land they can occupy and use.

As one court (Hinman v. Pacific Air Transport, Ninth Circuit Court of Appeals, 84 F. 2d 755, 1936) has held:

> *"The air, like the sea, is by its nature incapable of private ownership, except insofar as one may actually use it. . . The owner of land owns as much of the space above him as he uses, but only so long as he uses it. All that lies beyond belongs to the world."*

When it is said that man owns, or may own, to the heavens, that merely means that no one can acquire a right to the space above him that will limit him in whatever use he can make of it as a part of his enjoyment of the land. To this extent his title to the air is paramount. No other person can acquire any title or exclusive right to any space above him.

Any use of such air space by others, which is injurious to his land or that constitutes an actual interference with his possession or his beneficial use thereof, would be a trespass for which he would have remedy. But any claim of the land owner beyond this cannot find a precedent in law, nor support in reason.

Under our accepted concept of air rights, landowners can claim trespass whenever telephone wires, limbs of trees, or overhanging parts of buildings based on adjacent properties project into their columns of air space. Easements affecting air rights are often purchased by utility companies and others. These rights may also be secured by deed reservations or by adverse possession. In exceptional cases, they may be sold or leased to others. Airspace above railroad tracts in downtown Chicago and New York, for example, has been sold together with rights of support for commercial developments, such as the Chicago Merchandise Mart.

Surface landownership carries with it a right of access to sunlight, air, and rain. Landowners hold these rights within their own columns of airspace. Their rights may be limited, however, if tall structures are constructed on adjacent lands. American courts do not accept the claim of owners that they have acquired adverse possession rights to air space over neighboring properties. Property owners can put up buildings that completely shut off the air and light received by abutting windows on adjacent properties. Problems of this order are often averted by easements, deed restrictions, zoning ordinances, and building setback regulations.

A comparable problem of possible consequence involves the possibility of claims to atmospheric moisture. At present, landowners have no more claim to the rain clouds that cross their air space than they have to the birds that fly overhead. Should rain-making become an accepted practice, possible conflicts could arise should an operator appropriate needed rain that would have fallen on some other person's property. By the same standard, those who cause rain to fall could be subject to claims for damages if their actions should rain out a ball game or local celebration.

Another air rights problem stems from the noise associated with air traffic. Noise from low-flying planes, from ear-splitting takeoffs, and from nerve-racking sonic booms can make life unpleasant for neighboring residents and have injurious effects in lowering the values of their properties. The Supreme Court has recognized this problem and held that property owners can claim damages for actual losses of value caused by low-flying planes. In a case involving a chicken farm, located near an air base (United States v. Causby, 328 U.S. 256, 1946), the Court observed:

> *". . . the path of glide for airplanes might reduce a valuable factory site to grazing land, an orchard to a vegetable patch, a residential section to a wheat field. Some value would remain. But the use of the airspace immediately above the land would limit the utility of the land and cause a diminution of its value. We have said that the airspace is a public highway. Yet it is obvious that if the land owner is to have full enjoyment of the land, he must have exclusive control of the immediate reaches of the enveloping atmosphere. Otherwise buildings could not be erected, trees could not be planted, and even fences could not be run. The principle is recognized when the law gives a remedy in case overhanging structures are erected on adjoining land. The land owner owns at least as much of the space above ground as he can occupy or use in connection with the land. The fact that he does not occupy it in a physical sense—by the erection of buildings and the like—is not material. As we have said, the flight of airplanes, which skim the surface but do not touch it, is as much an appropriation of the use of land as a more conventional*

entry upon it."

Some of the most important issues involving air rights in 21st America stem from problems caused by air pollution. Communities have long been able to exercise legal remedies to protect themselves from offensive odors caused by slaughterhouses, glue factories, and other sources of foul odors. Smog caused by exhaust fumes from automobiles, acid rain caused by chemicals vented into the atmosphere, and the adverse effects of polluted air on public health have sharpened public demands for actions to control air pollution. This issue will be addressed in some detail in Chapter 15.

Subsurface Rights

Landowners hold rights to the minerals and other materials found beneath the surface of their land, as well as to the land surface itself. Surface and subsurface rights are usually held and conveyed together. But they can be divided and held separately, either by the sale, devising of leasing of mineral or oil and gas rights to others, or by deed reservations that provide for a grantor's retention of subsurface rights. Although leases, purchases, and reservations of these rights are fairly common, their separation from surface rights often complicate the ownership and mortgaging of landed properties. Some states now provide for the separate taxation of subsurface rights when they are known to have economic value or to encourage their reunification with the surface rights if they are not exercised or rerecorded within given time periods.

Rights to develop and use subsurface resources are frequently conditioned by the rights of other property owners. Owners who plan to excavate basements, for example, must respect the subjacent rights of adjacent property owners to have such side support as is necessary to keep their properties from caving into the excavated areas. In like manner, owners of mineral rights must respect the rights of surface land owners when they plan to open mines or drill for oil.

Mineral Rights

Landowners in the United States have a recognized right to take any minerals found under their surface holdings. When mineral rights are held separate from surface rights, owners of the mineral rights have recognized rights or easements over the surface. They can conduct mineral explorations, sink shafts, and build such roads and railroads over the surface as may be needed to transport supplies to their mines and to carry minerals to market. At the same time, holders of surface rights ordinarily retain rights for the continued use of their land. If there is no contractual arrangement concerning possible land disruption or subsidence, mining operations must be carried on in such a way as to prevent surface land from sinking.

Unlike the United States, many nations have reserved mining rights to the state. This situation prevails in continental Europe, in Mexico, and in South America. Among the English-speaking countries, royalties representing specified percentages of certain minerals were long reserved to the crown. This practice carried over in the early land legislation of the United States. The Ordinance of 1785 provided that the federal government receive one-third of the gold, silver, copper, or lead found in the lands granted from the public domain.

This royalty system was applied in the Missouri and Upper Mississippi valley lead region where it broke down, because of lackadaisical enforcement during the 1840s. No effort was made to collect royalties from the gold miners in California. Miners were left free to prospect all over the public domain and frequently rushed to new "strikes" in unsettled areas where public lands had not yet been surveyed for sale. With no enforcement of government regulations, miners staked out and operated individual claims in accordance with miners' rules. These rules spread from community to community and accepted the principle that claims were to be limited in area and that discovery and development were the foundation of a property right in whatever was found. Congress legitimized these mining rules, abolished the unenforced royalty system, and opened the public domain for free mining in its Mining Act of 1866.

Private rights in mining deposits have been modified in two important respects by federal legislation. The federal mining law of 1866 gives the owner of a vein or lode ore extralegal rights, the right to follow a claim beyond the boundaries of one's surface ownership, if the vein or lode has its apex within the owner's holding. A second modification of far-reaching consequence is contained in the Atomic Energy Act of 1946, which declares all fissionable materials, now or hereafter produced, to be the property of the Atomic Energy Commission. Individuals are encouraged to discover and develop uranium deposits; but those who possess and use the ores must be licensed to do so by the Atomic Energy Commission (now the Nuclear Regulation Commission).

Oil and Gas Rights

Rights to oil and natural gas deposits are treated in much the same way as mineral rights.

Like ground waters, oil and natural gas are migratory resources. They occur in underground basins that underlie substantial areas and often numerous ownership holdings. Landowners seldom know how much oil or natural gas underlies their land; and they cannot keep these resources from flowing to the ownership of others, particularly if others drill deep wells for their capture.

Because of the migratory nature of these deposits, owners of oil and natural gas rights do not acquire title to these resources until they actually capture them. This situation put a definite premium on the early tapping and capture of these resources. Landowners who struck oil often drilled offset wells around the borders of their properties to ensure a maximum take on their part. This practice forced owners of adjacent properties to either join in the mad scramble for oil or risk loss of their share of the possible profits. As one might expect, the acceptance of the "rule of capture" resulted in wasteful competition. Unneeded wells were drilled; and these wells reduced oil reservoir pressures and contributed to the too-rapid depletion of many petroleum deposits.

All of the leading oil-producing states now have conservation laws that prohibit avoidable wastes. These states fix and regulate production quotas for individual wells and thus reduce the underground waste that can result from overly rapid depletion. They may also require 10-, 20-, or 40-acre units as the minimum spaces for new wells. Unitization—the development of complete oilfields by one management under a unified drilling and production program—also has been suggested as a conservation measure. This approach is easily applied only in those cases in which an entire oilfield is controlled by one company.

Wide scale leasing of oil rights in areas believed to overlay petroleum deposits provides another means by which wasteful competition in the drilling of oil wells can be prevented. With the leasing approach, surface owners who lease their oil rights receive nominal rental payments together with the promise of royalties if petroleum is discovered and pumped on their land. Since lease rights are usually held by a limited number of oil companies, this system often results in the drilling of fewer wells.

Environmental Considerations

The rights we exercise as individuals in using the earth's environmental resources range from the free unfettered right we can enjoy to watch a sunset to the rigidly controlled rights we might exercise if we choose to use certain chemical substances. We benefit from the free or almost free use of some environmental resources. In some other cases we can benefit as free riders from the activities of others. In most instances, however, the extent of our rights is subject to institutional and social constraints, such as those applied with our recognition and acceptance of property rights.

Recognition of property rights has both narrowed and expanded the rights individuals can exercise in their use of environmental resources. Individual rights are narrowed when aggressive operators find that the institutions of society prevent them from doing what they might want. They are expanded when the rules provide protection from unwanted acts.

Over all, the property concepts various nations have adopted have contributed greatly to the economic growth they have enjoyed. Recognition of exclusive rights of use and benefit has provided incentives for operators to expand their operations as they seek maximization of the returns they receive from their various enterprises. It has brought added efficiencies in production together with increased security of expectations for producers. It has also minimized the conflicts of interest that could arise in their absence.

At this point, valid questions can be asked as to whether the interests of society with respect to our use of environmental resources can best be served by adjustments in our accepted concept of property and, if so, by what kinds of adjustments. Some economists argue that further privatization of the rights operators hold in environmental resources, such as air and water can lead to their more efficient use. Whether this or some alternative approach can best be used to handle resource pollution problems is very much a matter of dialogue and debate.

Further privatization of ownership rights to the use of some environmental resources may be warranted. Before decisions to this end are made, however, it should be remembered that governments have had good reasons to nationalize the private rights individuals once had to exclusive control of the air space above their properties and to the mining of uranium. Several nations have gone farther to withdraw and limit the rights private operators once had to develop their land resources in any way they wish. A key issue with any possible authorization of grants or licenses for private operations affecting the use of environmental resources centers in choices of the sticks from the bundle of rights that must be retained by government.

Some of the most pressing problems we face with the management of environmental resources involve property rights issues and decisions concerning the extent to which private operations are affected by public policy considerations. These issues will be considered from multiple perspectives in several parts of the following text.

Chapter 12: The Role of Government

"Government is our good friend. Without it there would be no civilization, no one to watch over us, and we would be swimming with the sharks."

~ Joel Ricks

Social issues involve matters that directly or indirectly affect members of society. Important examples include such widely diverse items as advancement of public health, control of pollution, crime, discrimination, global warming, human rights, poverty, and protection of moral values. They involve conflicts among members of society that go beyond the ability of any individual to control. Some of these matters, such as control of pollution, have far more bearing than others on the social management of the environment. With every case, however, our principal means for dealing with the problem calls for resort to use of the powers of government.

One of the most important features of the concept of property is it's requirement that there be a sovereign power that can protect and enforce one's claims to legal possession. In the family this can be the parents, in the tribe the recognized chief, under feudalism one's feudal lord, and in modern society the officials who conduct the functions of federal, state, and local government. The role government plays in the management of environmental resources is particularly important because, while individuals make most of the decisions about how environmental resources are used, it is to government that we look for prescription and enforcement of the rules and regulations that tell us what we can and cannot do.

Like Henry Thoreau, many environmentalists are individualists in the sense that they put great value on their Walden Ponds and would like to be left unmolested by government to enjoy nature as they wish, advance their mutual welfare, and at the same time avoid clashes of interests that could lead to the demise of our civilization.

The Nature of Government

Governments have come and gone with the rise and fall of past civilizations. Our own experience is an outgrowth of the conditions that prevailed in Europe during the Middle Ages.

Government was provided by kings and feudal lords. The concept of democracy had little standing in societies that accepted the notion that kings ruled by divine right. People, poor peasants and wealthy merchants alike, were expected and did obey the orders and whims of their lords, because they accepted their status as a manifestation of God's will.

There were always exceptions, rebels at heart, who saw themselves as being no less capable of directing their affairs than the lords above them. Their numbers grew after the invention of printing and the consequent growth of emphasis on education. It was people of that order who did much of the settling and developing of the American frontier. With the responsibilities caused by an ocean lying between them and their supposed betters, it was not unnatural that many of them placed high values on their economic and political freedom. Many believed "that government governs best that governs least." This emphasis on individual freedom from governmental restraint has permeated much of our political thought and has caused many people to view extensions of governmental influence with alarm. The Tea Party movement, active in U.S. elections in 2010, marked a resurgence of this thinking and created an organized movement to reduce the size of government.

Despite this point of view, recent decades have brought a gradual expansion of the scope of government in the United States and in most other countries. Much of this expansion has come with increased exercise of public power in the resolution of conflicts of interest, in advancement of public welfare, and in the pursuit of new social goals. While this expansion may have led to some losses of individual freedom, it has also created and enhanced the economic opportunities and freedom enjoyed by average citizens. As George Steiner (Government's Role in Economic Life, 1953) observed:

> *"The influence of government . . . is felt today in every home, every manufacturing plant, and every farm. It circumscribes, channels, directs, and controls actions of every description. Economic institutions operate on the basis of government action or the conscious lack of government interference. No corner of economic life escapes the hand of government. The touch is sometimes light and sometimes heavy, at times helpful and at other times restraining; it may be agreeable or arbitrary and beneficent or greedy. But whatever may be its character at any one point, the power of government affects our economic lives intimately and often irrevocably. Government regulation is a silent*

partner in all activity and an active partner in most economic activity."

Effects of Government Policies

Almost every decision regarding the ownership or use of environmental resources is in some way affected by public policies or restrictions. Governments can draw the lines on how far we can go in polluting our land, water and air resources. Real property taxes represent an annual levy on real estate ownership and can be used to force lands into more intensive uses. The power of eminent domain can be used for public acquisition of properties from owners who are unwilling to sell. The government's police power, its sovereign power to make and enforce rules and regulations, may be used to protect property rights, prevent fraud, and force citizen compliance with public health standards, building codes, or local land-use ordinances.

Public policies have had an important impact on the development and use of the nation's land resources. Rapid settlement of the Western frontier was facilitated by the liberal land sales and homesteading policies the government employed in disposing of its vast public domain. Since 1890 it has reserved large areas of public lands as public parks, forests, grazing land, and wildlife reserves. It has used public funds to reacquire some areas from private owners for forestry, military and other uses. It has undertaken large-scale multipurpose resource developments, such as the Hoover, Grand Coulee and Shasta dams in the West and the Tennessee Valley projects in the East. It has built its network of national highways, dug canals, and provided navigation improvements.

The federal government has established agencies to increase the credit facilities available to business operators, homeowners, and farmers. It has used tariffs to protect and favor domestic industries. It has authorized taxation arrangements that provide inducements for home ownership, residential housing construction, and commercial and industrial investments. It has used subsidies to encourage conservation practices, dispose of farm surpluses, construct factories for defense industries, and promote the construction of low-rent public housing. It has used price supports to bring stability to the agricultural sector of the economy and rent controls to prevent tenant gouging during periods of severe housing shortages. Cost sharing arrangements have been used with state and local governments to promote highway construction, small watershed improvements, metropolitan planning, and the redevelopment and renewal of blighted urban communities. Programs have been adopted for controlling air, water and land pollution and to protect wetlands and endangered species.

In addition to the federal policies, state and local governments also have policies that affect the uses made of natural resources. Some the most significant of these involve state authorization of land-use zoning ordinances, subdivision regulations, building codes, forest-cutting restrictions, and similar measures that direct private land-use practices in the public interest. Other important programs include the provision and administration of parks and recreation areas, the location and building of streets and highways, and the provision of public parking facilities. State and local action is needed with area planning, urban renewal, and public housing projects. State legislation also governs the rights we hold in land and other natural resources and the ways in which rights are allocated between landlords and tenants and between mortgagors and mortgagees.

Framework of Government

Governments vary considerably in their organization and in the scope of the powers assigned to their various levels. They range from the absolute monarchies of the past, under which all political power stemmed from the pharaoh, emperor, or king to theoretical, anarchistic societies in which no individual is subject to the control of others. Most nations now operate under constitutional forms of government. This means that their organization and the scope and distribution of their powers are spelled out either in a written constitution or in legislation and recognized precedents.

Some constitutional governments, such as the Netherlands, are highly centralized with most of the sovereign power concentrated in a central government. Others, such as the American states under the Articles of Confederation (1778–1789) may be loosely organized and vest virtually all of their political authority in the various state governments. Still others, such as the United States and Canada, operate as federal systems with the political power divided between a national government and several states or provinces.

Most national governments now follow one or the other of two major formats. Most nations use a parliamentary form. They have a king or an elected president who serves mostly in a ceremonial capacity. They have elected parliaments that vote on the enactment of legislation and choose a leader who acts as the prime minister and serves as head the executive, as well as the legislative branch of government. Prime ministers ordinarily remain in office only as long as they can command the majority support of their parliaments.

An alternative approach is prescribed by the Constitution of the United States. Here the executive and legislative functions are separated with an elected Congress being charged with the responsibility for making laws while a separately elected president heads an executive branch of government that enforces the laws. A comparable arrangement is used in the states where the elected governors operate separately from the elected legislatures.

Both systems support separate judicial branches of government. The judges, who are sometimes elected, sometimes appointed, are supposedly independent from executive and legislative influences and are charged with responsibility for interpreting and enforcing the law. Cooperation with the executive branch is mandated when police action is needed to enforce their judgments.

The federal government of the United States operates with delegated powers. Its express powers are limited to those enumerated and conferred by the federal Constitution. Those powers not delegated to the federal government are known as residual powers and are reserved to the states or to the people. Strictly construed, this framework of government leaves the states with the powers not delegated to the federal government and not prohibited to them by either the federal Constitution or their own state constitutions. Counties, cities, townships, and other local units of government operate with powers delegated to them by the states.

At the time the Constitution was adopted in 1787 the scope of the federal government's responsibilities was generally seen as being limited to the provision of national defense, handling relations with other nations, supervising interstate commerce, providing postal service, administering the public domain, and paying the nation's debts. The scope of its powers has since been definitely broadened by liberal interpretation. In the landmark case of McCulloch v. Maryland (4 Wheaton 315, 1819), Chief Justice John Marshall ruled: "*Let the end be legitimate, let it be within the scope of the constitution, and all means, which are appropriate, which are plainly adapted to that end, which are not prohibited, but consist with the letter and spirit of the constitution, are constitutional*." With its implied powers, however, Congress and the Executive Branch must still respect the prohibitions of the Constitution, the guarantees of individual liberties and privileges covered by the Bill of Rights, and the general reservation of residual powers to the states and to the people.

The division of powers between the federal and state governments has an important impact on their responsibilities for developing and carrying out environmental policies. The federal government can operate and administer its own lands, dispose of them as it wishes, and acquire private properties for public use. It can provide funds for various types of research, for housing and reclamation programs, making agricultural conservation payments, highway and canal construction, and the administration of government insured mortgage credit programs. It can use its commerce power and its civil rights and environmental protection programs to influence the uses made of natural resources. But in practice, except for its jurisdiction in federal areas, such as the District of Columbia, it has often lacked specific designations of the sovereign power needed to manage and control uses of natural resources.

Most public powers affecting the ownership and use of natural resources are vested in the states. Virtually all legislation dealing with police protection, landlord-tenant relations, water rights, property taxation procedures, and platting restrictions must be drafted on a state basis. The paramount position of the states in this area also makes them responsible for programs that affect the administration of highways and the control of air and water pollution. Congress, has found, however, that it can use its power of the purse to induce states to accept federal standards for highway construction and administration, and that it can use a related power to withhold grants if states do not accept its guidelines for controlling air and water pollution.

Counties, cities, villages, townships, and other local districts occupy the bottom rung in the hierarchy of political power. It is important that states vest them with governmental powers, because it is at this level that government has its greatest impact on the uses made of natural resources. They are the units that levy and collect property taxes; enact and enforce zoning ordinances; and provide the officials who protect individuals and their property from violence, theft, fraud, and fire. They enforce most of the public police-power regulations that affect public health, safety, morals and general welfare. Ad hoc units of government—such as conservation, drainage, flood control, grazing, irrigation, or levee districts that disregard local political boundaries—may also be set up to deal with specific problems.

Public land and water policies sometimes call for international agreements such as those that govern the development of power and water storage facilities on the Rio Grande or control pollution in the waters of the Great Lakes. Treaties and protocols, which have the enforcement status of laws once they are formally approved, are used to effectuate international agreements on matters such as control of air pollution and fishing rights in ocean waters.

The United Nations, through the Man and the Biosphere Programme, has developed guidelines and systems for managing natural areas across national political boundaries. These units, Transboundary Biosphere Reserves (TBR) , have great potential to maximize both conservation and economic goals through cooperation and collaboration. As of 2010, there were nine TBRs sanctioned by UNESCO and operating to various degrees under guidelines spelled out in “The Seville Strategy” (UNESCO, 1996).

Need for Government

Government is important to us as citizens, because it is only by abiding by mutually accepted rules that individuals and groups in society are able to live with each other in peace. The institutions that define the acceptability of our practices and decisions as managers of the environment are governed in large measure by arrangements in society that set the boundaries on what we can or should do. Most of these arrangements are provided by government and spelled out in laws. These are the formal institutions of a society; rules and regulations that are sanctioned and enforced by some level of government.

Governments have their flaws, are subject to modifications, and may even need to be replaced at times. At any given time, however, they represent a significant part of the institutional framework, which John R. Commons (Institutional Economics, p.45, 1934) described as: "the system of 'discipline and obedience'" into which people are born, and which they accept, because experience tells them that that *"conformity . . . is the only way to obtain, life, liberty, and property with ease, safety, and consent."*

The business activities that provide the pulsing blood of our global, national and local economies could not operate without general acceptance of the role governments play in defining the rules of the game. It is government that protects property rights, enforces the sanctity of contracts, provides coinage, and smoothes the free flow of trade. It is government too that spells out the limits of economic free agency by protecting us from pillage, thievery, and fraud.

Governments provided a far more limited role in our economic and social lives in 1800 than today. It was content then to provide protection and preserve order and supply a few amenities such as postal service. Since then it has broadened its activities to provide a wide array of social services that enhance the public welfare. Examples include the abolition of the right to possess the bodies of others, the abolition of child labor, protection of workers from hazards of the work place, rules requiring food and drug protection, measures to control diseases, welfare programs to care for the needs of the unable, expansion of educational opportunities, provision of social security, measures to aid victims of climatic and other disasters, and expanded programs to control environmental pollution.

The stretching of governmental authority and programs to bring more members of its citizenry under its protective shield has given rise to questions about how far governments can or should go in shouldering responsibilities for problems once borne by individuals and their families. It is obvious that the benevolent programs it has provided have come as a result of citizen desire and demand. They represent forms of collective action designed to enhance social welfare and have made us a more humane society.

Have we gone too far? Should the role of government be rolled back to place more responsibility on individuals for caring for their own problems? Some people believe this change is needed, many of whom are well-endowed with ability or financial resources. Others, with little to protect them from poverty or sickness, believe government should do even more.

No definite answer is possible. Proponents of additional or stronger programs for enhancing the social welfare can point to many areas in which additional public concern could be expressed. Critics of programs, such as those that provide an economic floor for the needy, that protect pension rights and worker security, that require safety precautions, and that underwrite the costs of providing health and medical benefits, complain that these programs are costly, that they place an unneeded burden on the economy, and that government is often more of a problem than a help.

Examples can certainly be cited of mistakes made by government and of public officials who forget that they are supposed to act as servants of the public. But is this a valid justification for rolling back programs that provide social benefits? Bad and improper administration are phenomena that should be corrected and condemned. Their existence, however, does not negate the need for governmental action. From an ethical point of view, if agreement can be reached on the nature of social programs needed, programs involving the collective action provided by government should be used any time they can supply the levels of service desired at less cost than they can be provided by private operators.

The Importance of Law

Law can be defined as that body of rules and regulations recognized as binding by citizens and nations. These rules and regulations involve an easily visualized type of collective action in control of individual behavior. Laws are important, because they set the legal boundaries within which acceptable individual and group behavior takes place. Their all-pervading scope is such that there are few times in a resource manager's lifetime when one's activities are not in some way subject to legal evaluation.

What we ordinarily recognize as law really comes from three sources: 1) From statutes, ordinances, and administrative regulations; 2) from established customs that have gained the sanction of legal authority; and 3) from judicial interpretations and court decisions. Altogether, we probably have several million laws. Some have been passed by Congress or state legislatures, many more by city councils, county boards, and voters themselves. Others involve executive orders and administrative rules laid down by various public agencies. Yet as important as these examples are, one should not lose sight of the fact that a considerable portion of our law is court-made.

From a historical standpoint, the beginnings of law are found in the social customs accepted and enforced by primitive peoples. As civilization developed, these social usages often became the basis for written law. Sometimes their substance was enacted into statute. More often they were accepted as a type of precedent and became part of the law, because of their recognition and acceptance in judicial decisions. Eventually, many judicially sanctioned customs found their way into various codifications of law, such as the Code of Hammurabi (2000 B.C.), the Justinian Code (A.D. 529), and the Code Napoleon (A.D. 1804). But even when codified, the real meaning of these laws has usually depended on judicial interpretations.

This evolutionary pattern describes the development of the legal system accepted in most English-speaking countries. Units of government within these countries have their constitutions, statutes, ordinances, and regulations—many provisions of which are based on custom. Some of them have codified portions of the prevailing legal theory advanced in judicial decisions. But most still look to the English common law for significant portions of their ruling law. This is particularly true of laws relating to land resources. In practice, almost all of the law of contracts that affects our use of environmental resources, most of the laws of agency and torts and the laws affecting real estate are based not on written statutes but rather on court opinions.

The English common law on which much of our legal system is based involves court-made law. Many common-law principles go back to the customary practices of medieval England. But while the common law places heavy emphasis on precedents established in times past, it nevertheless represents a dynamic, flexible body of legal doctrine. Its framework is such that it can easily adjust to new situations and changing conditions.

The common-law approach, with its acceptance of individual decisions as precedents for future actions that thereby become rules of the game, is widely used in our society. It is frequently applied in individual households and firms, as well as in public actions. It provides a workable means for resolving conflicts of interest. In their use of this approach, courts often make far-reaching decisions that have a telling impact on various aspects of economic and social life, as well as on legal institutions. When the Supreme Court reaches decisions on subjects, such as racial segregation, antitrust regulations, or land-use practices, it spells out principles that will guide our economic and social system for years to come.

It should be noted in passing that the legal system accepted in English-speaking countries is not the only system of law that prevails in the world today. Roman, Germanic, Slavic, Chinese, Hindu, Japanese, and Muslim are some of the larger systems that apply in other nations. They differ in content and points of emphasis. Some, such as those accepted in some Muslim nations, give heavy emphasis to theocratic influences. With these differences, it is only natural that the legal concepts of rights and responsibilities accepted in some countries may appear quite foreign to the thinking of others.

The Making of Law

Much of the law we live under is court-made in the sense that judges base many of their decisions on precedents, which in many cases involved logical acceptance of customary practices. These precedents have been recorded in the annals of ongoing court decisions for several hundred years and are frequently cited by lawyers in their legal briefs and by judges in their decisions. New laws that go beyond established current law to deal with new issues or to change, define or refine existing rules are being enacted almost every day by various legislatures. The process by which laws are made is of interest to environmental resource managers, because considerable possible legislation that will affect them is still being made.

Laws do not just happen. They are made, because individuals or groups identify issues that can be dealt with through the adoption of new rules. Proposals for legislation are submitted to legislators. The proposals must then be drafted into proposed bills. These proposals may receive extensive review or no review at all prior to their introduction in Congress or a legislature as proposed laws. Once introduced, a bill is assigned to an appropriate committee for consideration. The bill can be amended, accepted or rejected in committee. If approved, it goes to the full house for possible debate and formal acceptance if it receives a majority vote. With two-house legislatures, a bill then goes on to the other house where it again is sent to the appropriate committee for hearings and consideration. Should a bill be approved by the committee and be passed without amendment by the second house, it is sent on to the president or governor for approval and signing into law.

Amendment of a bill by the second house calls for sending it to a conference committee, made up of selected members of both houses, which is charged with responsibility for designing a compromise measure that can secure the approval of both houses. Presidents and governors have the option of vetoing passed legislation. When this happens, legislatures have the option of overriding the vetoes with a two-thirds majority vote in both houses.

The process of making a law is logical and in theory above-board. It embraces a formula by which proposed legislation can be carefully considered and adopted on its merits if it receives majority approval. This simple process is complicated in many instances, however, by quirks in the system. Paid lobbyists place strong pressures on legislators to favor their interests, pressures that distinctly favor the interests of small segments of the total electorate. Large sums are needed to elect members to Congress and recognition of interests comes with the flow of money.

Powerful committee chairman may exercise near dictatorial powers over the agenda of their committees. Legislative rules can thwart the voice of protesting legislators by denying them the right to offer amendments on pending proposals. The conference committees selected to negotiate differences between Senate and House versions of a bill can be loaded with proponents of particular points of view while recognition of other views is denied. With numerous bills running several hundred pages in length, opportunities exist for committee members to make notable changes in the proposed legislation and also add irrelevant provisions that provide "pork" concessions for various groups. Non-amendable bills can then be returned to the two houses for hasty consideration and passage before members really have an opportunity to read and analyze the bills on which they are voting.

Possibilities for correcting these deficiencies could be handled by measures, such as acceptance of a presidential right of line veto, by changes in House and Senate rules of operation, and by a requirement that no proposed law contain provisions not included under its title. Valuable and workable as they may appear, remedies of this order are often opposed by members of legislative bodies. They see politics as the art of compromise. For them, the business of trading votes and showing willingness to give ground on some issues provides a practicable means by which they can secure acceptance of programs desired by their constituents.

Economists use a concept known as Pareto optimal, named after an Italian economist, under which policies should be so devised that no one gains at the expense of others. Politicians can only hope for such ideal situations. They realize that virtually every proposal for action has its losers, as well as its gainers, and that the prospect for securing Pareto optimal solutions is as rare as unanimous votes in the House and Senate on matters of substantive importance. For them, making necessary compromises provides the only practicable way by which they can secure majority support for desired programs.

Powers Affecting Use of the Environment

Government plays a manifold role in supporting, directing, and controlling the uses we make of environmental resources. It has a long record of underwriting our efforts as individuals and as groups to bring the resources of the earth under our control. Governments have acquired sovereignty over new lands, made them readily available for settlement, provided roads and other needed infrastructure, undertaken resource developments, and provided financial and research programs that have expanded the ability of its citizens to make productive and beneficial use of our resource base. It has supported use of the laws of property, agency, contract, and torts for this purpose. At the same time, it has recognized a need to reserve portions of our environmental resource base for public rather than exclusive private possession and control. It has found that protection of its citizenry calls for using the sticks from the bundle of rights that are reserved for use by government to operate in the name of society. Understanding the role government plays with environmental resources calls for recognition of the authority associated with the government's use of its police power, its power to levy taxes, and its proprietary, eminent domain and escheat powers.

Police Power

Of the several powers states and the federal government have over landed property, the police power is often regarded as most important. It involves the basic right of governments to govern and exercise their inherent right to legislate for the advancement, preservation, and protection of public health, safety, and morals, convenience, and welfare. As one court (Motlow v. State, 125 Tenn. 589, 1911) has observed, the police power

> *". . . is of vast and undefined extent, expanding and enlarging in the multiplicity of its activities as exigencies demanding its service arise in the development of our complex civilization. It is a function of government solely within the domain of the legislature to declare when this power shall be brought into operation, for the protection or advancement of the public welfare."*

In some respects, the police power is a singular American institution. No mention of it is made in the U.S. Constitution. The concept has evolved instead as a product of judicial interpretation. The term police power was first used by the Supreme Court in 1827 and its recognition as a source of legal authority came two decades later when Chief Justice Taney (License Cases, 5 Howard 583, 1847) defined it broadly as "the power vested in the legislature . . . to make, ordain and establish all manner of wholesome and reasonable laws . . . for the good and welfare of the commonwealth, and the subjects of the same." Since its legal recognition, courts have gradually expanded the scope of what can be accomplished with police power to permit an ever-widening latitude of social action in areas involving the public interest and welfare.

Since its judicial beginnings, police power has been treated as a residual power of the states, which the federal government can also exercise in its administration of federal territories and as a delegated power incident to its commerce, postal, taxation and war powers. It has provided the legal basis for a variety of public measures that limit or regulate vested property rights. But while courts have accepted an expanding concept of police power, they have held rigorously to the view that every exercise of this power must be reasonable, must enhance the public welfare, must not be arbitrary or discriminatory, and must not deprive persons of their rights without "due process of law" or of "equal protection of the laws." The due process and equal protection restrictions against state action were adopted as part of the Fourteenth Amendment to the U.S. Constitution following the Civil War in 1868. These provisions were designed ostensibly for the protection of individual civil rights. In practice, they have often been used to protect corporations, as well as individuals, against possible uses of the police power.

The police power can and has been employed in many different ways to influence and direct the uses made of environmental resources. Some of its leading applications, such as its use to establish land zoning ordinances, regulate the handling and recycling of waste products, and provide standards for air and water quality will be discussed in greater detail in later chapters. Among its many other uses, some are primarily concerned with protection of public health, some with safety measures, and still others are welfare-oriented. Regulations affecting the safety of foods and drugs, sanitation and waste disposal requirements, air and water quality standards, maintenance of quarantines, and disposal of diseased animals fit in the first category. Fire control ordinances, measures affecting the storage and transportation of dangerous substances, and regulation of working conditions are safety-oriented. Several other measures, such as those affecting rent controls, noise ordinances, strip mining, regulation of subdivisions, and the provision of parking spaces are welfare-oriented.

Power of Taxation

Few people enjoy paying taxes. We pay them, because we realize that their payment is part of the necessary price we pay for civilization. Taxes involve compulsory charges levied on persons, properties, and activities to support the cost of government, charges considered as necessary, because no modern government can operate without appropriate funding. As the Supreme Court (Nichol v. Ames, 173 U.S. 515, 1899) has observed:

> *"The power to tax is the one great power upon which the whole national fabric is based. It is as necessary to the existence and prosperity of the nation as the air he breathes is to the natural man. It is not only the power to destroy but also the power to keep alive."*

There are no simple formulae that indicate the tax systems governmental jurisdictions should apply. Adam Smith (<u>The Wealth of Nations</u>, 1776) argued that a sound tax system should reflect ability to pay, be certain and understandable, convenient to pay, and take as little from taxpayers as necessary. As additional requirements, one can assert that they also should reflect benefits received from public expenditures, provide a reliable and relatively uniform yield, not be subject to arbitrary administration, and have low compliance and administrative costs.

Taxes take many different forms and usually involve levies of either uniform or graduated rates on persons, transactions, properties, incomes, or privileges. From an ethical point of view, it is generally conceded that the share of the total tax load that individuals, groups, and corporations pay should 1) reflect both their ability to pay; and 2) the extent to which their ability to pay reflects dependence on workings of the social order. Since accumulation of wealth ordinarily involves a taxpayer's exercise of ability to cash in on opportunities provided by society, it may be argued that wealthy taxpayers have a moral and ethical duty to bear more than a proportionate share of the tax load. This concept calls for the acceptance of a progressive tax system.

It is understandable that high income taxpayers often favor shifting more of the tax load to sales and flat-rate taxes that place higher portions of the tax burden on lower-income taxpayers. Proposals of this order favor regressivity in the tax system, a system, which proponents claim allows the wealthier taxpayers to use their tax savings to invest in ventures that will produce benefits that trickle down to lower-income workers. Public tax policy at both the federal and state levels during recent decades in the United States has moved generally in the direction of making their overall tax systems less progressive than they were in the mid-1900s. Whether this has resulted in an actual trickling of more financial benefits down rather than up is a debatable matter of opinion.

Local governments depend primarily on the revenue they receive from property taxes while state governments are heavily dependent on their receipts from sales taxes, and both federal and state governments rely heavily on income taxes. No level of government is limited, however, to the use of a single tax. All use combinations of taxes, some that are progressive in incidence, some regressive. It is the combined impact of all of the taxes one pays that indicates the relative and ethical fairness of one's tax burden.

While governments can use taxes for regulatory and non-fiscal, as well as revenue collection purposes, the taxing power has its limits. Most governments are constrained by constitutional principles that specify the circumstances under which this power can or cannot be exercised. In the absence of these limits, governments are also limited in an ultimate sense by the fact that they cannot tax property beyond the point of confiscation and taxpayer compliance.

Throughout the United States taxes are fixed within a wide range of voter tolerance. The taxing power is vested in the legislative branch of government, a branch subject to voter approval, and cannot be delegated to other agencies. Except for constitutional restrictions, every legislature is free to tax persons or property subject to its jurisdiction at rates of its own choosing. It can group or classify particular persons, properties, privileges, or incomes for taxation purposes. But these classifications "must be reasonable, not arbitrary, and must rest upon some ground of difference having a fair and substantial relation to the object of the legislation, so that all persons similarly circumstanced shall be treated alike" (F. S. Royster Guano Co. v. Virginia, 253 U.S. 412, 1920). The courts have also held that all taxes must be levied for public purposes and that they must be levied in an equitable and reasonable manner.

In addition to these judicial limitations, the taxing powers of the federal, state, and local governments are subject to constitutional provisions. The federal and state governments are sovereign within their own spheres. Neither level has a right to infringe on or interfere with the other's legitimate functions and neither can tax the agencies or instrumentalities of the other. The federal government has only those taxing powers delegated to it by the federal constitution. States and local governments in turn have only those taxing powers not prohibited by the U.S. Constitution and not limited by state constitutional provisions.

Congress has the power "to lay and collect taxes, duties, imposts, and excises." This constitutional grant of power is subject to five specific limitations: 1) No tax or duty can be laid on exports from any state; 2) except for income taxes, which are authorized by the Sixteenth Amendment, all direct taxes must be apportioned among the states according to population numbers; 3) all direct taxes must be applied uniformly throughout the nation; 4) discriminatory taxation cannot be used to deprive any person of "life, liberty, or property without due process of law;" and 5) taxes can be collected only "to pay the debts and provide for the common defense and general welfare of the United States."

The constitutional provision that taxes can be collected for "the general welfare" both expands and limits the scope of the federal taxing power. In practice, legal questions are seldom raised about those taxes whose revenues go into the general fund, because the courts ordinarily refuse to question the character of expenditures made from this fund. But when a tax is used for regulatory purposes, or when its receipts are earmarked for a particular activity or function, the courts may consider the nature of the tax and its objectives to determine whether it actually provides for the general welfare. Should a court decide in the negative, the tax would be declared unconstitutional.

Except for a requirement that no state levy import, export, or tonnage taxes without the approval of Congress, the Constitution makes no direct reference to the taxing powers of state and local governments. But indirectly, these units are limited by the constitutional requirement that they 1) make no laws "impairing the obligations of contracts;" 2) treat federal treaties as "part of the supreme law of the land;" 3) take no actions to discriminate against citizens of other states; 4) grant "equal protection of the laws" to all persons; 5) deprive no persons of "life, liberty, or property without due process of law;” and 6) adhere to the judicial doctrine of non-interference with interstate commerce.

State constitutions often contain provisions that limit the taxing powers of state and local governments. One of the most widely accepted provisions is that of "uniformity" or "equality" in taxation. This requirement usually applies primarily to property taxes, although it can be applied to other taxes as well. As usually applied, it requires all properties, or all properties of the same class within any taxing district, be taxed at the same millage rate and according to the same assessment-value ratio. State constitutional provisions are also used at times to provide that 1) all taxes be for public purposes; 2) property be assessed at its "fair" market value;" 3) tax levies not exceed specified maximum millage levels; and 4) property not be subject to double taxation.

Insofar as environment resources are held as private property, they are always subject to property taxation. Property taxes can be used to force the shifting of properties to higher uses. This can be considered an equitable matter when vacant lots are assessed at low values while neighboring lots around them are being used for higher valued residential and commercial uses. A very different situation exists when owners want to retain areas of environmental significance as open space while an economic case can be made for treating their holdings as prime sites for commercial or industrial development.

Properties of recognized environmental significance can be treated separately from other real properties for tax purposes. Special taxing arrangements are used in several states for such varied purposes as protecting open spaces, retaining land in agriculture, encouraging the acceptance of conservation practices, taxing forests on a one-time crop basis rather than as a resource than can be taxed at its increasing market value every year, and providing incentives for improved methods of handling oil, gas, coal, and mineral resources.

The Proprietary and Spending Powers

The federal and state governments have a clear proprietary or public ownership right to acquire, develop, manage, and dispose of properties. Closely associated with this right is the spending power, the power of the purse, which allows them to spend money for a wide variety of purposes. Both powers have been used in manners that affect environmental resources and both have considerable potential for being used for this purpose in the future.

The federal government exercised its proprietary power when it acquired land title to the various Indian cessions, when it bought the Louisiana Purchase and Alaska; when it devised policies for disposing of the public domain; when it reserved large areas for federal forests; when it designated particular areas as national parks, seashores, recreation, and wilderness areas. Similar powers have been exercised by the states. Some of the more important uses of these powers today involve the acquisition, development, and holding of land and water areas for future recreational and open space uses. The power is also used for such environmental enhancements and protective purposes as sponsoring research and educational programs, stocking fisheries, controlling forest fires, and providing protection and relief from natural disasters. Coalitions of states have continually sought new ways to manage resources, most notably water, which they share in common.

Congress commonly couples use of its spending power with its use of its proprietary power when it devises measures to enhance environmental conditions. It has found that it is usually far easier to get compliance when it uses a "carrot" approach rather than mandate that certain things be done. The courts have held that Congress can spend funds for almost any purposes as long as its spending is for the public welfare. Powers of a comparable nature are held by state legislatures subject to possible limitations imposed by their constitutions. Local governments in turn enjoy all of the spending privileges granted to them by their charters and enabling acts. Acting with these powers, governments use their spending authority to provide a wide range of services extending from fire, police, and military protection to the financing of education, public works, and various resource development programs.

During recent years, the United States has used its spending power in five important ways to direct resource use practices. It has used public funds to 1) acquire lands for various purposes; 2) carry on resource development programs; 3) provide public credit facilities; 4) subsidize desired private practices; and 5) finance the cost of various state and local projects.

Mention has been made of its use to acquire lands. Examples of its use to secure resource developments include major undertakings, such as the construction of the Hoover and Grand Coulee dams, sponsorship of the Tennessee Valley Authority, digging the Panama Canal, the financing of superhighway construction, the provision of river and harbor improvements, and the financing of pubic research. Thousands of businessmen, homeowners, farmers, and students also have benefited from special credit programs designed to make financing available to them at less than the normal commercial rates.

Public subsidies have been used to promote the provision of low-rent public housing, to finance food stamp and school lunch programs, to insure the provision of industrial facilities during wartime periods, and to provide payments for following soil conservation practices.

Subsidies may also be included in cost-sharing arrangements. With the Federal Aid Highway Act of 1956, for example, the federal government pays up to half the cost of highways located entirely within states and up to 90 percent of the cost of constructing highways and expressways classified as parts of the interstate highway system.

Federal assistance for slum clearance and operation of public housing projects has been available to cities since 1937. The National Housing Acts of 1949, 1954, and 1956 authorized federal grants to finance two-thirds of the cost of approved local urban renewal projects. Later housing acts have provided funds to pay for up to 40 percent of the cost of local open space land acquisition and 80 percent of the costs of model city program projects. Federal agencies have also made grants to state agencies for acquiring recreation lands; paying substantial portions of the cost of state, regional, metropolitan and local planning efforts; facilitating regional economic development programs; and providing waste water treatment and toxic waste disposal facilities.

The federal government's power to spend is coupled with a right to withhold subsidy payments to state and other governments if they do not meet federal standards. This practice is known as sanctions. Considerable payments are made every year to the states as part of the federal government's highway construction and maintenance program. Congress has found that it can seek sanctions, withhold portions of its nominal payments, if states do not accept standards, such as requiring drivers to use seat belts. Sanctions involving the withholding of highway funds also are used to secure state compliance with federal standards for non-highway projects, such as the enforcement of air and water pollution regulations.

Eminent Domain, the Taking Power

Eminent domain, which literally means "highest authority or dominion," involves an inherent right of government to take private property for public use without the owner's consent. As a community control over property, it can be exercised alone or in combination with other powers of government to secure particular ends. Its exercise is necessary for the orderly acquisition of sites needed for highways, streets, utilities, military installations, and other public purposes. Without it, individual property owners could block the will of the majority by simply refusing to sell land needed for various public purposes.

The term "eminent domain" was first mentioned by U.S. courts in 1831. Prior to that date there had been few occasions to require it. Following its recognition by the courts, possible applications of the government's taking power were soon accepted as an established feature of American law subject to three modifications: 1) The federal and state governments could delegate the power to other units of government and to public and private corporations; 2) the power must always be used for public purposes; and 3) just compensation must be paid for all properties taken.

Like many legal concepts, eminent domain has an elastic scope. Almost from the start, state legislatures regarded eminent domain as a power they could delegate to private corporations and groups, as well as to state agencies and local governments. Its use was delegated to railroads to acquire rights-of-way for their tracks, to mill-dam owners to acquire flowage rights, to mine owners to acquire land for tramways, and to drainage districts for the construction of ditches and drains. Most of these delegations were legitimate; but with the rising tide of American industry, it soon became apparent that the taking power could be abused and even be used by corporations to seize properties of their competitors. Meeting this problem called for putting emphasis on takings for "public use."

Judicial limitation of the concept of "public use" has resulted in complications, uncertainties, and some legal inconsistencies. Some courts continued to hold for broad definitions, others have favored more limited definitions, and the question of how far the taking power should be extended is still subject to debate. Some courts have tried to limit "public use" to "use by the public." Most courts since the 1930s, however, have considered this an inadequate test.

The Supreme Court took a broad view of the power in Berman v. Parker (348 U.S. 24, 1954) when it held that: "It is within the power of the legislature to determine that the community should be beautiful, as well as healthy, spacious, as well as clean, well-balanced, as well as carefully patrolled," and that: "Once the object is within the authority of Congress, the right to realize it through exercise of eminent domain is clear." In Kelo v. City of New London (545 U.S. 469, 2005), it held in a five to four decision that cities could use their eminent domain power to acquire well-maintained properties to advance local economic development programs. The court in this case, however, also recognized a right of individual states to limit the extent of their taking power.

With the broad position taken by the courts, it is now generally recognized that the taking power may be used for matters of environmental enhancement. The power can be delegated to private corporations if the purpose is to contribute to public welfare and advantage. It has been used to acquire sites for airports and expressways, to take blighted properties in urban areas for area renewal, and even to take commercial properties so that urban areas can be redeveloped for higher uses.

Payment of just compensation has been accepted as a recognized principle in American law for more than two centuries. Provisions were made for it in many early state constitutions and were specifically provided for in the Fifth Amendment of the Bill of Rights in 1791 and later reemphasized by the Fourteenth Amendment. The pertinent question with just compensation is determining its precise meaning. Courts have rejected the idea that it means "value to the taker" or "value to the owner," either answer of which could inflate a property's value. Instead they hold generally to treating it as "fair market value" or "the price a willing buyer would pay a willing seller" in the market.

Payments for consequential damages, such as moving costs, personal inconvenience, interruption of business operations, or loss of good will, are usually rejected. Payments may be made for severance damages when the taking of a portion of a holding reduces the prorated share of the value of an owner's remaining holding. The problem of severance damages often provides justification for excess condemnation, a situation in which the taker may take larger properties than those required with the expectation that the excess taking will be either put to a public use or be sold in the market to a willing buyer.

Escheat

Escheat involves the residual power of governments to take over the possession of properties that are abandoned by their owners or if owners cannot be found. It is usually seen as a power of infrequent occurrence. Yet a surprising number of cases, most of them involving forgotten bank deposits, do occur and provide governments with a minor source of revenue. The significance of the power is obvious. If owners abandon their properties or if owners die without leaving any known heirs, it is logical that the state assume possession and take the necessary steps to restore it to the possession and use of a willing operator.

Government and the Environment

Government is a manifestation of our collective will as citizens. Ideally it is what we, or a majority of us, want it to be. It is not unnatural that some people do not like the constraints government may place on their activities. That is their privilege; but we must recognize that the policies and rules carried out are there, because our elected representatives have put them there. The concerns they have shown for the environment reflect the concerns that we the people have. As long as the general public was content to allow operators to use natural resources as they wished, no public action was taken to manage or control those practices. When the pubic recognized need for public action to direct environmental use practices, governmental programs were developed for that purpose.

Our federal and state governments showed little concern for many of the issues we now associate with management of the environment until the middle 1900s, because few people regarded them as problems. As the listing of landmark examples of legislation reported in

Table 12–1 indicates, however, Congress has had a long standing interest in the development and productive use of the nation's land. This interest was displayed in the early action taken to make provisions for surveying and offering the public domain for sale to prospective settlers. Action was taken later to encourage internal improvements, to grant public lands to companies for building railroads, to withhold sales of forests lands and create a Forest Service, to apply conservation measures to the nation's public grazing lands, to create a Soil Conservation Service (created by executive order), to launch area development programs, such as that undertaken by the Tennessee Valley Authority, to finance the building of a network of interstate highways, and to undertake programs for urban renewal.

Table 12–1. Landmark Legislation Affecting Natural Resource Development in the United States to 1956

Year	Legislation
1785	Land Ordinance
1841	Internal Improvements Act
1850	Illinois Central Railroad Land Grant
1862	Homestead Law Morrill (Land Grant College) Act
1866	Mining Act
1891	Forest Reservation Act
1897	Forest Organic Act
1902	Reclamation Act
1911	Weeks Forest Purchase Act
1916	National Park Service Act
1920	Mineral Leasing Act
1933	Agricultural Adjustment Act Tennessee Valley Authority Act Taylor Grazing Act Soil Conservation Service (Established by Executive Order)
1946	Flood Control Act
1949	Atomic Energy Act
1956	Housing Act Interstate Highways Act

Source: Dr. Raleigh Barlowe, Michigan State University, 2012.

As the listing of federal environmental legislation reported in Table 12–2 suggests, 1970 was a key year in the rise of the environmental movement. It would be wrong, however, to assume that Congressional interest stemmed from the celebration of Earth Day in that year.

Congress started to take interest in the problems of air, water and land pollution in the late 1940s. Little was actually done at the time, however, because the power to control these problems was seen as being vested in the states. The first federal laws in this area limited federal action mostly to research and provision of advice.

Table 12–2. Landmark Federal Environmental Legislation

Year	Federal Environmental Legislation
1948	Water Pollution Control Act (Amended 1972, 1977)
1954	Watershed Protection and Flood Prevention Act
1955	Air Pollution Control Act (Amended 1970, 1977, 1990)
1960	Multiple Use-Sustained Act
1964	Wilderness Act
1965	Water Quality Act Land and Water Conservation Fund Act
1966	National Historical Preservation Act
1968	Wild and Scenic Rivers Act National Trails Act
1970	National Environmental Protection Act Water Quality Improvement Act Resource Recovery Act Occupational Safety and Health Act 2071 National Forest Act
1972	Coastal Zone Management Act Noise Act Marine Protection Research and Sanctuaries Act (Ocean Dumping Act) Federal Environmental Pesticide Control Act
1973	Endangered Species Act Flood Disaster Protection Act
1974	Forest and Range Renewable Resources Act Safe Drinking Water Act
1976	Resources Conservation and Recovery Act National Forest Management Act Toxic Substances Act
1977	Soil and Water Resources Conservation Act Surface Mining Control and Restoration Act National Earthquake Hazards Reduction Act
1979	Federal Emergency Management Act
1980	Comprehensive Environmental Response, Compensation and Liability Act (Superfund Act) Alaska National Interest land and Conservation Act
1981	Farmland Protection Policy Act
1982	Coastal Barrier Resource Act
1985	Food Security Act
1989	North America Wetlands Conservation Act
1990	Oil Pollution Act Pollution Prevention Act Global Change Research Act
1996	Food Quality Protection Act
1999	Chemical Safety, Site Security and Fuels Regulatory Relief Act
2000	Land Conservation, Preservation and Infrastructure Improvement Act Beach Environmental Assessment and Coastal Health Act Federal Disaster Mitigation Act (FEMA)
2002	Small Business Liability Relief and Brownfields Revitalization Act
2005	National Energy Act

Source: Dr. Raleigh Barlowe, Michigan State University, 2012.

The situation changed as mounting public demands for action brought passage of the National Environmental Policy Act in 1969 and its signing into effect in January 1970. A bolder approach was now accepted as Congress enacted programs that called in many cases for enforcement by state action. More than 20 major laws dealing with environmental protection measures were passed during the Environmental Decade of the 1970s and this drive for action was capped off with the passage of the Superfund Act of 1980.

The National Environmental Protection Act of 1970 was the most important single law enacted during this period. Its provisions called for the creation of a Council on Environmental Quality, which was authorized to establish an Environmental Protection Agency. The EPA was organized and has gone on to provide a useful service in establishing environmental standards for dealing with air, water and land pollution. As originally planned, the Council on Environmental Quality was expected to provide an environmental service for the President comparable to that provided in the economic and business area by the Council of Economic Advisors. This expectation is yet to be fulfilled, because no president since has been willing to give this much emphasis to environmental concerns.

The Future Role of Government

Attitudes about government and the extent of its role vary. Many people believe that the role of government should be sharply curtailed and perform only those services that are absolutely necessary. Numerous others contend that the increasing pressures of modern society can best be handled by governments acting for our benefit and taking on "cradle to the grave" responsibilities for enhancing human welfare. A reading of history shows that the American nation started over two centuries ago adhering largely to a rugged individualistic view that favored limited government. Government then provided for order and national defense, the regulation of interstate commerce, timely distribution of the mail and little of anything else.

Little by little its functions have since expanded, as in most of the more developed nations, to provide protections and services that meet a wider scope of human needs; such needs as providing education, securing protection for citizens in their private and commercial working relationships, and giving people greater security in their lives while expanding their opportunities to enjoy fuller lives. Many people would extend the responsibilities of government to provide health and medical protection to all citizens for their lifetimes, to expand its efforts to educate and train its members so that they might use their skills to greater purpose, and to provide a higher economic floor for the nation's poorest members. Given our sorry record in international comparisons of student achievement, many people agree that more effective training is needed to enhance the technical capacity of our young workers to compete on an even basis in a global economy.

At present there is no widespread agreement in the United States regarding the appropriate role of government. The elections of 2010 showed a deep divide among citizens who favor cutbacks in government programs, services, and power, and those who favor strengthening or adding programs to provide for social welfare.

Chapter 13: Emerging Institutional Considerations in the Emerging New Global Economy

"Interdependence is the occasion for both cooperation and conflict"

~A. Allan Schmid

The earlier chapters of Part Three largely focused on institutions, addressing issues, such as property rights and the role and nature of government entities empowered to aid society in managing and adjudicating such rights. Property rights are central to the efficient and smooth running of land-based assets. Since these assets have economic value and the market economy is based largely on the activities of people and companies in their quest to extract or create value from land, institutions designed to manage and adjudicate property rights are central to the optimization of land use and land-based resources. The role of government in managing property rights is, therefore, an important one, one that is required in order for natural resource markets to effectively function. But the role of government goes beyond insuring that land and natural resource markets function well. Since land forms the basis for much of the wealth in advanced societies, the government's role is crucial in wealth creation and prosperity development.

By defining the basics of property, rights to property, transfer of property, property taxation, different ownership and use arrangements, various institutions involved in property allocation, and unique considerations associated with different types of rights and properties, Chapters 11 and 12 provide what we believe to be a solid foundation for understanding the basics of land related institutions. By delving into the various roles of government and the institutional arrangements and rules designed to make property markets function, a solid foundation is also laid for deeper examination of emerging legal and policy issues in the land arena. In this chapter, our goal is to present some of these emerging issues, especially focusing on the limitations of the neoclassical perspective on property, rent, taxation, rights and the roles of government. We do this by recognizing that because government behavior is endogenous, patterns are increasingly emerging on the landscape that suggest more fluid and less predictable roles of markets and governments in the future.

Property Rights and the New Economy

We begin by examining the changing nature of property rights as the world has transitioned from the Old Economy to the New Economy. As established in Chapter 10, the nature of the economy has changed drastically, so much so that our view of natural resources must also change. The neoclassical framework for resource allocation presumes a role for natural resources, which is predominantly driven by its direct contributions to output through the production process. This makes sense in an economy where a huge part of the economy is related to production and the primary explanation for the role of materials is their use in production. With only about 12 percent of the U.S. economy now in manufacturing, and the bulk of the economy connected to services (particularly IT, CT and global connections), most productive activities no longer require a manufacturing pass-through or the transformation of natural resources into consumable and durable products. Given this situation, land-based natural resources need to be examined in a different context.

This brings to light the need to consider changes to our view of essential property rights. Many of the rights that our national and state constitutions and laws protect that relate to property fall in the realm of real estate (land, as well as residential, commercial and industrial development). Such real property was essential to production (farms, mining land, factories, and commercial real estate) and the realization of income and wealth to property owners under a system where the economy relied very heavily on the effective management of these assets in production. The presence of a new economic paradigm necessitates rethinking the relevance of the current system of rights management, raising the issue of whether or not the current property rights framework fully and effectively addresses the resource management challenges of society today. The fact that significant economic production activities exist outside of the use of traditional real property, and that such things as intellectual property (patents, trademarks, House Marks, trade secrets, special formulas, etc.) play significant roles in economic value creation, suggests that much less emphasis will be placed on existing land-based property rights in the future.

In the United States, property owners have historically maintained nearly complete rights over natural resources within the boundary of their property. Those rights were commensurate with the national philosophies of free enterprise, capitalism, protection of human attainment, and the right to prosperity. Property markets and rights were essential to the actualization of those philosophies. Today, when much of the opportunity to create value, income and wealth may not relate directly to landed property rights, several questions arise, including: 1) Is the current property ownership and rights management structure appropriate in the New Economy; 2) are existing institutional arrangements and institutions still capable of efficient and optimal allocation of resources; 3) are there critical areas where property rights need to be better defined in order to complement the ability of land-based property rights management arrangements to yield optimal outcomes for society; and 4) are there areas that need to be highlighted where the current property rights management infrastructure is being systematically compromised?

A production-oriented view of land and resources established our current system of rights and the formal institutional arrangements to manage them. In a knowledge-driven world where information is important and access to information provides added power to individuals, our political system also allows people to leverage their knowledge to generate influences that can impact on traditional and formal rights and institutions that affect resource use. Using the example of a piece of valuable land for which the economic benefits would mostly be realized by the individuals with rights over the associated bundle of opportunities through the extraction of associated resources, one can envision how such opportunities might be impacted when the same parcel of land potentially provides benefits to others. As the economy transitions from a production economy to one where non-production based value can be realized from an asset, the influences and political clout of those other beneficiaries must be taken into consideration.

Hitherto we discussed the implications of the changing nature of the economy from Old to New for the treatment of property rights and the importance of land-based assets. There are other areas, however, where the changing nature of rights is impacting on the role and implications of property rights. Take the “Not-In-My-Backyard” (NIMBYism) phenomenon as an example. It is typically used to explain the influences of neighbors over the use of land and associated resources in a community but also highlights the potential role that beneficiaries of externalities can have in defining property rights. Person A can own the bundle of rights on a piece of property *x*, but if person B’s interests in how person A uses that land are strong, in a democratic environment, person B can leverage his political clout in the definition of how much of person A’s rights political and government institutions will allow him/her to enjoy. This suggests that while rights are protected by laws, rights are also subject to prevalent public opinion. For example, if wind resources are abundant in an area and person A has both the land rights to construct wind turbines and air rights, which allow him to do that, person B can champion a NIMBYism movement with support from others in the community that essentially guarantees that Person A does not fully actualize his/her rights. Particularly in recent years, as the environmental movement has matured, the role of interest groups in determining the legal rights of property owners has changed. Such things as landscape, viewscape, soundscape, and community character (rurality, etc.) are emerging as new areas where, while legal rights have not been defined, certain concerned community members tend to influence real outcomes through the political process.

Zoning was an instrument designed to protect the rights of land owners and the community from negative externalities. But zoning is the result of a collective decision-making process where power influences and politics matter. In their work on downzoning, which they described as community exercise of both police and eminent domain powers to define land use rules that favor the community (Adelaja and Gottlieb, 2009), showed that motivations, such as potential gains in the property values of neighbors, and their preferences to overreach their own property rights, can often be translated into outcomes that erode the effective value of the rights of others, especially when the others fall into the minority. The recent interest in American communities in what many have termed "public participation" should be cause for interest, if not greater concern, over the sensitivity of rights to local political and economic contexts.

Another area where it has been shown that the local political economic context can define property rights is the area of Right to Farm (Adelaja and Friedman, 1999). In this example, the property rights of farmers in a settled farming community can be significantly impacted if even one or two large farms are sold as housing sites for numerous new home owners. New entrants can readily dominate local decision-making, implement new zoning ordinances that ban traditional or normal agricultural activities, set the stage for the demise of the local agricultural industry while simultaneously enhancing the values of their properties by reducing working farms into pure and unadulterated open space. Evidence continues to emerge that open space enhances the value of developed properties in a community (Ibid). Leveraging the political clout of the non-farm public to constrain normal agricultural activities could be a self-serving strategy to enhance the property values of home owners.

In a traditional production-oriented world, negative externalities are simply irksome byproducts of the production process, which public policy (rights and governance) seeks to ameliorate in order to optimize social welfare. The perceived high value of the underlying production activity itself shifts the balance of influence in favor of the activity, especially in an environment where market mechanisms do not exist to effectively value the externality or institutions do not exist to correct resource misallocation. However, in a non-production-oriented world where markets are better defined for those externalities, or where institutional factors can be developed through the political process, the outcomes may more than correct for the true value of the underlying externalities. This raises severe questions about the role of government at a time when the underlying priorities of society are changing, or when a new economic paradigm emerges in which the appropriateness of rights is more difficult to determine. The key point here is; "How much can we rely on existing systems of rights and governance to allocate resources when the systems may not be up to speed with respect to new paradigms?" If indeed the industrial paradigm has waned, and the New Economy is upon us, society needs to evolve a new rights and governance framework that will continue to optimize societal welfare.

A recent debate in the Great Lakes provides an interesting example of the emerging challenges to the rights system. In this case, the Great Lakes bottomland is owned and managed by the state in trust for the citizens of the state. In Michigan the development of offshore wind power to help reduce the state's dependence on fossil fuel sources is of high priority to the state, and likely to the majority of state citizens. Wind generation of electricity provides an opportunity to leverage the abundant wind resources of the state for economic development through the development of the wind industry. Evidence from Europe suggests that manufacturing and other production activities to support the wind industry are far more likely to locate near large scale wind installations suggesting that Michigan has the potential to leverage its Great Lakes assets for economic development.

A limited but vocal minority, comprised largely of coastal residents, values the unobstructed Great Lakes viewshed and opposes any consideration of offshore wind development in the state's Great Lakes waters. Even when proposed installations are beyond the shoreline viewshed, palpable oppositions still surface. The calculation of lost turbines, power generation, energy independence, reduced reliance on coal, reduced carbon emissions, and reduced opportunities for job creation would suggest that the opportunity cost of resistance to offshore wind turbine siting is astronomical, and largely due to the Not-In-My-Viewshed (NIMVS) attitude or the Build-Absolutely-Nothing-Anywhere-Near-Anything (BANANA) stance. Our current system of rights and governance would allow outcomes that many view as a compromise of their public rights despite our well-established system of property rights and governance. But as long as policy is highly responsive to those with political voice, this gap will continue.

Some believe that the solution to this problem is not a change in the existing property rights structure, but in the use of informal institutions to attain workable solutions. This brings one back to the issue of the local political and social structures and how they affect rights outcomes in an increasingly non-production-oriented economy. At best, the property rights structure in any evolving country is endogenous and subject to evolution. Similarly, institutional and governance structures are also endogenous. A key question is the relative degrees of adjustability and the possibility that rigidities can create disequilibria, which can cause huge disruptions in the market system. Our key point is the need to recognize the evolving climate and the adequacy (or inadequacy) of existing frameworks to explain or optimize resource allocation and management.

The focus here is on changes that have occurred in institutions. The Barlowe three-fold framework specifies that proposed uses of land resources have "institutional acceptability." A key concept is that formal institutions dictated guidelines in the Old Economy and informal institutions have a greater role in the New Economy. Institutional acceptability means that a development project not only must satisfy legal requirements (formal institutions) but is accepted by the general society (mores, norms, values, and opinions). None-the-less, institutional acceptability is increasingly being driven not by Old Economy rules of property rights and management, but by new arrangements more akin to the New Economy.

Emerging Institutions and Arrangements

Barlowe's work popularized the three-fold framework, suggesting that institutional acceptability helps to shape market outcomes from a well-defined institutional framework. This means that in addition to laws, rules and regulations, public opinion contributes to the realization of outcomes. In this context, existing legal and institutional frameworks help modulate what would otherwise be unfettered market outcomes, with the market still playing a dominant role.

Increasingly, policy is looked at as a game-changer with respect to those things that society really wants and needs but the market cannot accommodate (energy efficiency, renewable energy, climate change, global warming, brownfields remediation, protection of wild species and biological diversity, waste management). This view is in contrast to historical reliance on the market mechanism as the panacea to address all resource allocation problems. There are cases in which the influence of the market mechanism is minimal and institutional frameworks trump the market mechanism. One example is where public opinion essentially dominates public choice, with the market mechanism being somewhat irrelevant. In this case, policy becomes a driver rather than a control mechanism. But policy is subject to the interests and aspirations of the general public.

The decision by a township to block the construction of an equestrian center, where the owner of the land would have realized significant economic value by building the center, is an example. If the people of the town don't want the additional traffic, they can organize and nullify the market process by largely working through informal institutions. This example raises questions about the market approach but also raises questions about the power of institutions, especially since outcomes can vary markedly depending upon which dominates. In an environment where more and more public decisions will result from informal institutional arrangements, one is encouraged to ask, "What is optimal?"

One question is whether or not a societal optimization process determined largely by institutions, not markets, is appropriate. Since our concepts of efficiency and optimality are so rooted in the neoclassical production-oriented framework, questions arise about whether or not issues, such as efficiency and optimality are achievable in an environment where institutions and governance have increasingly greater bearing on societal outcomes. We will examine some domestic and international examples.

Domestic Examples

Open space preservation is one glaring example of formal and informal institutional arrangements to correct for the failings of the market mechanism. In the period following WWII, many American cities started to empty out via a phenomenon typically known as sprawl. Urban populations declined in most American cities and many jobs and employers moved into the suburbs. The impact on metropolitan land use has been quite significant as the new footprint of the average out-migrant family or business in their new suburban environment is typically 10 to 20 times the space they occupied in the city. Sprawl has been attributed to the growing desire for open space, quality of life, reduced crime, close proximity to nature, better schools and more wholesome neighborhood than found in core urban areas. While sprawl is a market phenomenon whereby individuals vote with their feet and take advantage of better opportunities, perhaps at a better price, the public implications have been deemed significantly negative as sprawl exhausts ecological natural resources, challenges the integrity of agriculture, intensifies traffic, facilitates social distancing, accentuates the racial divide, creates unfavorable regulatory environments for land-based industries, duplicates infrastructure, and increases the cost of doing business, thereby compromising the competitiveness of American states and communities. So, on one hand, the sprawl process is essentially the actualization of the forces of supply and demand and is consistent with the concept of efficient allocation of resources. However, when one adds the dimension of social and ethical considerations, sprawl is neither optimal nor sustainable.

Society has developed a number of formal and informal institutional arrangements, not only to mitigate the effect of sprawl, but in some cases to actually deter and avoid sprawl. This is in recognition of the long-term damage that sprawl can do to the integrity of places, including the environment, the economy, and quality of life. An example of a formal institutional arrangement is the creation of open space preservation funds that tax local residents to create a war chest to compete with development in the acquisition of land. In other words, tax generated funds are then used to acquire open space or development rights to prevent development. Another variation on this theme is the growth over the last several decades of land trusts focused on conservation and preservation. Again, these promote the purchase of development rights through voluntary contributions of donors.

These two approaches obviously utilize a non-market mechanism to intervene in the marketplace, however, other non-market approaches have also evolved. For example, more and more communities are exercising their police power to change zoning to ensure that sprawl and suburban development are slowed down. Others are utilizing approaches that border on taking, often couching these as the protection of public health and safety. The fact that the potential to mobilize preservation funds is related to the political clout of the anti-growth lobby suggests that informal institutions significantly shape outcomes for society. The evidence suggests that growing interests in amenities and natural features may well indicate a less significant role for market mechanisms in the future.

Another example is the broader area of placemaking. Traditionally, developers build real estate and capture the appropriate rent or income to compensate them for their various costs. In some cases, the rent relates to past public investments. So, the spillover positive externality implications are palpable. However, there is a special class of real estate that confers greater benefits to the community or region than standard real estate. Communities should be interested in those benefits, because of the economic development impact. Examples include major economic attraction projects, such as Public Square in Cleveland or the Meadowlands in New Jersey. Should communities help defray the costs of these projects as they often confer public goods and benefits, or should the developer be prepared to help society pay for the positive benefits outside of the traditional scope of real estate?

One area where policy continues to emerge is the area of brownfield redevelopment. This is an interesting example, because it highlights the transition from the Old to the New Economy and recent attempts by institutional and market infrastructure to continually find workable solutions. For starters, brownfields are abundant in places where manufacturing activities were dominant. The fact that these sites became listed as brownfields is itself a reflection of changing societal values and diminishing tolerance for the polluting activities of the Old Economy. The basic national policy solution combines penalties for polluters and incentives for potential brownfield redevelopers. Both the EPA and states' brownfield redevelopment authorities provide incentives to enable the shifting of new development away from greenfields toward brownfields. This policy seemed to work, at least partially, at a time when significant development demand existed that could be shifted through incentives and developers would consider brownfield locations as alternatives if those incentives were adequate. That model was somewhat beneficial as long as development demand existed, but may not be so beneficial at a time when limited or no growth of any type is anticipated.

In 2011, the real estate development demand was almost at a standstill nationwide in the U.S. Some estimates suggest that it will take 10 years to eliminate the float in the property market due to the wave of foreclosures that dominated the real estate landscape following economic upheaval between 2008 and 2011. With few substitutes for development, the tax bases of many communities have become compromised to the point that communities have little resources available to begin to shape their future. At the same time, new ideas are emerging whereby these brownfields could be used for non-traditional production activities.

An example of the above is the ongoing attempt by the U.S. Department of Energy and the U.S. Environmental Protection Agency to create incentives to encourage renewable energy projects on brownfield sites. Coupled wind, solar, and battery systems can be used to turn brownfield sites into beneficial community activities that generate income for the community. In their 2010 report and paper, Adelaja et al. provide an illustration of how brownfield sites in a state can be repurposed in light of dwindling market demand for brownfield sites by commercial, industrial, and residential developers (Adelaja et al., July 2010). This example illustrates how institutional arrangements can be used to correct for a market failure and how market mechanisms can eventually help address inadequacies in institutional arrangements.

Various institutional arrangements have evolved to address these issues. A more market focused example is the implementation of tax increment financing (TIF) by local officials to provide funding for the project based on anticipated property value increases in the community. Another is the institutionalization of direct bond issues to aid the construction of such projects. Obviously, this represents some form of government intervention in the free marketplace, however, it is intervention that allows the government sector to participate in the shaping of the future of the community.

In the examples above, we examine land and natural resources and associate property rights in the context of an emerging economic paradigm (New Economy). The New Economy literature, however, also prescribes a role for land and natural resources other than their diminished value in the production process. Significant research in the endogenous growth theory area highlight the facts that population and firms have become more fungible on the landscape, that amenities are important drivers of the location choices of talented individuals and firms, that economic activity agglomerates around knowledge and talented workers, and that natural and other amenities are key drivers of location choices (see Clark, 2003; Deller el al., 2001; Florida, 2002 and 2008; Hackler, 2003; McGranahan and Wojan, 2007). These studies suggest that the draw of a place is a key determinant of economic performance and that natural resources and other place assets play less of a direct role in production and more of an indirect but prominent role as attractors of population and economic activity. What does this mean for property rights? Will this erode the focus on property rights and present opportunities to address community rights? What type of majority is needed to declare or define community rights? How does one deal with people who have dissenting opinions or those that are disenfranchised?

International Examples

We use the example of renewable energy to demonstrate the international dimensions of emerging institutional arrangements. In many parts of the world, coal remains the primary source of power base loads and a cheaper alternative to renewable energy sources (without full accounting for social and environmental costs). However, while not currently efficient, renewable energy has great potential to solve the sustainability problems of society. In Europe several governments have effectively moved to implement policies that would make up for the high cost of renewables, usher in new renewable energy developments, and eliminate current barriers to the sector's development. Utility companies would typically argue for no intervention. Yet activists would prefer the adoption of such rules as renewable portfolio standards (RPS). The fact that some places and some states have adopted RPS suggests societal interest in promoting renewables despite higher cost.

Renewable energy links to a related global problem; increasing levels of CO_2 released into the atmosphere while simultaneously reducing the forest areas that sequester carbon. While it may be in an individual or a nation's economic best interests to burn fossil fuels or cut trees to obtain current benefits, science has shown it is clearly not in the planet's interest or in the interest of future generations to do so at current and increasing global rates.

Enforceable property rights evolved in an environment where national powers served as the ultimate enforcement authority. With the recognition of global connections and impacts, new institutions are needed to address property rights and land use beyond borders. These institutions can take the shape of formal agreements (often with limited enforcement options) or informal networks of people, groups, or governments that put pressure on governmental agencies to make legal reforms in different nations and places across the globe. These same networks can mobilize millions of people via ICT to pressure businesses or corporations to become carbon neutral. What was previously an externality of the market, the contribution to increased CO_2 in the atmosphere and associated global warming, is increasingly incorporated into new institutions that function at a global level yet link to local actions and can impact markets at all levels.

Carbon trading programs have been based upon the Kyoto Protocol, which entered into force in February 2005, and commits industrialized country voluntary signatories to reduce their carbon emissions by an average of 5.2 percent below their 1990 levels in the period 2008–2012. In addition to the ability to buy carbon credits for excess emissions, two of the flexible mechanisms incorporated into the Protocol—the Clean Development Mechanism (CDM) and Joint Implementation (JI)—enable industrialized countries to meet some of their obligations through projects generating emission reductions in developing countries and economies in transition (World Bank, 2010). These arrangements recognize an interrelationship between clean technologies, renewable energy, and reductions in carbon emissions. A wide variety of partnerships and programs have evolved globally to interact in new ways to encourage carbon neutrality and to help make the use of renewables economically attractive.

A few more examples of emerging institutional arrangements are in order. One interesting phenomenon that is gaining widespread acceptance internationally is the creation of formal public–private partnerships around land use and economic development. In many cases, and in diverse parts of the world, governments are partnering with the private sector to build new cities that are designed from scratch to be sustainable, environmentally benign, based on a reasonable transit infrastructure, and developed around sustainable energy. While planned cities are not a new concept, two important aspects of current initiatives are worthy of note: 1) The emerging institutional arrangements that allow more effective collaboration between the private sector and governmental units; and 2) the degree and detail of planning for sustainability that has emerged with new technology, new knowledge of the environment, and the increased recognition of natural resource amenities as key to place and placemaking activities that serve as drivers in the New Economy.

Over the past decade, remarkable advancements have been made in the area of social media, social network development, and other on-line facilitated relationships among people, organizations, and communities. Individuals can now connect with people sharing similar interests in other parts of the country or globe, making it possible for them to drive agenda and opportunities that previously did not exist. Professional networks are emerging that allow collaboration in solving societal problems, including land use problems. The rate at which solutions can be developed for problems, even in the most remote places, has grown exponentially. One area in which this promises to drive change is in the development of challenges to antiquated institutional arrangements and solutions that are more consistent with the needs of the future.

Social media was recently responsible for the almost bloodless change in leadership in Egypt (2011) after almost 30 years of a dictatorship-like democracy. Places, such as Tunisia, Morocco, and Yemen, experienced major shifts in leadership, with huge expectations of land use reform and changes in ownership rights. The almost unilateral position of government on natural resources (oil, agricultural raw material, minerals, etc.) will likely be replaced by more deliberative public decision-making processes that involve the consideration of the “people’s interests.” It is also likely to be the case that environmental considerations will feature more prominently in the ways nations choose to advance in the future. While the international dimension of resource management could be the subject of another book, we have chosen in this one to at least provide a glimpse of the types of issues that are emerging or could emerge on the global landscape.

Externalities associated with the extraction of natural resources were traditionally considered the problem of the people of the country of extraction, not the people of the country of use. For example, there is typically no compensatory scheme in place for the people who live in oil producing regions of developing countries, even in cases where flared plumes of natural gas, major oil spillage and pollution, inadequate drilling techniques and other factors contribute to a badly polluted environment. On the other hand, users of gasoline in developed countries may not fully bear the costs of the fuels they use, because international borders create a barrier between those who suffer from externalities and those whose use activities generate the externalities. The result is very cheap oil and natural gas that itself translates into over-exploration. The growth of the middle class in emerging oil producing countries suggests that people will value quality of life and the environment more in the future than they do today. One implication is growing environmental premiums associated with the use of products whose production processes involve negative externalities that adversely affect public health and safety in resource exporting nations. The reader can almost be guaranteed that international institutions will be more active in this area in the future.

The Importance of Public Knowledge and Awareness.

One issue that becomes relevant in thinking about the relationship between market mechanisms and formal, as well as informal interventions, is how knowledgeable the public is about what is in its best interest. Our current framework recognizes the role of formal and informal institutions based on the notion that somehow they help shape market outcomes in the direction of what is optimal for society in general. What if society does not know what it wants? What if aspirations are dominated by a non-progressive mindset? What if the desire to continue to do things the way they always have been done is what drives institutional arrangements? Then it is possible that institutions are not helping to enhance long-term optimality, because there is a lack of understanding about what long-term optimality really means. In many cases across the nation leaders and activists are identifying unique needs for public education and reorientation.

The take away point is that not only can markets fail, but institutions can fail also, be they formal or informal. When institutions fail, what options does society have? Clearly, the dysfunctionality of institutions might suggest that solutions can be found in market mechanisms. However, we have demonstrated that markets are often inadequate to deal with increasingly complex problems in land resource management. Recognition of what system is most appropriate for what times and circumstances might be a more relevant question.

Land grant public universities provide an interesting case study of arrangements to correct for market failure while they themselves became too compromised to make that correction effectively. These universities received state funds to drive state economic development through education and research, and were established to correct for market imperfection in how society allocates funds to support an important public good. These universities received direct funding from the federal government primarily to match state and local dollars in building a system that was effective to drive local economic development and impact the lives of people and businesses in the states. Complaints about an unacceptable ivory tower mentality in education are forcing states to reexamine the return for these investments. Almost every land grant university has experienced a budget reduction in real terms over the last two decades, suggesting that the price that society is willing to pay for the services of these institutions is falling. In some cases, states are angling to get out of the business of supporting four year institutions or research universities entirely. The argument is that these institutions are less responsive to academic and research needs and are skeletons of what they were a century ago. The solutions that these institutions are providing seem important, but it is often claimed that academics are so insular that they have lost touch with the real world and those they are charged to serve. The problem is not the absence of an institutional framework, but is indeed the effectiveness of the institution. But what universities are doing to respond seems to suggest reliance on more market approaches. Universities are urging their faculties to write more competitive grants and compete for National Science Foundation (NSF) and National Institutes of Health (NIH) funding. They are also ramping up their support infrastructure for pre-award support to faculty to improve while seeding many market-oriented approaches for universities. What we see nationwide is a shift toward markets and entrepreneurial approaches in the way many universities do business. Terms we hear from higher education today include such things as efficiency, productivity, multidisciplinary work, team building, effective technology transfer, accountability, public-private partnerships, and entrepreneurial approaches, all terms that seem to suggest that universities are gearing up to increasingly replace the ivory tower model with a model that is more market-based, flexible, creative, and impactful.

The Adequacy of the Existing Systems of Rights and Governance

This chapter would not complete without at least a cursory discussion of emerging issues that challenge the adequacy of existing systems of rights and governance. Many current institutions of rights and governance in the United States focus on securing the most essential rights to production and future abilities to produce. In the past, efficient and adequate production guaranteed prosperity. So, protecting the rights of entities in ways that encouraged them to optimize the management of resources was a goal of rights management systems. As society became less production-oriented, the system of rights and governance has evolved, so much so that one has to question whether it has evolved to be relevant and impactful in the current environment. Do we need an alternative way of looking at property and economic rights?

One example is intellectual property rights. Much of what these rights protected were technologies, processes and ideas that were related to production. As a nation, we are evolving a better intellectual property management framework, but a key issue is that while we have well-defined systems for handling land, capital and financial rights, and for managing traditional intellectual property, we have not adequately addressed the issue of which assets of society are most important and how we can facilitate economic growth by ensuring that they are protected the right way. A piece of software for balancing accounts may be more valuable than a piece of machinery for building better roads, but the status of software rights protection may not be as clear.

Another example is the "right to farm." These legislations emerged at the state level in an attempt to protect farmers from nuisance suits, trespassing, vandalism, etc. by mitigating the right of the non-farm public to restrict or hinder farming activities. These laws were passed in recognition of the fact that agriculture is vitally important yet often subject to poor treatment by the non-farm public. Our policy framework dictates that a community decides, based upon its population and local political interests, how to regulate local agriculture. However, states have consistently stepped in claiming that farming is a desirable activity that benefits state residents, and local communities' naive attempts to over-regulate them should be overruled by state law that supersedes local ordinance. The recognition that agriculture conveys non-market and other benefits that go beyond food and fiber in enhancing the quality of life was an important factor in developing rules and regulations to protect faming. But this institutional arrangement is very sensitive to the political clout of the farm and non-farm populations. In other words, the institutional arrangements that result can be varied, depending on what segment of society has more influence. If rights are indeed endogenous to political clout, rules and governance arrangements can not only become obsolete, but they can become so very fast. They can also fluctuate, depending on the capacity of advocates or opponents interested in the issue to work together to agree or build consensus.

So, as society is making rules, what are some of the considerations it must address in ensuring rules that are consistent and yield the best outcomes? One such consideration is how the political economy infrastructure can change, therefore affecting the effectiveness of institutions and markets.

Selected Future Issues at the Interplay between Institutions and Markets

In the balance of this chapter, we will examine some of the issues that we believe will raise even more questions about the optimal framework for moving society forward. Please note that these are just a few examples.

We start with the issue of public participation. The impetus for increased interest in public participation was the desire to enhance the voice of stakeholders in public decisions, especially considering the extent to which the community of impacted people can be diverse in their views about pending policy or industry related change. The ideal situation is that the public be well-informed and knowledgeable, while being provided the opportunity to voice their opinions. On one hand, if the public is knowledgeable, then the voicing of opinions can be very beneficial in the design of programs and activities that impact on people. This of course is based on the premise that a process exists for ensuring that public input results in a workable win-win solution and that the people to be impacted can agree on a mutually beneficial strategy. On the other hand, if the public is not knowledgeable, making it difficult to choose those options in their best interests, the added agency problem exists that can only lead to sub-optimal program choices. But far too often, public participation means that public decisions are slowed down by the need to get public input. In an environment where the need for public decision-making around an issue is not urgent, then the length of time it takes to engage the public may not compromise the welfare of the public. But sometimes, waiting is costly and competing communities or countries can easily move forward while we are still trying to decide whether a program is good for us. Examples of such situations today include the debate about renewable energy policy in the United States, the extent to which government should spur development of the renewable energy industry, and whether or not we provide incentives for energy developers and investors. In the past, when the United States was more isolated from the world in energy, and we were not in competition with China and India for market share in renewable energy, public opinion in the United States about wind turbines may not have been viewed as connected to global competiveness in renewable energy. But today, how quickly we move will determine how competitive we are with China, India, Brazil, and others around the globe that see the green alternative energy domain as a contestable one. In other words, while China, India, and Brazil can easily decide which direction to take, the process in a U.S. state might take months or years due to the existing process for public opinion input and resolution.

The next example is local food security. The sustainable agriculture movement has long argued that the environmental footprint of our current food supply and distribution system is not sustainable. This thinking has driven significant interest in the issue of local food security and more communities are thinking about how to reduce reliance on food imports into their region, recognizing the potential to utilize local underutilized land in production, leverage the capacity of local farmers to meet local demand, minimize wear and tear on roads, address local food desert issues, and develop a new supply chain that more meaningfully engages otherwise unemployed local labor. The existing market for food distribution is obviously efficient but does not meet the needs of people who live in inner cities, many of whom live under food desert situations. This is a form of market failure. On the other hand, institutional arrangements do not exist yet to solve the problem due to the inability of the legal framework to mandate the food supply system to service food desert locations. Yet the public health implications of food deserts abound, encouraging some form of intervention that would yield more optimal solutions. Some have argued that food deserts are the result of collusion between food distribution companies to generate more profitability from urban areas by creating a large metropolitan market system that services cities through suburbs. The rationale for this argument is that by colluding to undercut new entrants or competitors through low pricing, existing players can maintain an oligopoly structure that results in better returns. If this is the case, the solution would be the exercise of anti-collusion controls and the penalization of colluding companies. This is an issue to watch at the interface between markets and institutions, but is one where research would help decide which institutional arrangements would be most optimal.

This leads to the issue of experts, science and property rights. Information from science and experts often dictates the direction of institutional arrangements to deal with market failure. In the food desert above, if the primary reason for food deserts is the lack of opportunities to profit from the urban location of food stores, then the solutions set could include such things as tax incentives, abatements, and other tools designed to mitigate the losses of food stores. However, if the primary reason is unlawful collusion and price fixing by food firms, which essentially turns an otherwise normal food market into a large profit opportunity, then a regulatory approach would be warranted. The primary mechanism for deciding on the optimal solution is information from experts or scientists. Yet, science is not always known to be timely or responsive. Better still, science is not always known to be unbiased. More importantly, sometimes, those with vested interests can often afford to pay for supportive science. So, it is possible that the institutional and market arrangements that emerge to address market failure issues could themselves be compromise solutions. This raises the question of how reassured the public should be about policy research. It also raises the question of how to facilitate such research at universities and in the private sector.

Another interesting issue is the role of entities with large influences but narrow agendas. One example that comes to mind is the issue of coal and nuclear energy use versus wind and solar energy. While utility companies are often progressive in their interests in renewable energy, many feel strongly that any regulation, even those that would move them toward a more sustainable future, may compromise them short-term. Often with a loud voice, these utilities may, therefore, advocate for coal-fired or natural gas plants and seek new facilities that will use these non-renewables, even though other alternatives may be better in the future for the public. A relevant issue is the inadequacy of the grid to handle the intermittence of wind- and solar-generated energy in the short run. But if utility companies do not advocate for the deployment of smart grid technology and a major overhaul of the gird, then renewables may have limited likelihood of being a tangible part of the energy portfolio. In this case, the public just wants the convenience of turning on their light switch and getting light. The public also wants cheap energy and does not want to enter into a debate about renewable energy versus coal. Although the growing international competition for coal, uranium, and natural gas suggests higher prices ahead for conventional energy, while renewable energy prices are dropping rapidly, the silence of consumers in the debate about best options may well do society a long-term injustice.

We now turn to the issue of public-private partnerships. In the Old Economy our economic model and regulatory framework dictated that we keep public interests separate from the activities of private for profit companies. Many of our policy tools and regulations were based on not crossing the line. Governments serve the public. Companies produce goods and services. The job of government was to regulate companies while the job of companies was to hire people. If the public sector were to need private sector involvement in a government activity, the standards call for a competitive bidding process between private firms rather than a process whereby a private sector company and the government can collaborate without the need for competitive bidding. But today, the co-discovery of opportunities has become central. There are stronger potentials to serve the public through private sector co-delivered products. As long as our regulatory framework is rooted in the old model, however, there will be missed opportunities to optimize the welfare of the public. A good example of this, as mentioned earlier, are placemaking projects that are clearly the responsibility of real estate developers but for which some collaboration between such developers and government can yield better value added projects that deliver good returns to the developer and good economic development impacts. Around the globe, governments are building new cities and projects based on concepts of public-private partnerships, but the basic U.S. framework does not yet herald these as a way forward that is sanctioned by public policy. Airports, seaports, new high-speed rail systems, business incubators, economic development centers, charter schools, and export development centers are good examples of emerging market related activities that have their roots in public-private partnerships.

On the international scene, we turn to the example of an issue that has emerged as a great concern in recent years but that is not being addressed adequately. That issue is land grabbing, or the increase in incidents of sovereign governments and their parastatal extremities going internationally to countries with significant available productive land that is being underutilized and buying such land in preparation for greater ability to meet their long-term food security needs. For example, governments in the Middle East and the North Africa Region, as well as from Asia and Europe, have heightened the acquisition of strategic land in the less developed countries in Africa in recent years. From a free market perspective, land grabbing is just an expression of the desire of a country to meet its future food demand, just as western countries have been involved in strategic oil field exploration and acquisition for decades. From a social justice perspective, however, some argue that uninformed developing countries are being taken advantage of by the richer, more advanced countries (the exploitation argument). It is true that the control of land in another country in order to meet one's food needs can result in misallocation of resources such that poor countries are growing food to feed rich countries. But it is also true that those poor countries may, through such arrangements, be able to quickly gain the ability to produce through induced innovation. Related to this is how much of the output is sold domestically in a poor country versus exported, how much the poor country is able to generate foreign exchange earnings and tariffs from future food exports. Also related are the notions of representation by citizens in the poor country, corruption of local leaders who may in fact sell the land and pocket the money, the extent to which local people become employed by new large global industrial farms, and the extent to which the poor country extracts economic development from these land arrangements. This is the case where issues, such as morality and exploitation are superimposed on otherwise simple market transactions. There is also the case of ensuring sustainable food production in poor countries. This is one of the most important issues in international development today and it is laden with several emotional and ethical aspects.

Another issue worth exploring is the issue of mindset. Sometimes, global market realities dictate outcomes that essentially exploit others due to the latter's non-progressive mindset. A good example is fishing in the West African marine fisheries zone. While many Africans may be hydrophobic, and their institutions lack the infrastructure to fully engage in offshore fishing, the Chinese not only have huge fishing fleet capacity but also the adventurism to deploy their vessels as far away from home as West Africa. What role does government have in encouraging a more positive mind-set? Would that be considered manipulation of the people or an anti-free-trade activity, especially if it involves the subsidization of local capacity to develop marine fishing interests? Again, this is a market related issue, but one with significant institutional implications.

Finally, we raise the issue of the absence of an adequate number of established institutions that deal with the issue of sustainability. Trade associations exist, perhaps as outcomes of long-term industry and market-centric thinking, to advocate for policies that favor their clients. While environmentalist organizations essentially provide a counter balance, their objectives often directly related to the desire to mitigate the adverse effects of unfettered economic activity. But sustainability itself goes beyond mitigating unfettered economic activities and relates directly to the notion of picking solutions that meet the triple bottom line standard (people, planet, and profits), while ensuring appropriate balance between today's needs and the needs of future generations. In this respect, a relevant question is, "Are there institutions missing whose responsibility should be to define and promote sustainability?" Would the knowledge base about the science of sustainability advance enough for the right institutions to be designed to promote it? As we try to better manage the environment, hopefully with the goal of sustainable outcomes, would the right institutions emerge to guide our options? These are relevant questions about the complex area of the interface between the market and institutions in the future.

Part Four:

Addressing Resource Management Issues

Chapter 14: Current Issues in Land Management

'The magic of property turns sand to gold."

~Arthur Young

In the past land was often treated, along with capital and labor, as a basic factor of production. Being the least mobile of the three production factors, the land base of the community largely defined its productive capacity. Capital was somewhat mobile. Other than the affinity that people have toward their communities and home towns, labor was also mobile. Land represented a most important factor of production within the context of specific locations. Many people saw it as the key factor in production. For them, it was the God-given resource upon which they depended for their livelihoods and fortunes.

Shifting Importance of Land

The view of the role of land has slowly changed over time. Many now see land as no longer as important as the other two factors of production. Some economists have even downgraded land by considering it as nothing more than a special type of capital. Considered in market value terms, it is true that land has not increased in value as fast as capital or labor. But there has been no decrease in its value. Indeed, the overall value has increased hundreds of times over only to be dwarfed by tremendous additions in the volume of capital and the much expanded labor force made possible by burgeoning population growth.

Viewed from the paradigm of the New Economy, and the emphasis it gives to valuation of environment amenities and benefits, it may well be that the value of land to society is increasing. This prospect calls for recognition of new horizons, some involving opportunities and some involving problems, in managing land resources for society's benefit.

The one factor that one must look at in thinking about the value and role of land in society is the fact that it is not altogether renewable. We can reclaim brownfields, at huge costs. We can tear down abandoned urban properties and turn them back into greenfields but at huge costs. We could considerably take out some of our huge road infrastructure with the future deployment of high-speed rail, but at huge costs. We can repurpose our landfills so that they produce methane to be used as an energy input, but with significant effort. With these constraints to the reuse of land, the inventory of valuable and useable land will diminish over time as population and income grow. But unless our rate of technological capacity growth is more than commensurate with the added demands from population and income growth, we will have less land to meet the needs of future generations. For example, it is estimated that the world's population will reach nine billion by 2050, but that we will have to increase food production by 70 percent to meet the increased demand. Will we have the land base to produce all that added food? Across the world great minds are obviously examining this issue. For example, in the last few years alone, numerous investment banks, private equity firms, family trusts, investment advisory firms, sovereign wealth funds, and even governments (China, India, Qatar, Egypt) have been buying heretofore out of mind farmland in developing countries at astronomical rates as part of what is now referred to as "land grabbing." With land selling at $25,000 an acre in Iowa and $500 per acre in Guinea, the potential for an upside will attract price gap arbitrage and speculators. In other words, in the advent of globalization, the potential value of land in Guinea is much higher and more of the world will probably be fed with food from Guinea.

The above suggests numerous things. First, the traditional simple view of land may no longer be relevant. Second, the emergence of a new global economy suggests that while the world is deemphasizing production, the role and importance of land is by no means diminishing, considering the growing magnitude of land related human needs and wants. Third, land management has become more complex as it seeks to find a balance among multiple objectives. To be effective it also requires managers who are multidisciplinary and integrated thinkers, and land management infrastructure that allows multiple perspectives, multiple disciplines, and multiple objectives. Land management can no longer be viewed quite simply as the making and carrying out of the decisions needed to put land resources to productive use. It must also be viewed as the making and carrying out of decisions needed to put land to the greatest use that optimizes production goals, environmental goals, and social goals. In other words, the concept of highest and best use has gone beyond "highest and best productive use." A primary issue then in management involves the choice of goals and the identification of the ends management seeks to attain. Obviously, in an environment where multiple goals exist, both private and public, and multiple parties harbor alternative views, perspectives and goals, it is clear that no single entity (government, industry, consumers) can effectively work unilaterally to resolve the emerging challenges of land management. New, and perhaps more appropriate balance, is needed between public and private goods and the exercise of public and private ownership.

The Need for an Applied Systemic Approach

At this point it may be valuable to once again stress the need to view land management activities through multiple lenses. Economic, social, and biological perspectives are all needed (minimally), but these are not enough. Even if a multidisciplinary team is assembled, with competent experts from the appropriate disciplines, a method must be implemented to allow these people to transcend disciplinary boundaries and to embrace multiple paradigms simultaneously. Too often multidisciplinary teams are incapable of seeing the perspectives of other members and a power struggle results with diverse interests in competition when collaboration is the only way to obtain an optimal solution. To work effectively on complex land management issues, planners must have an applied systemic approach that uses multiple disciplines, simultaneously, and examines how these dimensions interact to impact a single system; the earth and all its inhabitants.

Goals in Environmental Resource Management

Five specific goals can be recognized with the management of environmental resources over time. They include: 1) Secure an economically effective use of resources; 2) recognize and respect the ecological limits that affect the use of environmental resources; 3) protect and enhance the social and ethical values associated with resource use; including intergenerational equity; 4) minimize wasteful uses of resources and facilitate their recycling or reuse as inputs to another production cycle; and 5) minimize the possible negative externalities associated with their use.

The first objective corresponds with the goal most resource managers have pursued, some with notably more success than others. It would be irrational to assume that managers should deliberately plan to use their resources in ways that cannot or that have little prospect for covering their costs. Their overall success in securing economically effective use of the earth's resources is demonstrated by their record of past accomplishments. It is important to note, however, that questions have emerged about the need for full cost accounting and whether or not the ways we achieved the first objective in the past truly covered the overall costs, including the costs to society.

Since the beginnings of organized settlements, users of land have been motivated by desire to secure sufficient returns from their inputs of labor and capital to at least cover their costs of production. There have been occasional cases of failure. On the whole, however, operators have succeeded in meeting this objective, even if they have not always pushed their production all the way to points at which *MFC* = *MVP*. Again, questions have arisen about whether *MPC* or *MPV*, as typically calculated, truly account for the reality of costs and revenues.

Most societies experimented with different productive practices until they discovered arrangements that worked. These arrangements were soon embraced by custom and operators clung to their customary practices, because deviation from them carried a risk of failure and failure presented the specter of starvation. Better management of most land resources started about 300 years ago when the breakdown of feudalism, abandonment of the open field system of land tillage, and the spread of education prompted profit-seeking venturesome operators to experiment with new production practices. Their success brought significant improvements that led to huge increases in the production of food and other products. With the onslaught of venturesome and passionate ethicists and environmentalists, one can expect huge increases in the application of land to the production of new services that meet environmental and social needs.

Many early improvements called only for rearrangement of the various inputs used in production. Operators soon found though that further increases could come with upgrading the nature of their inputs. Some of the most significant of these adjustments have come with the use of improved machinery. Use of modern farming equipment now makes it possible for operators to produce much more grain with fewer man-hours of labor than was the case when grain was harvested by scythe and sickle. Selective and cross-breeding activities have brought comparable improvements in the productive potentials of various plants and species of livestock. Continued experimentation with these inputs together with the possibilities of gene manipulation promise additional production benefits in the future. However, critics argue from another perspective that gene manipulation may lead to the eradication of some indigenous varieties of plants, the loss of which is currently an externality, but if captured in the market, may negate some or all of those benefits. One can begin to imagine the technical and biological improvements that will result from the current growth in interest in sustainability and the concern about global warming. This may explain the rapid increase in interest in green technologies (greentech) focused on waste management, water quality, renewable energy, energy efficiency, recycling, and urban renewal.

Farmers have long appreciated the effects plowing manure and plant fibers into their soil can have in improving its tilth and sustaining its productive potential. During the 1700s, plantation owners in early America found that adding marl and limestone could sweeten the productivity of acidic soils. The use of commercial fertilizer that followed provided a highly important means for stretching the productivity of agricultural soils. Land owners learned at an early date that dredging operations could promote needed drainage of wet soils. Scraping and filling operations also are used to level the terrain of land areas needed for highway and urban uses.

Other major developments involving the stretching of land for more intensive uses have also come in cities. A prominent example came with the construction of multistoried buildings that stacked floors for residential and commercial uses on top of each other. Ancient Rome had regulations that limited buildings to maximum heights of around 100 feet and even at that height buildings frequently collapsed on top of tenants on the lower floors. This constraint was met during the 1800s when the introduction of steel beams made it economically feasible to push skyscrapers to greater heights.

Urban space was stretched again when transportation improvements—streetcars, buses, trains, subways, and automobiles—made it possible for cities to expand outward far beyond what were practical limits in the days when people had to walk to shops and to work. The superhighways that brought customers into cities were soon used by residents to move farther out and commercial and industrial users moved to suburban locations as well.

As this recitation of achievements suggests, resource managers have contributed much to economic progress by accepting the challenge of their times in adopting new and improved production practices. Most of what has been accomplished can be credited to good management; and continued progress can be expected. Logical questions may be raised, however, about points of reference in managerial decisions. Much of the emphasis in the past has involved single purpose concern over maximization of economic interests. Changes are needed for effective management in today's world. Effective management of environmental resources now calls for a broader-based approach that gives due emphasis to ecological and ethical considerations.

Until recent years, managers of land and other environmental resources have had little reason to show much concern for ecological considerations. If they were sportsmen, they may have had an interest in providing habitat for the game they hope to hunt in season. If they were anglers, they may have been concerned about over-fishing by others in their favorite fishing streams. Or if they were ranchers who grazed sheep or cattle on the public domain, they may have had concerns about overgrazing. Their reactions in these cases often led them to increase rather than decrease the pressure of their own use on the common resource. With a broader knowledge of the significance of carrying capacities and about the fragility of important wild resources, today's resource manager has far more incentive to try to protect fragile resources and to look to collective action as a means for securing this end.

Much the same can be said about the need to give more than nodding acquaintance to the ethical considerations and social values people associate with environmental resources. Forest owners are more conscious than ever before of the broad interests people have in the possible multiple use of their forests and of the need to accept practices, such as leaving unharvested strips of forests along highways to protect public scenic values. Businessmen realize that the day has passed when they could dispose of their wastes by simply dumping them into public waters or venting them into the atmosphere. The potential damage of these practices is too great to go unnoticed and the goodwill of society for being a good neighbor is worth more than the economic advantages lost. Managers accordingly have a definite responsibility, often overlooked in the past, to recognize and respect the ecological limits associated with use of many of the earth's resources.

Average citizens with their mountains of trash are now the chief generators of wastes. Businesses are finding ways to reduce the quantities of wastes they once produced, and in the process, are finding ways to profit by reclaiming products they once threw away. The disposal of industrial, municipal and other wastes on land, in water, or in the air is more closely monitored than ever before and most cities and industries are finding it socially, and to some extent economically, desirable to recycle large quantities of wastes for possible reuse.

Control of negative externalities has become a major point of focus in public environmental policy. Drivers can be fined for dumping trash along highways. Injunctions can be sought in the courts to prevent some types of damages while civil suits for damages caused by offenders are common. Externalities passed off only a half century ago as unfortunate social costs of resource development are now castigated as impediments to social harmony that must be controlled.

All things considered, changes in the public perception of the importance of environmental issues and the willingness of Congress and the states to assume responsibility for passing and enforcing environmental regulations have had a considerable effect in creating new ball parks in which land managers must play by different rules than they once did. Managers may be just as interested in maximization of their personal interests and those of their firms as they ever were, but they must now give more attention to ecological and ethical concerns and to the interests of the general public.

Land Ownership Systems

Desire for land ownership has provided one of the great motivating forces in history. Promises of ownership have been used as lures to entice young men to join armies. Families have toiled much of their lives pursuing this goal. With the United States, it has provided a powerful magnet that drew thousands of European migrants to seek home sites in the new world.

The present patterns of land ownership found in the U.S. did not just happen. They have come as a result of a long period of evolving change in policy emphasis. A review of these changes and their effects on land ownership provides a useful step in explaining why the nation's land is used as it is.

Emphasis on Private Ownership

The Europeans who first settled along the Atlantic coast of the United States and Canada found the land occupied by a Native American population that had its villages, fields, and hunting grounds. This evidence of civilization was brushed aside, however, as settlers proceeded to develop the land in their own way. From the beginnings of settlement on, emphasis was placed on encouragement of privatization of land ownership. The system of communal ownership embraced by the Plymouth colony was abandoned after a scant few years when it was realized that more production could be expected if every family worked in its own interests. The attempt of the Calverts in Maryland and the Dutch patroons in New York to establish a manoral economy soon yielded to pressures for privatization. Headrights of around 100 acres were granted to operators in the Southern colonies for every person brought to their settlements. Towns, which handled the distribution of land in New England, voted small acreages to settlers with the understanding that more would be given to them if they proved their worth.

Land was treated as a scarce commodity in most of the early distribution schemes. Attitudes changed as settlers started to see it more as a commodity that could be bought and sold in local markets. Land speculation became a common practice as the recipients of large grants found opportunities to profit from the sale of their surplus acres. From the beginning, it was recognized that the function of acquiring land from the Native Americans was a responsibility of government not of individual settlers. It was also realized that while individuals were to hold possession and management rights to their fields and houses, the areas occupied by public buildings, roads and streets, and military installations were to remain in public ownership. A third class of lands, the unassigned meadows and forests found around the settled areas, were held as commons for the use of members of the various communities.

Settlements were confined mostly during the colonial period to sites located within 200 miles of the Atlantic coast. While a few enterprising settlers had crossed the Appalachians, the real opening of the West for settlement came after the American Revolution when the new national government acquired public domain from the states and proceeded under the Ordinance of 1785 to establish a program for surveying and selling the land.

With passing time, continued emphasis was placed on encouraging private ownership. Lands were offered for sale at a price of $2.00 an acre, later reduced to $1.25 an acre. The Homestead Act of 1862 further broadened the disposal policy by authorizing homestead grants of 160 acres with no charges other than filing fees. It was generally assumed that all but a small portion of the area acquired through the Louisiana Purchase, the Mexican Cessions, and the annexing of the Oregon Territory would shift into private ownership. A minor exception to this policy came in 1872, when Yellowstone National Park was reserved from private settlement as a national treasure that should be saved "for the benefit and enjoyment of the people."

As the nation came into the 1890s settlement had spread to the Pacific coast, and except for the Yellowstone reservation, individuals could still homestead or buy land in any portion of the remaining public domain. An area of 625 million acres (Alaska not included) remained in public ownership, because no one had seen fit as yet to buy or homestead them. It was at this point that concerns about past exploitation of the nation's natural resource base and the need to protect its remaining forests gave rise to the Conservation Movement.

The Forest Reserve Act was passed in 1891; and during the 10 years after, 46.4 million acres were set aside as national forests. President Theodore Roosevelt set off a storm of controversy when he added 148.1 million acres to this total between 1901 and 1908. A large area of comparable size remained available for unsupervised private grazing operations until the Taylor Grazing Act in 1934 reserved its use for what is now the Bureau of Land Management's leasing program.

Table 14–1 indicates the extent of federal land ownership and management in the United States in 2003. A total of 671.8 million acres representing 29.6 percent of the area of the 50 states is held in federal ownership. When Alaska, where 66.7 percent of its area is federally owned, is excluded from the total, 22.5 percent of the area of the lower 49 states is federally owned. An estimated 83 million acres of parks, recreation areas, forests, and wildlife refuges are managed by state and local governments.

Table 14–1. Ownership and Major Uses of Land, United States, 2002

	Million Acres	Percent
Ownership		
Total Surface Land Area	2,271.3	100%
Estimated Privately Owned	1,516	66.7%
Federally Owned	671.8	29.6%
State and Local Government Owned*	83	3.6%
Administration of Federal Lands		
U.S. Bureau of Land Management	263.9	39%
U.S. Forest Service	192.8	28.9%
U.S. Fish and Wildlife Service	92.8	13.8%
U.S. National Park Service	79	11.8%
U.S. Department of Defense	18.6	2.9%
Other Agencies	24.7	3.7%
Major Uses of 1,535.8 Million Acres of Non-Federally Owned Lands in 49 States (Excluding Alaska and the District of Columbia)		
Water Covered Areas	50.4	
Area in Farms	938	
Privately Owned Forest	357	
Built Up Urban Areas	84.3	
Rural Transportation Areas	22	
State and Local Parks	13.6	
Other	70.5	

Source: Basic data on land use from the U.S. Department of Agriculture, National Resources Inventory, 2002 update.
*Does not include Alaska or the District of Columbia.

The highest percentages of land area held in federal ownership are found in the Western states where large areas of mountainous or arid lands were bypassed, while they were available for homesteading. One should not assume though that public ownership is confined to residual lands that did not pass into private ownership while they were still available for sale or homesteading. Substantial areas are held and managed by public agencies as streets, highways, airfields, public building sites, military establishments, public service areas, and parks and recreation areas.

As this recital of past experience indicates, public management of environmental resources is far more acceptable now than it was a few decades past. We see reasons for retaining areas in public ownership and managing them for purposes that had not occurred to the nation's leaders as being important prior to the late 1800s. Some groups still see privatization of management as an answer to resource management problems but the overall shift in emphasis in recent decades has been in the other direction. Advantages are associated with both public and private management of resources and neither system can operate effectively with exclusion of the other. With the redirection of public land ownership policy that came with the Conservation Movement, different emphases were given to the policies affecting agricultural, forestry, grazing, wildlife, parks and recreation, and urban land uses.

Policies Affecting Agriculture

The areas patented to private ownership under the government's homesteading policy rose from an early peak of four million acres in 1890, to a high of 10 million in 1913, after which annual totals declined until the program was largely phased out during the 1930s. Federal interest in resource development and the promotion of private farm ownership was further expanded with passage of the Reclamation Act of 1902 under which several large dams were constructed on rivers in the West to provide water for farm irrigation purposes.

Other congressional measures designed to further the interests of agriculture included enactment of a rural free delivery postal system, establishment of a Federal Land Bank and a Production Credit system to provide improved credit facilities for farmers, aid for constructing rural roads and highways, financial aids to states to establish agricultural experiment stations to conduct research and for a Cooperative Extension Service to extend new agricultural knowhow to farmers. Further attention was given during the 1930s to initiating a soil conservation program and to directing attention to the financial security problems of small farmers.

The nation's principal agricultural policy problem since the 1930s has been that of dealing with overproduction of agricultural products. Farming in the United States has always been treated as an open access industry in which anyone is free to engage, and in which producers have been free to expand their production even beyond the point at which it might distress the markets shared with others. Congress has used varying techniques to discourage overproduction. The possible issuance of marketing quotas to producers, however, has always been rejected as politically unacceptable.

The problem of overproduction in the United States started during World War I when farmers were urged to increase production to provide support for the nation's European allies. This market collapsed after the war and gave rise to the Agricultural Depression of 1920 during which the nation's markets were flooded with more produce than it could use. Prices dropped to low levels. Depressed market conditions continued until the 1930s when several New Deal programs were undertaken to boost commodity prices.

A price support program was adopted during the 1950s to guarantee minimum prices for products, such as wheat, corn, and cotton. Farmers responded by increasing production. Acreage allotments were then used to control the acreages harvested, and many farmers responded by intensifying their operations by using fertilizer and improved farming practices to increase their yields pr. acre. The emphasis in policy has since shifted to use of a Conservation Reserve program under which up to 40 million acres of environmentally sensitive farmland is voluntarily leased to the government for periods of 10 to 15 years. Deficiency payments can be made to farmers who reduce their plantings by portions of their crop acreage allotments. Production flexibility payments are also payable to operators who adopt soil conservation programs and comply with flexible planting requirements.

With these factors at work, and with commercial operators expanding the scale of their farming operations, the total number of farms in the United States dropped from a high of 6.8 million in 1935 to only 2.1 million in 2002 of which only 46 percent were commercial farms in the sense that they marketed over $10,000 in productive output during the preceding year. The area in farms dropped from a peak of 1,159 million acres in 1950 to 938 million in 2002 while the size of the average farm more than doubled from 214.6 to 446.6 acres. Meanwhile the proportion of farms operated by owners and part owners rose from 57.9 percent in 1935 to 90.3 percent in 2002; and 54.7 percent of the farm operators, a category that included a high proportion of the small operators, reported full or part-time employment (39.1 percent over 200 days in the preceding year) off their farms.

Critics of the nation's farm price support policies charge that most of their benefits accrue to large commercial operators rather than the smaller family farmers in whose interests the policies supposedly operate. Commercial operators in turn argue that they have to operate on a larger scale to compete successfully in today's economy and that they are family farmers. For them, the family farm now has a somewhat different definition than it had when it was seen as a unit operated on a largely self-sufficient basis by farm families that depended primarily on use of their own labor resources.

Forest Land Management

For almost a century after the nation set its public domain disposal policy in motion, public policy was guided by the assumption that virtually all of the land would shift into private ownerships. Much of the public domain was forested and it was assumed that settlers could provide for their timber needs by cutting trees on their own land as they cleared it for tillage. No provisions were made for the timber resource's needing of sawmill operators. These operators proceeded to cut free timber on the unsold public lands, and few objections were raised, because their operations saved settlers much of the toil required for their clearing of land.

Private cutting of timber on unsold public lands was finally prohibited in 1843. Another 35 years then passed before Congress authorized sales of timberland for $2.50 an acre. This legislation enabled timbermen to acquire forested areas, but generally ignored the fact that operators in the now established timber industry were more interested in acquiring the mature timber found on the land than in possessing the land itself.

Limited enforcement of the laws made it possible for timbermen during this period to secure headquarter properties, use dummy entries to secure additional acreage, and to cut "round forties" on adjacent lands, all to provide timber for the thriving market for timber products in the nation's growing cities. As the Commissioner of the General Land Office reported in 1882 (Benjamin H. Hibbard, History of the Public Land Policies, p.464, 1939):

> *"Depredations upon the public timber by powerful corporations, wealthy mill owners, lumber companies and unscrupulous monopolists . . . are still committed to an alarming extent."*

Growing interest in possible needs for forest conservation led to the adoption of the Forest Reserve Act of 1891. During the next 10 years, 41 forest reserves, covering 46.4 million acres were reserved. With President Theodore Roosevelt's reservation of an additional 148 reserves between 1901 and 1908, the total area included within the national forest reserves, much of it privately owned land, increased to 194.5 million acres. The U.S. Forest Service was established in 1905, and Gifford Pinchot, its first chief, embarked on a conservation program that called for continued harvesting and use of the nation's forests rather than just their preservation. In the years that followed, the Weeks Forest Purchase Act of 1911 provided funds for acquiring private lands to establish national forests in the eastern states. The Clarke-McNary Act of 1924 provided matching funds for joint activities with states and private forest owners for fire protection, distribution of seedlings, and assistance to farmers in establishing woodlots. Land exchanges were authorized to block up forest holdings. Conservation programs also were undertaken with Civilian Conservation Corps help during the 1930s.

The forest reserve movement did not end the looting of public forests. Paul W. Gates (History of Public Land Law Development, pp. 584–591, 1968) indicates that large acreages were acquired by large timber companies through dummy entries under the Timber and Stone Acts and by acquiring railroad grant script. Forest exploitation continued in many areas until the 1930s, after which there was a distinct shift of interest toward adoption of sustained yield management practices.

With acceptance of forestry as a long-term production enterprise rather than as a simple timber cutting operation, questions arose concerning the management practices that should be followed. Operators could start with bare land on which they plant seedlings that can grow into valuable forests over a several year span and face a situation like that illustrated by Figure 8–3 that was discussed in Chapter 8. Should these operators charge compound interest on their holding costs and discount the value of their expected net returns at current market interest rates, they could well reject forest growing ventures as being financially unrewarding. Numerous operators, both public and private, have faced this prospect and ignored the interest rate issue simply because there was no other practical way for getting their lands back into productive use.

A somewhat different situation exists when operators have stands of merchantable timber on hand. Operation on a sustained yield basis can now involve annual harvestings, such as was pictured in Figure 8–4, which provides current flows of income in excess of current accumulating holding costs that need not be discounted. Operators have a choice of using selective cutting practices or clear cutting. Selective cutting may be the preferred approach if operators have limited acreages or stands with mixed ages and species of trees. Clear cutting, on the other hand, may be the preferred method when operators have sufficient acreage to operate with long-term cutting cycles in which cleared forests can be expected to regenerate and grow to maturity before they are again ready for harvesting.

Timber sales from Forest Service lands remained at a low level until the mid-1960s. Marion Clawson (Forests for Whom and for What, 1975) criticized the Forest Service's managerial policies at the time on two grounds. As an economist, he argued that USFS should be selling timber at a faster rate from its mature growth forests, because the timber had reached its peak growth value and should be harvested to provide space for renewed growth. He also argued that too much emphasis was being given to investments on less productive lands at the expense of the returns that could be secured, accepting the equimarginal principle discussed in Chapter 5, by applying them on its more productive lands. The USFS timber sales rose considerably after 1965 and reached a peak of 4.8 billion board feet in the 1994 fiscal year after which they declined, in part, at least, because large areas were withheld from sales.

Congress passed the Multiple Use Sustained Yield Act in 1960. The law called for recognition of the fact that the national forests are used for many purposes besides growing timber. Important among these uses is their value for grazing, hunting, wildlife protection, flood and soil erosion control, camping, hiking, berry and mushroom picking, and bird watching, as well as the recreational, scenic and existence values they have for many people.

All of these uses deserve recognition. It may be noted, however, that giving equal emphasis to all of them can result in inefficiencies. An economically ideal approach calls for assigning values to each use and seeking that combination of uses that provides the highest total benefits. Such an arrangement could result in some forest areas being used primarily and even exclusively for single uses.

Designation of large portions of the national forests as wilderness and other special use areas and President Clinton's designation of 58.5 million acres in 2001 as a roadless area have cut into the timber sales potential of the national forests. Meanwhile, private forest management has been moving ahead. Data reported by researchers at the University of Georgia (Bugwood Network and Forestry Images, 2002) indicate that 736.7 million acres, or about one-third of the nation's area, was forested and that federal ownership accounted for only 34 percent of this total. Only 490 million acres, roughly two thirds of the forested area, can be regarded as commercial timberland. Of this total, 288 million acres, or 59 percent, was operated by seven million private non-industrial owners, only 600,000 of whom had personal holdings of more than 100 acres.

An additional 69 million acres, or 14 percent, was operated by forest industries; 83 million acres, or 17 percent, by state and local governments and trusts; and only 49 million acres by the U.S. Forest Service. Their findings also indicate that a high proportion of the nation's timber is now being grown on timber farms and other small forests in the southeastern states and that annual timber growth for the nation now exceeds losses from harvesting, fire, pests, and disease by 33 percent annually.

Forest protection problems. Illegal forest cuttings have become crimes of infrequent occurrence. Important management concerns are still occasioned by an ongoing need to protect growing and mature forests from the devastation that can be caused by disease, pests, and uncontrolled fires. Diseases and pests cause considerable damage in conifer and hardwood forests every year; and control of this damage has become a major function of many public and private research and management agencies. Past experiences, such as the near total destruction of some native American tree species caused by the accidental introduction of diseases, such as the chestnut blight, the white pine blister, and the Dutch Elm disease highlight the need for continuing vigilance to keep the threat of new and already recognized hazards under control. The Emerald Ash Borer crossed the Pacific in wooden shipping materials and is now decimating ash trees in North American forests.

Need for fire control affords a comparable challenge. The brush and litter ordinarily found on the forest floor provides the combustible material that easily feeds expanding wildfires during periods of dry and windy weather. Wild fires, some that have burned over considerable areas, have been a common problem almost every summer in the forested regions of the American West. The incidence of large fires, both there and elsewhere, has become more prevalent since 2000. With the advent of global warming, periods of dry weather have brought a marked increase in the number of fires, the extent of the damage they cause, the forced evacuation of residents, and the loss of homes, as well as natural areas. As housing developments spread into natural areas, difficulties are compounded in controlling fires.

Improvements in firefighting organization and technology may provide workable answers for containing wildfires in the future. Landscape design has identified several best practices to minimize fire danger. To the extent that the fire problem is aggravated by global warming, it may become more rather than less critical in the future.

Other nations face problems similar to those experienced in the United Sates in protecting their forests from fires, pests and disease. Two other problems of environmental consequence call for attention. Some nations need to protect mountainsides that should be kept in their present state for environmental reasons. This requires governments to prevent deforestation by land-hungry peasants who are seeking new sites for crop cultivation. Similar action is needed to discourage the cutting of tropical forests for short-term profits with long-term, often permanent, destruction of globally important ecosystems.

While rules and regulations must be in place, there are enforcement costs that are so high lawbreakers often go unpunished and forests continue to be cut. Clearly, there are benefits if incentives can be introduced for natural resource preservation. These incentives can include unique arrangements that range from compensation for watershed services to an economy built upon the presence of high quality natural amenities. Forest cover is especially important if global warming is considered since trees sequester carbon from the atmosphere when they are alive but release carbon into the atmosphere when they are cut and burned to clear land for grazing or agriculture.

Grazing Lands

As land settlement moved westward past the 100^{th} meridian that stretches from the Dakotas south through Texas, problems arose, because of the adverse effects of the drier climate had on the suitability of large areas for agricultural use. Settlers kept up their practice of freely grazing their cattle on unclaimed public lands. The expansion of the nation's railways into and through the area permitted the rise of a livestock industry that could ship cattle to eastern urban markets. Ranching became a profitable business; and ranchers and their crews competed with settlers for possession of the unclaimed lands.

The story of the managerial problems that arose in the settlement and development of the region has provided the grist for many novels and movie scripts about the settling of the West. (Gates, History of Land Law Development, Ch. 18 and 21, 1968) There were conflicts between cattlemen and homesteaders, the "nesters" of Western literature, some of which led to bloodshed. Overall, it was an unequal fight. Cattlemen sometimes had the brute force to prevail, but the law was on the side of the homesteaders. Climate played the deciding role. Farm settlements were established on a permanent basis in places that had sufficient rain to support their operations. Other settlements made during periods of above average rainfall were abandoned during dry years that followed.

With passing time, most of the area ill-suited for farming was left for grazing use. A cattle and sheep raising economy developed but always existed under the duress of an incongruous land disposal system that simply ignored the cattleman's need for far larger areas than the 160 acres that the homesteading laws permitted. Operators were able to acquire more land by purchase of other ownerships and sometimes by filing bogus claims. Congress finally recognized their plight by passing the Stock Raising Homestead Act of 1914 that allowed grants of 640 acres. This area, however, was still far less than that needed by the average rancher.

Ranchers continued their practice of grazing their animals on the unsold public domain and by the 1920s there was evidence of overgrazing. As Gates (Ibid, p.607) has noted:

> *"Overgrazing, destruction of the better grasses and survival of poisonous plants, erosion of steep hillsides and silting up of reservoirs, all emphasized the need for control."*

An answer to the overgrazing problem came with the passage of the Taylor Grazing Act in 1934. This law set aside 80 million acres, later expanded to 142 million acres, which were to be administered in 50 grazing districts by the Grazing Service; later renamed the Bureau of Land Management. Provisions were made for issuing grazing permits based on animal units of grazing potential to local graziers, charging grazing fees that were shared by the districts, as well as state and local governments, and undertaking grazing land improvements. Local advisory boards were vested with considerable responsibility for guiding the operations of the various districts. Similar arrangements were made to permit the leasing of grazing rights on tribal lands within American Indian reservations with the grazing fees going to the Native American governments.

Exercise of control over rights of entry and limitation of grazing rights has had a desirable effect in improving the quality of the grazing areas. Administration of the law, however, has not been without controversy. Critics have charged that the districts operate too much in the interests of local graziers, that public welfare is ignored, that grazing fees have been held at lower levels than apply with the leasing of privately owned grazing areas, and that local operations are subsidized at federal expense.

It has been argued that large areas should be turned over to the states for ownership and administration, and that arrangements should be made to sell them to the graziers. Neither of these alternatives has commanded much local support for the simple reason that with the present system of districts turning half of the grazing fees over to state and local governments, it provides a less costly approach than if the graziers owned the land and had to pay local property taxes.

Other Land Uses

High land values are associated with the areas used by cities and their suburbs for residential, commercial, and industrial uses. Surprisingly enough, little recognition was given to this need for land in the nation's public land disposal policies, the assumption being that towns would develop on privately owned lands and that additions to urban uses would come as lands of lower valued uses shifted to higher and better uses. Areas needed for public uses, such as streets and public buildings would be acquired by purchase or dedication.

The area used for urban and suburban purposes in the United States increased from about 10 million acres in 1920 to 106.3 million in 2002. Nearly all of this increase can be attributed to private developments. This movement was facilitated in large measure by public policies. Large public expenditures on improved highway and other transportation facilities made it possible for thousands of urban workers to live in suburban communities. Federal housing programs, including the provision of low cost credit facilities for financing resident developments, made it economically feasible for families to buy houses in outlying, as well as urban centers, and aids to local governments contributed greatly to the provision of needed urban and suburban infrastructure.

Urban expansion can be expected to continue into the future as urban and suburban living space is needed to accommodate the nation's increasing population. A pertinent issue associated with the expected increase in area needed for urban expansion centers on the need to minimize the possible adverse impacts it can have on efforts to safeguard open space areas from development. Planning efforts are needed to direct needed expansion along desirable routes and to recognize natural amenities as economic drivers that must be preserved and integrated into new housing developments.

Transportation improvements have made it possible for operators to leapfrog their developments rather than follow the older practice of gradually adding subdivisions around the fringes of existing urban areas. Their success in acquiring sites for development in the open country have often had disrupting effects on local land markets by ascribing as yet fictional values to nearby lands that are not as yet needed for other than their currents uses.

As Table 14–1 indicates, a considerable area of federally owned land is also administered as wildlife reserves, wilderness areas (administered by the Forest Service), and park and outdoor recreation areas. None of these uses were regarded as important when the nation's land disposal system was organized. The examples of wildlife refuges and wilderness areas will be addressed in more detail in later chapters. With parks and recreation areas, our current emphasis on their provision has come as a result of changing circumstances.

Land was used for recreational purposes in colonial America; but it was generally assumed that sufficient land was available for this purpose in the village commons, on private land holdings, and with public woods and waters where individuals could hunt and fish. Recognition of need for public parks came later as cities grew in size.

National park areas were reserved at first, as much for protecting scenic treasures from exploitation and abuse, as for providing opportunities for recreational use. Numerous new public parks and recreation areas were established; but it was not until the growing affluence of the American public during the mid-1900s led to demands for the acquisition and development of additional areas where average citizens could go to engage in a wide range of recreational activities that concern for this need was recognized as it is today.

National parks, monuments, seashores, and hiking trails provide valuable resources where people can go to view and experience the wonders of nature. Other facilities of comparable nature are needed near centers of population where visitors can come for a few hours or days to enjoy outdoor activities. Many local needs have been provided for by private and community groups in the form of golf courses, ball parks, and playing fields. An emerging problem with both the public and private provision of needed facilities is that of possible overuse. If today's parks and campgrounds are overcrowded, what will be the situation be in the future when population pressures have increased to new levels? With the changing preferences of humans and the emerging public views of the communities they reside in, in what context would these complex questions and issues be addressed? Our traditional disciplines have been very effective in training professionals with narrow views. However, society's needs are best met by professionals with broad views, as well as depth in the understanding of disciplinary sciences. Managing land use has, therefore, not only become complex, but requires expertise, which universities are having a difficult time producing. This is a dilemma in higher education.

Some Management Issues

In addition to its concern with issues that arise in dealing with various types of land use, land management involves a miscellaneous group of concerns that have important bearings on managerial decisions and operations. A basic issue involves the right to manage and the central questions, "Who decides?" and "Who decides who gets to decide?" There are legitimate cases where the decision about the decision maker must be made at a high level where it is recognized that actors at the lower levels are conflicted, do not see the big picture, require better education to add value to decision-making, and are probably driven largely by their own self interests. That is the context within which most municipal land use decisions are being made today. However, there are cases where tremendous public participation is required and all stakeholders may need to provide input. The area of wind turbine siting is one that illustrates how complex the choice of decision-making could be. On one hand wind turbines are good environmentally, and are often profitable when the policy framework is in place to support such profitability. On the other hand, depending upon their political clout, a few costal residents can, in fact, shape the decision about whether or not to approve the deployment of wind energy in the community, even if it makes environmental, social, and economic sense for the community.

Other issues concern problems that arise in acquiring ownerships, considerations that affect land tenancy, the worldwide emphasis that has been given to land reform, and the view of property ownership as an entitlement. In addition to these, there are land management issues that are emerging on the landscape and should at least be examined in this book. This will be done toward the end of the chapter.

The Right to Manage

Ownership and management go together in our society. Owners of resources have the right to manage their use and, if they choose not to, delegate this privilege or responsibility to others. No one, however, has a legal right to use or manage property without owning it or securing a delegation of managerial rights from the owner. No one, it may also be observed, has to pass a test or meet any qualifications other than being accepted or designated by an owner to manage a resource.

While the question of having a right to manage seems to be settled, it may be noted that the situation has not always been as it is at present. During the Middle Ages, right by birth was often associated with rights to own and manage. Rights to manage are no longer dependent on birth rights although it must be admitted that children born to families with wealth have greater opportunities for acquiring property ownership than those without. Rights of ownership can be purchased almost everywhere.

Here again though, there are inconsistencies in the system. Businessmen and some professional personnel can sell their businesses and practices when they want to retire. College professors, service workers, government and industrial employees enjoy no such advantages. As late as 1815, military commissions were still being bought and sold in Great Britain, and a wealthy merchant could buy a general's commission if he was willing to pay the price. Recognition of the fact that armies are best led by competent trained officers brought an end to the sale of commissions. Might comparable requirements for meeting minimum qualifications someday be required of those who manage environmental resources?

The rights held by fee simple owners are often considered as inviolate. In truth they are not. Owners can lose their properties and the right to manage them if they violate the law. Their rights can be taken under eminent domain for public uses. Great Britain and Nazi Germany both had regulations in effect during World War II that allowed them to remove and replace farm operators who were considered ineffective producers of food for national needs. Land reform programs have expropriated estates, some with compensation, and some without. Military conquests have uprooted thousands of land owners, as they did in what had been eastern Germany at the end of World War II to make room for the resettlement of thousands of Poles who in turn had been uprooted from their properties in the portion of prewar Poland taken over by the Soviet Union. These examples illustrate the fact that rights to manage environmental resources are always subject to the approval of a sovereign government that supposedly operates in the interests of society. Individual managers have the rights society is willing to recognize and enforce, nothing more.

It is important to note that new land management frameworks are arising on the landscape due to the growing complexity of land management objectives. For example, to address the issue of adequate management of foreclosures, land banks have emerged as a management framework to correct for errors in the market mechanism with respect to protecting communities from blight. Similarly, special tax districts have emerged that give communities greater ability to manage land and related resources within purposefully developed districts. These issues will be examined below.

Acquisition of Managerial Rights

Management rights are typically acquired as an incident of property ownership. Ownership rights can in turn be acquired in any of several different ways. They can be acquired through: 1) Patent or grant from government; 2) private grants by deed; 3) grants by devise through a will; 4) acquisition under the laws of descent when the deceased owner leaves no will, 5) dedication as when a developer donates land in a subdivision for streets; 6) eminent domain with the taking of land for public use; 7) forfeitures as when ownership is lost through non-payment of taxes; 8) adverse possession; 9) accretion as when a stream that is designated as a property boundary provides one with additional acreage, because it changes its course; and 10) escheat.

Need for clear titles. Regardless of how they acquire property, owners want and need the security in possession provided when they have clear and merchantable titles to the properties they claim. To secure this end, they should insist on receipt of a valid deed, which is properly recorded, and under which they are granted all of the expected rights of ownership. The requirements of a valid deed vary somewhat from nation to nation and state to state. As a minimum, it must list the name of the grantor, the name of the grantee, a recital of the consideration given for the property, a statement of conveyance, and the signature of the grantor. Recitals of consideration often list actual sales prices although this detail can be cloaked with statements, such as "for one dollar and other considerations." Deeds may also list the date of transfer, the addresses or some other identification of the grantor and grantee, a warranty of title, statements concerning outstanding mortgages and other encumbrances, a statement of possible restrictions and conditions, a waiver of dower and homestead rights, signatures of witnesses, an official acknowledgement by the grantor before a notary public or other public official, the grantor's official seal, and revenue stamps.

Once prepared, a deed must be delivered to the grantee (usually during the lifetime of the grantor) and be accepted before it becomes valid. This action makes the transfer effective as far as the two parties to the deed are concerned. For official purposes, however, the deed should then be recorded with the public recorder or register of deeds and thus become a matter of public record.

Possession of a valid deed or other legal instrument showing conveyance of ownership gives an owner evidence of title, but this unfortunately does not necessarily mean that the owner has a clear and merchantable title. To have a clear title, one must acquire and still possess all of the property rights one claims and be able to support the claims with legal evidence of the extinction or severance of the interests previous owners and others have held in the property.

Owners have perfect titles when they can show that every item in the chain of legal actions involving their properties going back to the original patent from government has been properly recorded without error and that all claims against the title have been properly cared for and removed. Titles with this measure of perfection are a rarity in older settled areas. Somewhere in its history, almost every record of title contains some errors or defects, such as a faulty property description. Defects of this order can be cleared by reasonable interpretation or the use of affidavits and quit claim deeds. Titles involving minor errors and omissions are imperfect and care should be taken, as far as is practicable, to clear them before they are transferred, even though they could be received by grantees with little risk.

Title examinations. As few buyers have the necessary training to examine legal records and vouch for the merchantability of titles, the services of an attorney is normally required. The title examination process ordinarily calls for the preparation or updating of an abstract of title. The abstract provides a chronological summary of all the recorded legal actions that have had an effect on the title. Abstracts do not provide a guarantee of title, but a properly prepared abstract usually discloses any errors or omissions that can cloud a title.

Even under ideal conditions, a title search will sometimes fail to disclose hidden defects, such as a forged signature on a deed, a grantor's minority or failure to indicate that he or she was married. This problem has led many buyers to seek other means for guaranteeing titles. The most common approach calls for use of title insurance.

Title insurance is available in most areas, is now used with most transfers of urban properties, and is commonly required with transactions that involve the use of mortgage financing. Insurance companies naturally refuse to insure defective titles. They agree to defend titles at their expense if the validity of an injured title is questioned and to reimburse owners up to the amount of their policies should they be ejected from ownership. Unlike other insurance, a title insurance policy involves a flat fee that protects owners for the full period of their ownerships. Policies vary in their details and are not usually transferable. They apply to defects of title that exist prior to the date of the policy; and may specify exceptions and conditions that limit their liability.

Tenancy Problems

Land ownership is one of the important objectives most people seek in life. In the practical world, considerable landed property is occupied and used by tenants and most of us must expect to spend part of our lives as tenants.

There is nothing demeaning about being a tenant, especially if an operator can be viewed as an owner-in-prospect or one who could be an owner if he or she so chose. Tenants often find it to their economic advantage to remain as tenants and they may choose to forego the joys and headaches of ownership. Problems with tenancy occur when it is a forced situation, when tenants want to become owners but find this opportunity denied to them, because of financial or other obstacles, and when their status makes them prey for landlord exploitation.

Strained relationships between landlords and tenants have developed at times in the past as in 19th century England and Ireland when absentee landlords sometimes demanded higher payments of contract rent than calculations of the fair land rents from their properties could justify. Similar problems arose in the United States during the 1930s when farm properties that could produce sufficient net income during prosperous periods to support both landlords and tenants produced barely enough to support one of the two parties.

Problems of this nature have often exacerbated the normally cordial relationships between landlords and tenants, often to the harm of both parties. Measures to improve their relationships have called for more reliance on the use of written leases, extending lease periods, providing tenants with assurance that their leases will not be canceled without cause, spelling out in some detail the contributions of both parties, and correlating contract rental payments with the actual production of income. Offers to compensate tenants for unexhausted improvements can provide them with incentives to adopt conservation practices and to undertake improvements that can add to property values. Provision of improved credit facilities can also provide tenants with needed production credit and with needed financing for acquiring ownership.

Rent controls. Rent controls provide a means that governments can use to limit the rents that tenants are required to pay. They were applied in the United States and several other countries during World War II to protect residential tenants at a time when supply and demand conditions provided many landlords with opportunities to gouge tenants by requiring payment of higher than normal contract rental payments on residential housing. They, have also been used by several countries as a feature of land reform programs to limit agricultural rents to equitable levels that were often far below the repressive levels landlords had been able to charge.

War time conditions often bring sudden increases in the need for residential housing at sites near defense industries and military installations. Waiting periods are needed before additional facilities can be provided and wartime restrictions may prevent builders from acting to meet the needed demand. Conditions of this order create housing shortages that put a premium on ability to rent and may lead to discrimination problems, such as refusal to rent to parents who have children.

Rent controls were instituted during World War II to deal with this problem. It was generally assumed that the controls were temporary and would be retracted once the emergency was over, as did happen in most cases. The popularity of the controls among tenants, however, brought political support for their continuance in New York City and several European cities. Continuation of these programs has necessitated adjustments that make it possible for landlords to secure sufficient income to maintain and improve their properties. Without adjustments of this order, landlords would often lack incentive for keeping their properties in acceptable rental condition.

Land Reforms

Maldistribution of wealth within and between nations is one of the most pressing issues of our time. In general it is an issue that people are more willing to talk about than to try to solve and it most certainly is an issue most politicians choose to ignore. At times conditions in various parts of the world have become so unacceptable that people have marshaled their forces to demand and secure changes. Some of these have resulted in far reaching land reforms that have brought sweeping changes in the entitlements associated with the holding of land management rights.

History is filled with accounts of peasant revolts and other attempts of rural people to throw off or at least lighten the yoke of slavery, serfdom, or peonage. Most of these strivings for agrarian reforms have failed, but some succeeded and brought added advantages and privileges to peasant populations. The first large scale land reform movement of modern times followed the French Revolution and led to a general freeing of land tenure conditions in western Europe. Land reforms spread to Central and Eastern Europe following the uprisings of 1848, the Russian peasant uprisings before 1861 and again in 1905–06, and the armistice of 1918. Land reform became an issue of worldwide significance following World War II when the demand for reforms spread from the more developed nations to developing areas in Africa, Asia, and Latin America.

The land reform programs adopted in different nations have involved a wide range of measures. Some have involved the use of single reforms, some have called for combinations of several measures. Some of the reforms, such as the provisions that have been made to improve landlord-tenant relationships and to provide improved credit facilities, can be characterized as mild reforms.

Among the more far-reaching moderate reforms, mention may be made of the regulations in France, Germany, and Sweden that prohibit sales of farmland to foreigners, non-farmers, and speculators; the limiting of farm sizes to maximums of 15 hectares in Poland and 7.5 acres in Japan; prohibitions against parcellation of farm holdings beyond specified minimum limits in Denmark and Switzerland; and programs for the mandatory consolidation and rationalization of scattered tracts of farm holdings in France and Germany.

Some of the most far-reaching reforms have called for the expropriation of certain land holdings with their redistribution in smaller sized units to actual farmers. Land expropriation and land distribution programs were carried out in most of the nations of Eastern Europe following World War I. A large program of this type was started in Mexico during the interwar period, and large-scale programs were carried out in Japan, India, Pakistan, Iran, Italy, Algeria, Egypt, Kenya, Bolivia, Chile, Cuba, and Peru after World War II. Some land owners in these countries were divested of all of their land holdings, others were allowed to retain specified maximum areas. Compensation was paid for the expropriated land in most countries but several variations in compensation arrangements were used.

Land expropriation was usually followed by redistributions of the acquired lands among tenants, landless workers and small peasant proprietors. Forests and other non-farm holdings were often kept in public ownership, and estate holdings with building improvements were often retained as units and used for educational, research and community purposes. Individual allotments of redistributed land were usually small and recipients were required to pay for their lands. Long-term credit with liberal repayment schedules was provided to accommodate the needs of new owners.

Another variant of land expropriation took place in the Soviet Union and China where properties were expropriated without compensation and the land was made subject to collective rather than private management. Two systems of management were used in the Soviet Union. Most of the farmland was incorporated in collective farms that were operated under state management by workers who were provided with individual houses and garden plots and who shared in the income produced by the farms. A smaller area was operated in large state farms. This dependence on collective management broke down after the demise of the Soviet Union and most of the land is now operated with private management.

The land reform programs undertaken during recent times have had generally beneficial results. They have contributed to the self-esteem of farm operators and have permitted the first generation of recipients of land redistribution programs to enjoy better lives. Unfortunately, the benefits have often been swallowed up as increasing population numbers have complicated the ability of farm units to support additional workers. Progress, such as that brought by land reform, can be a hollow attainment if operators are left "to lift themselves by their own bootstraps." Once programs are used in rural economies to establish a desirable balance between humans and land, programs are needed to siphon off the excess of on-coming population to other forms of remunerative employment if the balance is to be maintained.

Ownership as an Entitlement

The right to own landed property is ranked by many people alongside their rights to life, liberty, and pursuit of happiness as one of the basic rights of mankind. It is perhaps natural that we are inclined to glorify it and assume that it has always been thus. Examination of its history and nature, however, show that the right to own landed property is more an entitlement and privilege bestowed by society than an inherent right of man. It has been a right vested in individuals at times and taken away on other occasions. Attitudes about it have changed somewhat over time and there is no guarantee that future generations will view it as we do.

Under the feudal system from which our concept of property rights evolved, kings could claim technical ownership of all of the land in their realms. Possession and responsibility for administration was delegated to their retainers among the leading families. The nobility who actually administered the land were a class apart from the villiens and serfs who actually tilled the soil, produced food supplies and provided soldiers for the many wars. With the ups and downs of intermittent intrigues, wars, plagues, and occasional local famines, some workers along with members of the lesser nobility were able to emerge as small farmers, some continued on as tenants, while hundreds of landless workers from the various manors were deprived of their land use rights. Land ownership became an entitlement of overlords who used the enclosure movement to shift once tilled fields into meadows to support a wool growing economy. Society was divided in a sense between those who had property and those who did not. Property ownership meant that a man had a right to be called "mister" and had the right to vote.

Review of the experience of other countries with land reforms show that shifts in attitudes about ownership have also occurred in other parts of the world. No one is suggesting that the high regard we have for property is wrong or that it should be changed. It must be remembered, however, that evolving change is inevitable in our society. Much as we appreciate our concept of widespread land ownership as a goal and as a right to be cherished, we must remember that it is an entitlement vested by a generous society. While numerous owners insist that private ownership gives them the right to do whatever they wish with their property, continued support for their rights in a crowded world calls for recognition of the view that land ownership carries with it a responsibility to manage land in the public interest.

Chapter 15: Emerging Issues in Land Management

"Only within the moment of time represented by the present century has one species—man—acquired significant power to alter the nature of his world."

~ Rachael Carson

In this chapter, we briefly discuss some of the emerging issues related to land management that are either the result of new tools or new thinking. Because the New Economy allows much broader consideration of land's features in the valuation and management of land, several new tools have evolved with the goal of more optimal land management.

Abandoned Urban Real Estate

We define an abandoned property as property that is found in such a state as to make it likely that the original owner has intentionally given up all dominion and control of the property with no intent of returning to or recovering the property. There are many reasons for property abandonment. Some property becomes abandoned at the time of intergenerational transfer when an owner passes and the public process is not able to hand over title to appropriate heirs, when heirs are not appropriately specified, or when heirs are just not interested. In some cases, potential heirs don't even know that they are entitled to an inheritance of real property, either because they are not appropriately notified, or the deceased did not leave a will. Another reason for property abandonment is foreclosure, whereby a mortgagee abandons the property and the bank, either deliberately or not, fails to gain title. The ultimate consequence is that property ownership transitions to the municipality, or through a tax foreclosure sale, to property buyers and speculators with interest in the property. Foreclosure sales frequently involve a period during which the previous owner can exercise his or her right of redemption (typically six months). In many cases, the purchase price at a "sheriff's sale," falls below the previous market price, a phenomenon, which attracts land speculators who do not intend to invest in the land. This phenomenon accentuates urban blight, especially in communities that have been devastated by a major decline in the economy.

The incidents of property abandonment mushroomed in the U.S. due to the real estate finance industry meltdown (circa 2008) and the sharp decline in the U.S. economy. Cities, most of which are well below their peak 1950's population, were already littered with abandoned properties, but the recent high incidents of foreclosure exacerbated this problem. While the federal government implemented aggressive policies to stem the tide of neighborhood declines from foreclosure (HUD's Neighborhood Stabilization Programs One and Two for example), property abandonment continues to be a major problem. Many communities are exploring supplemental mechanisms to address this major source of erosion to municipal tax revenue. Some of these involve greater control over the foreclosure sale process and greater capacity to take title and avoid speculators. Some of these solutions will be addressed in more detail later in this chapter.

Land Banks

It was mentioned above that the problem of abandoned properties has been overwhelming for municipalities, especially in recent years. Land banks were created as a solution to the market failure associated with the free market approach to dealing with vacant properties and as a mechanism for balancing the multiple objectives of host communities who are adversely impacted by blighted properties.

A land bank is a public authority created to efficiently hold, manage and develop tax foreclosed properties. It leverages its legal and financial stature in transforming vacant, abandoned, and tax-foreclosed property back to productive and valuable use. Such valuable use could be an alternative development in which case the property may need to be torn down and rebuilt. In some cases, teardown and repurposing for open space, parks, trails, and other green spaces may be the ideal end use. Increasingly, urban agriculture is becoming a relevant use. The essence of land banking is to bridge whatever gaps exist between beneficial end use and the state of confusion that often characterizes abandoned property.

Here's an example of how land banks work. By acquiring an abandoned property, it essentially cleans up the title, wipes out all convoluted interests in the property, and is able to deliver a clean title. Furthermore, as shown by Griswold and Norris in a report by the Land Policy Institute at Michigan State University (Griswold and Norris, 2007), tearing down the blighted property and turning it into green space not only eliminates blight, but enhances the values of the properties that surround the torn-down properties. So, neighbors benefit too. Similarly, by developing the property into a home or office, land banks further add value and can make a profit while enhancing overall property value in the community.

The benefits of land banks are significant. First, they stabilize community property values; secondly, they abate what would otherwise be a blight; third, they help enhance the tax base of the community; fourth, they enhance public safety; fifth, they can make housing more affordable; and sixth, they can be beneficial to the environment. Land banks have the capacity to assemble large chunks of land, making large scale projects possible. The types of large placemaking projects that have helped to transform some urban areas of the country can perhaps be envisioned in other cities with depressed properties. Without a land bank scenario, the land would have to be assembled piecemeal, which would be very difficult to do.

The State of Michigan has been at the forefront of innovative land bank legislation. The state empowered communities, in 2004, with better legal and financial tools to put vacant and abandoned properties back into productive use through the Michigan's Land Bank Fast Track Legislation (PA 258). Subsequent legislation, such as Michigan PA 259–263, enables the use of tax increment financing (TIF), tax exemptions for land banks, a tax-based revenue source for land banks, and a mechanism for extinguishing the rights of others. These legislations were catalytic and resulted in the creation of numerous land banks in the state.

Brownfields

As mentioned above, most American cities have lost significant population since 1950. With the exception of Miami, Seattle, Salt Lake City, and a few others that never lost population, population loss has been synonymous with cities. For example, between 1950 and 2010, Detroit lost about 60 percent of its population. While cities like New York, Boston, Philadelphia, Pittsburgh, and Chicago experienced a comeback, many others continued to lose population. In essence, the loss of population is characteristic of the impacts of the New Economy on activities in places built on the Old Economy paradigm. What is remarkable about comeback cities is that they all embraced principles of the New Economy and developed a comeback strategy.

American cities of the 1900's were industrial cities, and one of the features of such cities in the New Economy is the collateral economic losses due to the decline and loss of manufacturing production. A visual manifestation of the transition to the New Economy is, therefore, the abandonment of old industrial sites. The old industrial states of the U.S. are littered with abandoned and often polluted former manufacturing sites. The presence of these sites is often overwhelming for cities and other places that harbor brownfield sites. For example, a 2010 paper (Adelaja et al., July 2010), reported 3,262 contaminated brownfield sites totaling 57,574 acres in the State of Michigan alone.

The term, brownfield site, means “real property for which the expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Typical contaminants found in brownfields include heavy metals, lead and paints, arsenic, PCB’s, pesticides, asbestos, and hydrocarbons. Cleanup is required in order to put these lands back into productive use. State and federal incentives have, therefore, existed to help defray the cost of cleanup. The purpose of these incentives is to shift development patterns from greenfields to brownfields, consistent with sustainability and conservation principles.

The current challenge with brownfields is the lack of any development whatsoever, let alone that which can be shifted elsewhere. Since the U.S. economy ground to a halt in 2008, the status of brownfield development has correspondingly slowed significantly. New ideas are being proposed for alternative development patterns for brownfields and a case has been made for brownfield development into energy parks that feed wind, solar, and other renewable energy into the grid (Adelaja et al., 2009c). With the growing number of federal programs focused on adaptive reuse, the future of brownfield development appears relatively bright. In this section we highlight brownfields, because of their unique management requirements and the need to balance productive activity with community values, environmental pollution, and, in some cases, environmental justice.

Tax Increment Financing

The examples of emerging land use issues above connote the need to repurpose otherwise condemned land or land considered to be of low value after it had previously been used productively. The discussion of land banks and brownfields essentially highlighted the role of incentives in shaping behavior toward more beneficial use. Tax Increment Financing (TIF) is one of those incentives or policy tools designed to finance desirable development. By definition, it is a “public financing method, which has been used as a subsidy for redevelopment and community improvement projects." It is synonymous with a concept of value capture.

The way TIFs work is that it presumes that certain types of development would add value to the community that would not otherwise accrue if the development had not been pursued. In other words, the pursuit of the project ensures a certain pattern of new revenue generation to the city in the future. So, the city issues a revenue bond promising to pay back lenders who advance funding with the expectation that future tax revenues will fund the payoff of those bonds. In other words, the city borrows against the future. Presently thousands of TIF districts exist nationwide.

Special Purpose Districts

Special Purpose Districts (SPDs) are an attempt to implement a quasigovernment entity that is independent from general purpose local governments, such as counties, municipalities, and townships. The definition excludes school districts. SPDs provide special services that general purpose public governmental structures don't provide. In 2007, the U.S. had more than 37,000 Special District Governments. SPDs provide specialized services to those living within a designated area and can often cross the lines of towns and villages. They usually have boards or similar leadership entities. SPDs can derive revenues from local, state, or federal sources, as well as from philanthropic activities.

Special Purpose Districts present one of those tools that can be used to achieve the broader environmental and social goals of communities. We envision future districts with themes that center around natural resource conservation, quality of life, amenity enhancement, and other elements of lifestyle. Especially, with the strengthening of the New Economy, we envision more communities repositioning themselves based on their unique features, assets, and visions. To the extent to which these activities happen at scales beyond the current scales of government, the legal provisions for SPD's can be leveraged into new governance units that will drive land management decisions in the future.

Foreign Ownership of Land

One of the issues that sometimes elicits concern is the foreign ownership of land. For the United States such ownership has been well-documented as the U.S. Department of Agriculture maintains and publishes data on the subject. To production-centric pundits for whom the ownership of land represents the ownership of the means of production, ownership of land by foreigners is seen as an erosion of the economic clout of Americans and American-based companies. One of the areas in which foreign ownership is most contentious is agricultural land. The rationale for concern and, therefore, opposition, range from nationalism, fear of being "servants" of distant foreign masters, distain for aliens, fear of loss of control, concern for the survival of the farming community, concern over a feudal type of absentee ownership, foreign investments raising local prices of land thereby threatening "the way things used to be," higher rents, reduced soil fertility, and interference with the nation's food production policy. According to Cliff Dobitz and Donald Kirby, the concerns about foreign land ownership tend to be general, rather than specific, and seem to represent the fear of the unknown (Dobitz and Kirby, 1989). It does not appear as if the United States will lose control over this important source of food or its economic destiny and freedom through the sale of agricultural land.

The U.S. Department of Agriculture (USDA) statistics indicate that in 2009 approximately 22 million acres of U.S. agricultural land was owned by foreign entities. Forest land saw the greatest increase from 1999 to 2009, from six to 13 million acres and accounts for over half of all foreign holdings. Pasture land is the second largest holding but remained relatively stable increasing from four to five million acres from 1999 to 2009. While many countries worldwide have seen a huge spike in the purchase of agricultural land for food crops this has not been the case in the U.S.

Countries with the greatest holdings in the U.S. are Canada (approximately half of all holdings), Netherlands, United Kingdom, Germany, and Portugal, in that order (USDA, 2009). The listing of these countries reflects the speculative, long-term value hunt, and production-oriented interests (primarily forest industries) of buyers of U.S. land. Between 2008 and 2009, foreign ownership increased by 1.3 million acres. The 2007–2008 commodity price hike, which was caused by the global energy price shock, has been blamed for the growing incidence of cross-border land ownership. The idea is that more and more countries are concerned about their food security and wish to secure rights to land to ensure future ability to meet their food security needs.

Of course, U.S. companies own significant amounts of foreign land and so do U.S. individuals. So, foreign ownership should not necessarily be a threat. If the free market system works, the productivity of land and labor in the U.S. will always ensure optimal production. But a concern is the extent to which the free market system may not fully be operational. Another issue that arises with foreign ownership is how well these owners will perform their custodial duties, especially if the motive is arbitrage related.

It is important to note that while the verdict on foreign land ownership in the U.S. has been one of "no need for concern," the wave of international land transactions globally, especially since 2007, has been an issue of concern. The United Nations Food and Agriculture organization (FAO) estimates that between 2007 and 2010, 20 million hectares have been acquired by foreign entities in Africa. Many of these transactions involve more than 10,000 hectares and several more than 500,000 hectares (Graham et al., 2010). The National Food Policy Research Institute estimates that between 2005 and 2009 20 million hectares changed hands in the form of land grabs, a term that is now commonly used to describe transactions that are not of an ordinary nature but that involve some form of speculative, hoarding, or pre-emptive land acquisition for financial gain or strategic non-market food security advantage (Borras and Franco, 2010). The World Bank reports that 45 million hectares have changed hands globally (World Bank, 2010), while Cotula et al reports that Sub-Saharan Africa is the site of the most speculative land deals (Cotula et al., 2009). According to Zoomers (2010), major areas in Africa are being targeted for commodity and fuel crops investment and ecosystem services.

What is complex about this international land transaction process is the diversity of motivations and players involved. Key buyers include nations that are very dependent on food imports, companies in such nations, sovereign wealth funds affiliated with such nations, global food companies interested in expanding their global food systems reach, private individual investors whose interests tend to be speculative, and even investment banks and private equity funds whose interests are essentially to benefit from the opportunity that the growing opportunity costs of developing country land offers investors. One of the concerns about these so called "land grabs" is the lack of symmetry between the knowledge base of the host country negotiator, vis-a-vis more sophisticated land managers and investment bankers in advanced countries or wealthy countries. For this reason the Word Bank, the FAO, IFPI, and many international organizations and land tenure rights advocates globally have called for much better standards and guidelines for these international transactions. Of course, many host countries and investors do not see any need for intervention in an area where they believe that agents are effectively entering into transactions. However, the huge concerns about such things as corruption, appropriate representation of the people by government, existing food insecurity in the countries selling or leasing the land and the presence of substandard land tenure arrangements in host countries, all continue to draw the attention of these international agencies.

China and India have been major players in international land acquisitions and the expectations are that these countries are motivated by concerns about long-term food security. Given the limited arable land base in many countries whose middle classes are growing, purchasing power is growing, and the demand for food and other land created products are growing, the world should perhaps be concerned about whether or not powerful and wealthy nations would use their financial and political prowess to influence agricultural production and exports in ways that violate the free market system. More directly asked: Can one expect China, with its rapidly growing per capita income, to subject itself and the future food security of its nation, to the free global commodity market system when it knows that its growing demand can be blamed for a big proportion of the spike in prices of commodities? In light of the political and economic strengths of countries with interests in food security, one can envision powerful countries seeking to have more control over countries that have the land base and the capacity for agricultural exports.

In conclusion, international land acquisitions or transactions are nothing new and probably do not threaten the integrity of the United States. However, the current situation is that investors are reaching far deeper into developing countries, especially in Africa, to gain control of land. There perhaps should be some concern about whether such acquisitions are beneficial to the host countries that might be seen as mortgaging the future when substantive lands may be needed to maintain growing prosperity.

Urban Agriculture

As mentioned above, most American cities shrank in population and economic activity between the year 1950 and the present although cities like New York, Boston, Philadelphia, San Francisco, and Chicago have experienced come-backs while others like Detroit and Cleveland have not. A consequence of this is the massive amount of abandoned buildings and structures in urban areas and the little likelihood that those properties will ever be put back into their previous economic uses—housing, factories, and businesses. This provides tremendous opportunity to rethink options for new uses of the vast expanse of underutilized land. The recent emergence of land banks in many states has provided a framework for the teardown of old buildings and the creation of new open space within cities. Evidence from the literature suggests that the mere teardown of abandoned properties enhances the values of surrounding properties significantly.

In the quest for alternative uses for abandoned urban land, many new ideas have surfaced; turning them into parks, using them for urban gardening, building new playgrounds, or other leisure and quality-of-life related ideas. Urban agriculture has recently emerged as a production and economic reuse that can address multiple existing problems of cities – food deserts, carbon sequestration, air quality, blight reduction, diminished property values, and lack of employment. In the Ricardian world[2], urban lands were never to become so inexpensive that feasible uses include those that otherwise would happen only in rural areas where land values are low. But the dilemma in our cities today has brought us to the point that what was supposed to be a low value use can now be considered a better or higher use than housing due to the lack of demand for housing and high demand for food.

Urban agriculture can be defined as the practice of cultivating, processing, and distributing food in or around a village, town, or city where such practice would have been unfeasible in the distant past. It can include not only the production of fruits, vegetables, grains, agro forestry, and nutraceutical production, but can also include more intensive and controversial activities, such as animal farming, aquaculture, and medical marijuana. The idea behind urban agriculture is that the low cost of land now makes farming feasible and the presence of clean farming can add to improved viewshed, airshed, ecosystems, and environmental quality. However, it is likely that the problems associated with farming at the urban fringe will not disappear altogether and that the typical nuisance challenges that farmers face when their production activities are so close to homeowners will remain. This raises questions about the political, economic, and social feasibility of widespread urban agriculture. Many of the benefits of urban agriculture are public goods being produced by private entities for which there is no compensatory mechanism for farmers nor the ability of urban residents to pay for those goods and services. In any case, urban agriculture needs to be examined closely, because of its potential to transform the metropolitan landscape.

[2] Referring to the work of David Ricardo (born 1772).

We are not suggesting that urban agriculture is new. Various civilizations have chosen to concentrate farming activities near or in urban areas for food security reasons. This tended to occur at times when the urban use demand for land was not overwhelming and cities still had real opportunities to expand and grow new communities. Currently urban gardening is occurring in many U.S. cities as families have pursued this activity either for food or income purposes. What is unique in the debate about urban agriculture is the fact that the motivation of many players is profit / rent seeking. Are there existing models of profit driven urban agricultural projects that could be emulated? If so, many of the challenges associated with reaching consensus about urban agriculture can be eliminated.

Some 50 percent of the world's population now lives in cities. With the population of the world growing and potentially reaching nine billion within the next 40 years, access to land can easily be seen to translate into access to the ability to farm and produce food. Urban agriculture promises to be a mechanism for dealing with the food desert problem. Obviously there are many challenges facing urban agriculture and we will list a few of them below:

- Urban residents are used to sharing their neighborhoods with other residents. While they are warm to the idea of parks within the neighborhood, their reaction to farming is difficult to ascertain apriori. Urban residents tolerated factories, but whether or not they will be comfortable with urban farms will depend upon the nature of the farms, the benefits to residents individually, the overall benefits to the community, and how much input they have on the process.

- Urban zoning essentially revolves around residential, commercial, and industrial uses. While agricultural zoning is possible in many rural communities, and agriculture is generally considered a permitted use within residentially zoned areas, the history of agricultural zoning in urban areas is spotty at best. The process of changing zoning is not only complicated, but cities lack the experience of the type of drastic zoning change that will be required for urban agriculture.

- Agriculture is likely to be fraught with numerous nuisance challenges and it is unclear whether urban farming can enjoy rights-to-farm protection. In any case, if so, best management practices need to be developed in order to protect agriculture from unnecessary and burdensome regulations. Who will develop these best management practices? Without much of a history of urban farming what precedents would be relied upon to guide decisions about "what is best?" With the urban environment featuring an overwhelming imbalance between urban farmers and residents, how does one manage the political and economic process to yield a favorable urban agriculture policy environment? How does one handle the issue of taxation and would differential tax assessment for farmland be amenable to other residents.

- What about vandalism and possible cruelty to farm animals? One of the excuses that grocery stores provide for not operating within cities, and for perpetuating the food desert problem, is pilferage and product loss. What security systems will be needed to protect the assets of urban farms? Would those costs exceed what is tolerable to keep the enterprise possible? Is massive fencing going to be required on the perimeters of urban farms? Would these facilities require 24-hour security guards that farms in the country do not currently require?
- Liability issues will also emerge with urban agriculture. Another excuse that supermarkets provide for their lack of presence in major cities is the high cost of settling "slip and fall" liability lawsuits. Is it possible that urban land use policy will indemnify farmers as part of "protective farming environment" legislation? Where would the support for such ordinances come from and would state governments be willing to pass laws that supersede municipal ordinances as part of a policy to create a favorable environment for urban agriculture?
- What about product distribution and marketing? With many urban areas characterized by heavy traffic and congestion, it may not be cheaper to move farm products to market despite the proximity of products to demand points.
- How does a city ferret out serious agricultural investors from those land speculators and hoarders whose primary intention might be holding land for future profits? Proposals will surely come to cities from individuals who seek underutilized land at a low cost for speculative reasons. What type of arrangements can cities put in place to ensure the use of vacant properties for the intended agricultural use? Will redistricting be necessary? And if the land is sold cheaply, would the city seek a share of the

profits when it is resold at a much higher cost?

The existing distribution system was designed to accommodate past and current production systems. What collateral infrastructure is needed to provide for new urban agricultural marketing and distribution systems? There are indeed some opportunities for alternative marketing in inner city areas that are not possible in rural areas, for example, how will urban farms deal with issues related to ecotourism and farm-based recreation?

Urban agriculture promises opportunities but major challenges as well. It is an example of an area where we have the potential to apply the principles of sustainability in policy and strategy in centralizing both potential agricultural developers and urban land use decision makers simultaneously. This is an issue to watch in the future.

Air Rights

By definition, air rights are the rights to develop empty space located above physical property sites. Like any other real estate related right, air rights can be transferred to other parties while maintaining ownership of the property itself. In some areas of many cities where there are few or no remaining areas to develop, the only way forward is up. The acquisition of air rights provides the opportunity to build so called skyscrapers with huge value over existing property sites.

Like every other right, air rights can be restricted, especially around airports where “tall buildings legislation” limits vertical building options. Between the points where the height restriction starts and where the existing physical property height ends is space that is potentially buildable if the economics are right. Sophisticated developers have been known to accumulate air rights, especially in inner city areas. One of the questions that arises with air rights is what exactly are they worth? If there is no chance of vertical development due to the economics of the area, or height restrictions, then air rights are worth very little. This is why air rights speculators often target places where they have the potential to influence policy to enhance the value of their air rights portfolio.

One of the issues of air rights is the extent to which those rights could be curtailed by adverse regulatory action. Because air rights are viewed by many to be intangible, it is easy for action to be advanced that hurt their value. Air rights can be considered to exhibit hidden value, because most people cannot fathom exactly what they are, how valuable they are, and whether or not they are marketable. This explains the current low perceived value. It is important to note that building codes can significantly limit people's air rights.

Intergovernmental Cooperation

Intergovernmental cooperation can be defined as the process of working or acting together across jurisdictions to achieve mutual goals. Such cooperation can either be intentional and deliberate, or unintentional. Intergovernmental cooperation implies working side by side or working in harmony or unison. More complex forms involve major joint decision-making, co-investment in a mutually beneficial initiative, revenue sharing around vital mutual assets (a regional stadium for example) or merging departments across municipalities. Even more aggressive forms exist, including the merger of two municipalities or cooperation to attract major regional infrastructure. While the absence of cooperation does not guarantee competition, it is likely to occur. In the United States, the land use framework we have adopted as a society provides a lot of latitude for local units of government to work independently. The U.S. economy was relatively stable for 60 years and economic prosperity was almost guaranteed for municipalities that are not used to fighting for such progress.

The slowdown of the national economy and the presence of limited growth suggest the need for greater intergovernmental cooperation. However, the extent to which cooperation can be used to reduce the cost of doing business for both of two communities, collectively and individually, should also be encouraged by higher level governments. There are numerous cases of cost savings, and increasingly, more and more people believe that cooperation can indeed reduce costs. The problem, however, is a gap between understanding the value of cooperation and working collectively to unlock that value. Some of the obstacles to cooperation are existing cultures accustomed to acting autonomously, a fear of losing power, distrust, fear of job loss, reluctance of constituents to support joint activities, the "agency problem" (stakeholders want it, the powers that be don't), the lack of evidence that cooperation will yield results, the need to overcome search and discovery costs before benefits can start to accrue, and the fact that the benefits come later while the costs accrue much earlier.

Many states are considering the implementation of incentives to encourage or force municipalities to cooperate. Indeed, in some states there are calls for outright mergers, which are even more difficult to achieve. Proponents suggest that size matters and that the economies of scale exist in the delivery of key services. Opponents tend to argue that cooperation will actually yield no benefits and may increase costs by creating more complexity, as well as require additional efforts needed to overcome deep cultural differences and difficulties in shedding redundant personnel or infrastructure. In any case, with numerous local units of government across the nation, most of which work independently, the public is more interested today than in the past in intergovernmental cooperation. Real examples exist where cooperation seems to have been beneficial based on claims of cooperating parties. In 2004, the Intergovernmental Cooperation Authority was created by the governor of Pennsylvania and has since had a significant impact on the economic and quality-of-life turnaround of Pittsburgh. The New Jersey Meadowlands, with its revenue sharing, and the emerging environment in Grand Rapids, MI, for cooperation through the West Michigan Strategic Alliance, are both examples of intergovernmental cooperation.

Regional Organizations and Regional Governance

As stated above, intergovernmental cooperation is the act of governments working together across jurisdictions, either formally or informally. Many forms of such cooperation exist in various parts of the U.S. and Europe. The notion is that by working together across jurisdictions, municipalities can achieve the following joint or value added benefits:

1. Economies of scale—that may result in cost saving in a unit.
2. Cost savings from joint or collective negotiations.
3. Economic development prowess.
4. Placemaking benefits that may result from a region collaboratively creating an attractive environment.
5. National infrastructure development.
6. Better defined regional visibility.
7. Greater regional competitiveness.

Cooperation is the art of achieving the above through voluntary actions; however, it can be coerced by incentives, regulations, or proactive government funding. An alternative to voluntary cooperation is a formal attempt by independent governments to come together under a formal government structure. The European Union is perhaps the most glaring example of this internationally. The 27 permanent members of the EU came together deliberately to supplement their individual governments through a super-governance structure that, in some cases, supersedes national governance. The EU features joint currency, enables continent-wide policies, creates a free trade mega-region, and offers opportunities for cross border exchange of goods, services, and people. But the EU is an international example. In the U.S., while not firmly in place, joint regional governance has been drawing significant attention lately. Examples of what some have come to term “unigov” includes arrangements in the Indianapolis, Indiana region and the Portland metro region in Oregon. An alternative to regional governance is a council of governments, which serves more of a coordinating function rather than an outright decision-making function.

In states where local governments (townships) do not exist, then the smallest unit of government is the county. In essence, counties represent a “unigov.” Otherwise, “unigovs” require some type of agreement among the communities involved. This would require some form of government to cede some of their activities to higher levels of government. This is often contentious as individual leaders are not always willing to give up control. The potential for governments to create “unigovs” has been compromised by state and federal laws, which recognize or mandate local units of government as the legitimate unit at the local level. While some communities are getting wise and considering higher levels of government, it will probably take regulation, mandates, or legislation to force the creation of regional governments.

The U.S. government promotes regional planning organizations through the Economic Development Authority (EDA) and other units. In Michigan, for example, 14 Regional Planning Organizations (RPO’s) exit. The state enabled regions (comprised of counties) to form RPO’s . Local units of government in each RP area are required to pool resources to support their RPO. One of the criticisms of RPO’s is that they are not powerful, because they peruse what the locals agree to, which are perhaps the least progressive activities. In states, such as Michigan, efforts are underway (under Governor Rick Snyder) to strengthen the RPO’s. In Indiana, (2009 under Governor Mitch Daniels) proposals were put forth to consolidate local governments, but the proposals met significant difficulty with the people of the state.

India, China, and other emerging nations are poised to grow their economies rapidly, creating a growing middle class. China has maintained a nimbleness, which allows it to be able to adapt as it competes around the globe. Their centralized system of government makes it very easy to make collective decisions. In contrast, with over 89,000 units of local government in the U.S. in 2007, it is difficult to get collective action going on anything, especially policy. With our strong belief in local rights, change is slow. The growing incidents of individual centered behavior, such as “NIBYism,” raises questions about the ability to generate a collective voice around progressive issues. On one hand, independence is good. On the other hand, the ability to take decisive action could be beneficial.

In a recent study on intergovernmental cooperation and land use, Adelaja et al. laid down a framework for examining the feasibility of such cooperation (Adelaja et al., 2010a). They postulated and confirmed that intergovernmental cooperation is more likely to occur when cooperating or combining units are similar politically and size wise, when transaction costs are low, when cooperation is incentivized, and when there is a history of collaborative action. It follows from the above that the promotion or encouragement of regional governance will be enhanced by policies that build on the above.

Chapter 16: Planning for Better Land Resource Use

"Failure to plan is planning for failure."

~ Robert Schuler

Planning is a common everyday phenomenon. Almost everyone gives some attention to their next courses of action, how they organize their days and what they will do today, next week, next year. Some of us do a better and more realistic job of planning than do others. We all learn though that achieving success calls for planning.

Government officials plan as they prepare budgets and decide on courses of action. For its first hundred years Congress was far more interested in disposing of the public domain than in showing concern for conservation. More than a half century passed after that before it saw need to deal with the problems of air and water pollution. Valid excuses can be advanced for this failure of Congress to act sooner than it did. The policies it endorsed were for the most part what the citizenry wanted. Leaving the problem of managing the environment to the private sector seemed at the time to be the best course.

Over time, this situation changed. The decades since 1900 have brought increasing economic interdependency. With a three-fold increase in America's population and steadily increasing competition for the use of nature's bounty, new tensions and conflicts of interests have evolved. Solving environmental problems now calls more often for collective and group action. Public opinion has shifted to favor the exertion of more governmental effort to expand, coordinate, plan and direct many activities once handled, if at all, by the private sector. We have entered an age in which public planning at every level of government has become essential.

Nature of Land Resource Planning

Planning can be defined as the conscious direction of effort to attain a rationally desirable goal. Ability to reason and plan ahead is an attribute of human beings. Our national economy and the high standards of living we enjoy have not just happened. They have come to us as the result of millions of plans made by individuals, business operators and public officials. Most of our economic planning has been and probably will continue to be private decision-oriented. Varying amounts of coordinated planning are needed if people are to work together with the objective of maximizing social welfare.

No one questions the need for private planning. But wide differences of opinion are associated with mention of public planning. Instead of seeing it as essential, some people see it as a move toward regimentation, as an unwelcome threat to their right to operate as they wish. As George B. Galloway, (Planning for America, p.5, 1941) has noted:

> *"The word "planning" has been widely and loosely used. It has meant different things to different people. To crusaders it has been a Holy Grail leading to the sunlit hills of a better day. To conservatives it has been a red flag of regimentation heralding the dawn of collectivism and the twilight of the old order of free private enterprise and the democratic way of life. But to the humble practitioners of the art, viewing the matter with the cold eye of engineering rationality and a matter-of-fact indifference either to crusades, Red hunts, the class struggle, or the omnipotent state, it has been merely a process of coordination, a technique of adapting means to ends, a method of bridging the gap between fact-finding and policy-making."*

The Case for Environmental Planning

Like their counterparts in private business, governments must plan their functions and the uses they make of resources if they are to make order out of what might otherwise be chaos. But, granting that planning is needed with national defense and the maintenance of civil order, why must the modern state engage in economic and social planning? Why shouldn't we return to the relatively planless conditions of the 1800s?

Several factors have contributed to our present interest in economic and social planning. With an increase in population and the developments of our industrial society, people have been brought into closer contact with one another. The subsistence operator and self-sufficient community have become things of the past. Our health, safety, and welfare as individuals often depends on the activities and decisions of people we never see, people who may live hundreds or thousands of miles away from us. This dependence on others, in combination with the problems generated by the pressures of a larger and more consumption-minded population, has multiplied the prospect for individual and group conflicts of interests—conflicts that could easily upset our normal working and living arrangements were it not for our use of planned group action to prescribe minimum rules of the game.

Economic and social planning is not a recent innovation. Governments have used various types of pubic planning since the dawn of history. Ancient Egypt had its grain-storage and monument-building projects. Rome had its public works and its policy of "bread and circuses." Even at the height of the laissez-faire period, the United States had its protective tariffs, public land disposal programs, and experiments with monetary and credit policies. But while public planning is not new, much of the emphasis now given to economic and social planning can be credited to changing attitudes concerning the rightful functions of government.

Prevailing attitudes regarding the function of government in planning economic and social matters have changed considerably in the United States during the past century. Until the end of the 19th century, most Americans held religiously to a philosophy of rugged individualism. They espoused a laissez-faire doctrine, which assumed that an "unseen guiding hand" would operate to coordinate individual actions and bring forth the optimum in social welfare.

During the late 1800s, many average people began to question and reorient their attitudes concerning the desirability of unchecked free enterprise. Abuses associated with the rise of big business and the exploitive business practices of certain operators provided convincing evidence of the failure of unbridled individualism to maximize social welfare. Instead of the basic harmony of interests assumed by the laissez-faire doctrine, the uncoordinated self-seeking of millions of individuals frequently led to frustrating conflicts of interests, to human exploitation and misery, and to something less than optimum social welfare.

At this stage, people began to turn more and more to group action as a means for minimizing conflicts and maximizing their joint interests. Business operators joined together in corporations and trade associations; laborers organized unions; farmers formed cooperatives; and large blocks of citizens looked to the government for action programs that would enhance their economic and social interests. Whereas most individuals had once looked to government primarily for protection, justice, and preservation of civil order, the realization spread that collective action could be used to promote the social welfare and material well-being of the great mass of the citizenry. With this change in attitudes, it was easy to justify public economic and social planning, particularly when it contributed to the well-being of large portions of the citizenry, either by expanding their opportunities and liberties, or by minimizing the risks and uncertainties that would otherwise affect them.

The demand for public action that followed has brought new controls, such as the government's supervision of interstate freight rates, pure food and drug regulations, and requirements for safety standards in factories and mines. It has prompted social welfare measures, such as prohibition of child labor, urban renewal, the provision of public credit facilities, sponsorship of public multipurpose resource developments, social security, and public use of fiscal and monetary measures to stabilize the nation's economy. More recently it has brought demands for environmental protection, for action to provide clean air and water, for preservation of endangered wildlife species, and for saving wilderness areas from abusive use.

Some of our most important planning needs involve environmental resources. This is true, because the welfare and well-being of everyone in our society is dependent on how we use our common natural resource base. If people were completely free to use these resources as they might choose, the end result could be as chaotic and confusing as if all members of a symphony orchestra played their own tune. Undisciplined dumping of wastes into air, public waters, or on the land could make these resources unfit for human use. Some types of common action are needed to secure order.

Tom and Katherine Daniels, (The Environmental Planning Handbook for Sustainable Communities and Regions, 2003) urge communities to adopt Environmental Action plans that will enable them to shape their futures by "protecting and improving air and water quality; conserving farming, forestry and wildlife resources, reducing exposure to natural hazards; and maintaining the natural features and build environments that make a place livable and desirable." Kenneth Corey and Mark Wilson (Urban and Regional Technology, 2006) add another dimension with their recommendation that communities tweak planning decisions to create local wealth and jobs from an increasingly networked world.

Plans for the better use of our land, water, and air resources find justification in the objectives they seek. These objectives rank from the picayune to the grandiose. Most public resource planning in the United States has been designed to promote orderly development and use of the nation's natural resources, minimize problems and conflicts associated with private uses, foster optimum development of the resource base, and maximize public welfare. Our record in attaining these objectives has been relatively good. Yet mistakes have been made. Plans have been abandoned or revised at times, because they were considered overly ambitious or overly restrictive; and we have frequently erred in planning for too little rather than too much.

To plan or not to plan. Throughout its history, land resource planning has shown itself to be an essential and easily defended type of economic and social planning. Yet like other types of public planning, it is subject to varying amounts of criticism and fearful speculation. Critics argue that public planning is less imaginative and less forward-looking than the plans of selected entrepreneurs. Others fear that public planning logically leads to more planning and that the planning road inevitably leads to a controlled economy, a police state, or George Orwell's 1984. They question the motives of planners and ask whether we can really trust political leaders to stop with planning measures designed to enhance the public welfare. They question the willingness of the average citizens who make up the "mass mind" of our democratic society to resist the lure of public planning when it offers them "bread and circuses," job security, and other benefits in exchange for segments of their individual liberties.

Recognizing these arguments, it can be admitted that private plans may indeed be superior at times to public plans. Imaginative builders who operate with plentiful financing may provide developments with high quality levels that city planners, who have to operate with far more limited resources, can only dream about. Such cases tend to be exceptional. Communities ordinarily find it better to accept the coordination of efforts that come with public planning than to allow everyone to proceed as they might wish.

Acceptance of public planning measures can involve valuable expansions, as well as possible losses of personal freedom. Planning can trod on the ability of individual operators to reap profits from projects that are of debatable value to communities at large. But, the degree to which planning means more or less freedom for the average individual always depends upon the nature of the planning and the individual's definition of freedom.

The term <u>freedom</u> means different things to different people. When it is defined broadly as an absence of impediments to the realization of desires, almost every public regulation may be regarded as a threat to the freedom of some individual. Public laws that prevent one's license to appropriate the properties of others, or that prevent engagement in socially undesirable practices, restrict the freedom of those who operate at the fringe of social order. Programs that limit the liberty of some to profit at the expense of others can rightly be regarded as measures that expand the freedom of others in society.

Individual freedom is secured when governments act to protect individuals against the adverse actions of others. Viewed in this context, the concept of individual freedom is rooted in group action. Public planning measures may be used to deprive criminals, draftees, and others of their so-called inalienable rights or to limit the vested rights of various individuals or groups. They may also be used to expand the freedom and opportunities available to large segments of the citizenry.

With the basic question of whether or not it is safe to plan, it should be noted that every society is custodian of its own future. The planning process is neutral. A nation can plan to destroy its individual liberties, or it can use the planning process to maintain, strengthen, and expand these liberties. Democratic governments use planning techniques to enhance the public welfare and to attain socially desirable ends. Police states, in contrast, use planning as a technique of control—as a means for repressing freedom, in stifling criticism, and subjugating individuals to the will of the state. Public planning does not lead automatically to either end. If we cannot trust ourselves or our leaders, it is possible that planning will lead to abuses. But no nation can save itself from authoritarianism simply by refusing to plan. Far from being a threat to freedom, planning is necessary for the protection of freedom. Failure to plan can easily mean planning for failure, whereas planning can lead to expanded choice, even where there are limits on the options available.

Successful public planning in the United States has often led to more public planning, particularly when the majority of the people and their representatives have felt that planning provides the best means to attain desired economic and social goals. When we have weighed each new benefit against its cost in individual liberty, we have not hesitated to reject those types of planning we do not like. However, information costs are high in an increasingly global network and all stakeholders may not have equal access to information or the planning process itself. New planning methods can evolve to utilize new technology and social networks. While we have placed trust in a democratic government, planning for sustainable land use that most benefits society must be judged in the actions of its leaders and in the majority will of its citizens.

The Planning Process

Plans do not just happen. All planning, be it public or private, involves a process. As such, it embraces a series of important steps. These steps can be classified in different ways but normally involve 1) establishing the goals and objectives to be sought, 2) gathering and analyzing information, 3) examining the alternatives, and 4) formation and adoption of the plan or policy.

Steps in Planning

Every plan starts with some concept of a goal or objective, with some motive or purpose for the act of planning. The goal may be rooted in the individual's customary way of thinking and may be accepted without rational examination or thought; it may be the end product of the conscious thinking of an individual or a group of people; it may be specified in the legislation that establishes the planning agency. Planning goals may be wise or foolish. They may be regarded as fixed for all time or be accepted as temporary objectives subject to reevaluation and revision. Yet regardless of their nature, planning goals always play a vital role in giving direction to the planning process.

People engaged in the planning and policy formation process should always start with the question, “Planning for what?” They should think through their objectives and reasons for planned action. If they have time, they should formalize their goals by writing them down. They should examine them in detail and discuss them with others.

In this examination process, planners often find that they have several goals to consider, that some goals operate at cross-purposes with others, and that they must temper or compromise some objectives to attain others. Proponents of a pollution control plan may find that they must choose between control measures that will remove 80 percent of the pollution at a low cost and measures that will remove 98 percent at a much higher cost. Planners can often avoid considerable wasted effort by first identifying and thinking through their planning goals. By recognizing and ironing out possible conflicts between competing goals at an early stage, they can avoid later problems and gain a sense of direction that aids in the preparation of workable plans and helps them avoid embarrassing inconsistencies.

Gathering and analyzing information. Once the objectives are established, the next major step in the planning process calls for research or study concerning the nature of the problem situation, the resource base, and other factors that may be affected by the plan. Data are gathered and examined for their relevance to the goals and objectives.

Planning can go astray when it is based more on wishful thinking than on a sound understanding of the facts. By accidence or happenstance some plans do succeed even though they are made in ignorance of the facts. The weight of experience, however, shows that a good working knowledge of the problem situation is a necessary prerequisite to successful planning.

It is sometimes impossible for planners to assemble and analyze all the information that should be considered in their decisions. Policy decisions are frequently needed on short notice, and the processes of government and business cannot always wait for the final word in scholastic research. Planners and policy makers often find that they must make spot decisions without a full knowledge of the facts. Insofar as it is practicable, however, they should base their decisions on findings that represent a reasonably accurate picture of the situation at hand.

This responsibility creates problems in planning administration. Most successful planning directors recognize that every individual has blind spots. Regardless of how well-balanced their education has been, people are the product of the "roundaboutness" of their training. Their thinking and the points they emphasize reflect personal interests and backgrounds. In recognition of this situation, planning officials often find it advisable to seek the advice and inputs of people who have quite different backgrounds in the hope that their combined judgment will provide a balanced and reasonably realistic analysis of their problems.

Indeed, multidisciplinary planning teams are often mandated as a requirement for project funding. Experts from relevant disciplines are assembled with the hope that multiple viewpoints will be shared to create greater insight. Impacted stakeholders must also be identified as part of the planning process and they must have a meaningful voice in order to increase chances of intended success. Ideally, planners have the ability to examine options through multiple disciplinary lenses simultaneously and are able to work collaboratively for optimal outcomes. Because these skills are not easily found, and because solicitation of stakeholder input in planning can be costly and difficult, these two elements are often absent from the planning process despite their potential to increase the likelihood of attaining targeted goals.

Examination of alternatives. Going beyond the problem of securing a balanced view of the facts, planners have a responsibility to seek out, analyze, and consider the alternative approaches that may be used for attaining their objectives. The alternative, or combination of alternatives, usually includes the option of doing nothing (often expressed as maintaining the status quo). The various pros and cons of each alternative are examined and compared against one another. Ultimately a choice among the alternatives, or a new combination or phasing of alternatives, emerges.

Up to this point, the planning process consists of preparing to plan, not planning itself. Real planning calls for more than the collection of factual data and analyses of situations and trends. It calls for formulation of courses of action, for choices between alternatives, for definite recommendations concerning what should or should not be done. These decisions involve the substance of planning and provide the real test of a planner. Plans are sometimes ambitious or visionary, sometimes inconsequential or faulty. But good or bad, they stand as monuments to the planner's ability, or lack of ability, to prepare workable plans.

In their planning, planners and decision makers must avoid panaceas. They should reject those formulas that appear economically, politically, or socially unacceptable or unsound. Where possible, they should seek workable solutions that can be dramatized for popular acceptance, and they should always ask themselves: “Is this proposal workable from an administrative standpoint? Is it affordable? How well will it achieve its goals or objectives? What externalities can be expected and who bears its costs relative to its benefits? Is it fair?”

Formation and adoption of the plan. The planning process reaches its climax when the chosen alternatives are formulated into a plan and decision makers accept the plan and commit themselves to a given course of action or to a given set of recommendations.

Two key issues with land use planning concern the extent to which people from communities are involved in the planning process and the question of who makes the actual planning decision. Planning offices are typically staffed with professional planners who can take the lead in doing the research and providing the leg work required for good planning. Praiseworthy and imaginative as their plans may be, however, their planning can be ineffective if their proposals lack community support. Planning proposals that spring from exclusive reliance on "in-house inputs" often bask in the limelight for a brief day of glory after which they are shelved, filed away, and forgotten.

A practical alternative to this approach calls for the involvement of interested and responsible members of the community in the planning process. With their input and backing, planning proposals can be proclaimed to the public and submitted to elected legislative bodies with strong backlogs of public support. Indeed, some of our most effective land use planning has come when groups of concerned citizens have joined together to identify land use problems and seek workable answers for their solution.

Fruition of the planning process calls for acceptance of planning proposals by legislative bodies and their enactment of programs to put them into effect. Planning efforts to this point involve preparation and formulation of plans. Plans become effective only when the officials responsible for putting them into effect accept them as parts of their action programs.

Successful resource-planning calls for recognition of the political facts of life. Planners must usually operate in terms of the present, the next decade, and occasionally the next quarter of a century. They need to gear their plans to the possible. In this process they must be willing to adapt their goals and plans to political realities. They must recognize the power groups in their communities and adjust their roles and techniques to the sociopolitical system in which they operate.

Effectuation of planning. Many people feel that the planning process stops as soon as decision makers adopt a given operational plan, draw a land-use map, prepare a planning report, or issue a policy directive. There is little point in planning, however, if no action follows. Planners have a natural interest in the effectuation or carrying out of their plans. It is at this stage that a plan can prove itself, show need for reformulation or revision, or possibly fail.

The successful administration of any public plan calls first for a sound and reasonable proposal. Beyond this, it calls for capable and understanding administration, the cooperation of officials in other agencies and other levels of government, popular interest in the plan and its results, and continued political and public financial support.

Administrative problems frequently arise with the recruitment and training of capable administrative personnel. Care must be taken to emphasize results, to avoid bogging down in “red tape,” to keep policies or programs working in their intended ways, and to prevent individuals from scuttling programs or using them as stepping-stones to promotion. Coordination and integration are needed to keep individual officials or agencies from proceeding with policies that work at cross-purposes and to avoid jurisdictional conflicts over who functions where. Emphasis must also be given to the maintenance of good public relations both with citizens of the community and with other public officials.

Opposition to Planning. Environmental plans can be basically sound and enjoy popular acceptance. There is a big difference, however, between developing a plan and seeing it carried out. The process of selling a plan and getting it carried out can pit planners against powerful pressures exerted by operators or groups whose economic interests may be adversely affected. In this process, planners, who speak for the interests and enjoy the nominal support of the community, can easily find themselves opposed by forces that have both the political influence and financial capability for stifling action.

Planners and local officials have sometimes been offered financial incentives for "going along.” When they have refused local officials have faced demands for their recall from office and planners have been advised to seek employment elsewhere. In lieu of these actions, local governments have often been sued by developers who felt they were deprived of development opportunities; and local officials have frequently "caved in" rather than encumber local governmental funds for fighting expensive legal suits.

Operators and taxpayers have a legal right to voice their concerns and opposition to suggested resource use plans. Claims that have substance and seem valid should receive detailed attention. When they are based on self-centered hopes for economic advantage, this detail should be made clear to everyone concerned so that it might be examined in the full light of day as the public weighs it alongside the potential advantages of the plan in making its choice as to whether the plan should be effectuated.

Examples of Land Resource Planning

Resource planning takes many forms. Individual planning occurs when a gardener decides what plants go in different rows or a sub-divider draws a plat map. Private group planning takes place when a neighborhood association requires architectural approval of all new houses built in an area, or when a service club develops a summer camp. Public planning occurs before we build a highway or prepare a land use ordinance. Planning also occurs when governments set standards for clean air or designate wilderness areas. With public, as well as private planning, plans may be far-sighted and successful. They may also be faulty and result in failures. Significant examples of public planning occur with city and metropolitan planning, federal, state, and regional planning and with local community planning.

City and Metropolitan Planning

Archaeological findings indicate that the known beginnings of city planning go back some 5,000 years. These findings suggest that directional measures have been used to guide the layout of some portions of towns and cities almost since people first started living together. Until recent decades, however, city planning has been limited for the most part to street layouts, to the designation of areas for parks and particular public uses, and for the provision of public water supplies and defense facilities. Except for the constraints sometimes associated with defense considerations, most of the world's cities grew and expanded in an uncoordinated manner that reflected the myopic concerns of hundreds of individual operators.

Formal plans dealing mostly with street layout were prepared for several American cities at fairly early dates. William Penn devised a plan for Philadelphia in 1682; and plans were made for Savannah in 1733, Washington, D.C. in 1791, Buffalo in 1801, and Manhattan Island in 1811. Administrative pioneering in city development came during the middle 1800s with the appointment of boards in several cities to deal with water, sanitation, park, street, and transportation problems. Even with these beginnings, city planning, as we know it, did not get its start until the end of the 19th century.

Modern city planning in the United States began with the birth of the "city beautiful" movement at the Chicago World's Fair in 1893. Visitors at the fair were much impressed with the beauty of the grounds and the classic splendor of the architecture. Thousands went away imbued with a desire to beautify their own drab cities. This desire blossomed into civic improvement plans in several cities. The central thrust of this early planning effort was on municipal aesthetics and improvement of the surface appearances of public buildings, parks, and major streets. Little emphasis was given to the housing and social problems associated with rapid growth that had already left many cities with blocks of slum-like development.

A second milestone year came in 1909 with the holding of the first national conference on city planning and with the publication of the Plan of Chicago. This city plan had a broader orientation than earlier city plans and signaled a gradual shift of emphasis from the "city beautiful" to the "city practical.” Two new tools were accepted: 1) construction of public works consistent with the plans, and 2) local zoning. New York City adopted the nation's first comprehensive zoning ordinance in 1916.

City planning came of age during the 1920s as cities found that they could use land-use planning, building codes, and subdivision controls as planning tools to guide their future development. Numerous cities hired planning consultants and organized city planning commissions, and progress was made in preparing "comprehensive" city plans. Yet at the end of the decade, most city plans were still concerned primarily with only six major issues: civic appearance, parks and recreation, streets, transit problems, transportation facilities, and zoning. Only passing notice was given to economic and social problems, such as housing, public health, and medical problems.

Curtailment of operating budgets brought the city planning movement to near standstill in the early 1930s. This situation gradually changed after the launching of the New Deal in 1933. Attention was soon focused on the role city planners could play in caring for the problems of the "lower third" of the population. Staff assistance—often financed with public relief roll funds—was provided for planning surveys and research.

Federal, state, and local programs were set in motion to help cities clear away their slums, provide public housing, and undertake large-scale redevelopment programs. With these developments, the scope of city planning was again broadened. Planners began to think more in terms of the overall city and of the changes and redevelopment work needed to eliminate blight and slums, to improve living conditions, and to raise the standards of urban life. Master plans were adopted in more and more cities to guide the future patterns of land use and to give direction to programs for urban renewal and property conservation.

By the 1960s, federal financial assistance was provided to cities under the urban renewal and model city programs to replace substandard areas with new developments. Superhighways were extended at considerable expense into central cities to provide improved transportation access. Public housing programs provided replacement housing for residents displaced by slum clearance programs. Public planning combined with financial aid breathed new life into numerous urban communities.

Emphasis is still given today to problems associated with provision of public buildings, civic centers, parks and recreation areas and municipal aesthetics. But far more attention is now given to enhancing and maintaining the economic base of cities. Increased emphasis is given to the problems of industry and commerce, to solving traffic and parking problems, to maintaining the quality of residential housing, and to maintaining minimum public health standards. Major problems still remain as cities and their planners cope with issues, such as caring for homeless residents, providing high-quality educational systems, the aging of existing housing, the flight of the more affluent residents to the suburbs, and the continuing need to redevelop worn out areas for challenging new uses.

Virtually every city now has its planning consultants or planning department. The scope of the problems they deal with is larger than ever before. Our larger cities have come to realize that many of their problems overlap municipal boundaries and call for metropolitan rather than single jurisdiction solutions. Issues, such as water treatment, sewerage and trash removal, provision of parks and recreation facilities, can often be best dealt with on a metropolitan basis.

Rural Land Use Planning

Active land use planning programs are now sponsored on a local government basis in numerous rural townships and counties. Some of them employ professional planning staffs or consultants while some others operate with citizen volunteers. While local communities have a long record of willingness to work together on community problems, rural land use planning began largely as an outgrowth of a nationwide rural land use planning program that was sponsored by the U.S. Department of Agriculture and the Land Grant Colleges between 1937 and 1941. At its peak 200,000 people in 10,000 communities in two-thirds of the states were involved in this program to evaluate their community assets, identify problems, and recommend actions that could be taken to remedy local problems. The program was discontinued during World War II but provided a precedent that led in later years to the emergence of rural planning commissions.

Rural land use planning agencies have addressed a variety of issues not all of which are directly associated with uses of land. In areas subject to suburbanization, they often operate very much like the planning agencies found in established cities. In more rural areas, much of their emphasis has been placed on protecting and restricting the development of "critical" and "essential" land areas and on protection of farmland and open space from undesired development.

Federal, State, and Regional Planning

Some of the most important developments in land use planning during recent decades have taken place at the state and federal levels. From their beginnings, these governments have engaged in activities that have had both direct and indirect effects on land use. Throughout the 1800s, they were concerned mostly with the sale and settlement of the public domain and the provision of internal improvements. New types of resource planning became necessary after 1900 with the reservation and acquisition of public forests and parks. Some attention was given during the 1930s and in later decades to implementing federal, state, and regional comprehensive planning. But the principal resource planning efforts of this past century have involved piecemeal programs that deal, for the most part, with specific areas, problems, or types of resources.

Leading examples of state and federal land resource planning programs are found in their provision of the nation's network of highways and in the plans developed and used in administering state and national forests, parks, and wildlife refuges. Some principal problems with their management were highlighted in the report of the Outdoor Recreation Review Commission (1962) and in One Third of the Nation's Land, a report of the Public Land Law Review Commission (1970). Resource planning was emphasized with the passage of the Forest and Rangeland Renewable Resources Planning Act (RPA) in 1974. RPA requires the Forest Service to conduct and report periodic studies in which it assesses the nation's expected needs for these resources. The Soil and Water Resources Conservation Act (RCA) of 1977 requires similar action by the U.S. Department of Agriculture in appraising trends and presenting alternative strategies for developing, managing, and conserving the nation's soils, water and related resources.

Regional land use planning is being conducted on a multi-county basis in most states and also on a multistate regional basis. An excellent example of the latter is provided by the Tennessee Valley Authority. This organization was established by Congress in 1933 as a federal corporation to serve the seven state area included in the drainage basin of the Tennessee River. Among its objectives, TVA was designed to control floods and improve navigation on the Tennessee River and its tributaries, contribute to the national defense, develop and produce new types of commercial fertilizer, produce and distribute hydroelectric power, promote desired research, facilitate resource development, and improve the economic welfare of the people of the area. In fulfilling its purposes, TVA has built numerous dams to control floods, improve navigation, and produce public power. It has stimulated new economic development in the area, encouraged better farming practices, promoted soil conservation and reforestation measures, provided improved recreational opportunities, helped to stamp out malaria and other diseases, and encouraged community planning. It has also produced fertilizers and nitrates for explosives and contributed to the development and use of nuclear power.

Hawaii set an example for state action by adopting a statewide land use planning and zoning program in 1961. Several states have since created state planning agencies though none are as centralized as in Hawaii. Individual states also have enacted programs that deal with specific land-use problems. Maryland adopted the nation’s first use-value assessment legislation for agricultural lands in 1956.

Other innovative programs include California's coastal zone development program (1972 and 1976). Colorado's open space program (1992 and 2001), Florida's land and waste management act (1972), Maine's industrial site location law (1970), the Maryland-Pennsylvania-Virginia Chesapeake Bay Commission program (1983), Minnesota's Twin City metropolitan area growth management program (1967), Oregon's growth control program (1973), Wisconsin's farmland protection program (1977), and Southern California's establishment of its Regional Clean Air Incentives Market.

Interest in national resource planning blossomed during the 1930s, died out during World War II and was revived again during the 1950s and 1960s. National commissions were established to study and make policy recommendations on housing, outdoor recreation, material resources, water resources, and public lands legislation. Congress authorized grants of funds to carry on local and regional planning under the Housing Act of 1954, the Water Pollution Control Act of 1972, and the Coastal Zone Management Act of 1972. Proposals for adopting a national land use policy under which federal assistance would have been provided for state and local land use planning was considered by Congress during the 1970s but not passed.

Environmental Resource Planning

Environmental protection emerged as a matter of peak national concern during the last half of the 1900s. Policies dealing with specific environmental problems, such as soil erosion, destructive timber cutting, overgrazing of the public range, mine safety, and urban residential housing had been recognized and dealt with on a piecemeal basis for several decades, but they had not been really identified as environmental issues. Books, such as Rachel Carson's Silent Spring (1962), focused national attention on the injurious effects some of our practices were having on the ecology of nature. Scholarly works, such as John Kenneth Galbraith's The Affluent Society (1958) and Kenneth Boulding's essay "The Economics of the Coming Spaceship Earth" (1966) stimulated economic interest in the problem of environmental management. This interest flowered with the publication of dozens of books and articles and with the celebration of Earth Day in 1970.

Congress recognized the demands for action by creating the Council on Environmental Quality and the National Environmental Protection Agency in 1970 to deal directly with environmental issues. Attention was soon focused on the preparation and passage of a series of laws that deal with such diverse environmental issues as air and water quality, wetlands, protection of endangered species, worker safety, and the designation of wilderness areas. (See Table 12–2.) State legislatures also passed environmental laws, many of which tied in with national legislation.

The scope of the new legislation has been broad. It has provided considerable opportunity for the government to exercise its powers to improve environmental conditions. Several of its projects, such as EPA's establishment of air and water quality standards has definitely improved environmental conditions. Proof of their effectiveness, however, depends upon the attentiveness and quality of their administration. When rules and standards are ignored, set aside, or watered down, as sometimes happens, they can have far less effect than was originally intended. More detailed consideration will be given to the nature of some of these programs in future chapters.

Programs for Better Resource Use

Promotion of better resource use is a common goal of governments throughout the world and numerous programs have been devised for this purpose. Most of them optimize some aspect of social welfare. Their diverse nature makes it hard to categorize them but most fall into one of three classes. One group is designed to deal with resource ownership issues. A second is concerned with resource developments, while a third stresses the need to protect resources from abuse and overuse.

The ownership-oriented programs deal with such matters as promoting and distributing ownership rights, defining tenure relationships, facilitating the holding and transferring of property rights, and protecting the rights owners have in their properties. Education facilities, public sponsored research, credit programs, and public aids for building levies and dams, have been and are being used to promote resource developments.

The programs that call for protection start with measures designed to protect citizens and their properties from acts of war, terrorism, common crime, and extend to a growing list of environmental concerns. Among these are programs for reducing soil erosion; the use of zoning ordinances, subdivision restrictions, and fire and building codes to protect communities from undesired developments; and the various measures used to save open space. With our growing recognition and appreciation of ecological concerns, programs to protect wetlands and endangered species have been added to this list along with measures to protect the quality of our water and air resources.

Programs for promoting better resource use have called for extensive use of the police powers held by various levels of government together with exercise of their spending and eminent domain powers. Four examples of the exercise of these powers will be described in some detail in Chapter 17.

Chapter 17: Environmental Protection Programs

"Every man holds his property subject to the general
right of the community to regulate its use to
whatever degree the public welfare may require it."
~ Theodore Roosevelt

Environmental protection measures take several forms and impact on our lives in different ways. Some examples involving land ownership issues were discussed in Chapter 14 and emphasis is given here to five more sets of programs that bear on uses made of surface land resources. They involve solid waste disposal, the use of land use zoning ordinances, area renewal efforts, programs for saving open space, and measures for protecting endangered ecological resources. Comparable programs for protecting water and air resources will be considered in Chapters 18 and 19.

Solid Waste Disposal

Many of us come from families that a few generations ago followed policies of "use it up, wear it out, make it do" in their use of the world's goods. Even with this saving philosophy, solid wastes were often thrown into streets, stacked to decay or burn in smelly rubbish heaps, or consigned to ugly junk yards. With the emergence of our "throw-away society,” the problem cities face in protecting public health while disposing of mountains of solid wastes became an issue of major importance.

The United States produced 240 million tons of municipal wastes in 2005, an average of about 4.5 pounds per person per day. Not counting yard wastes, paper products accounted for slightly over half of this volume of solid wastes. Discarded food accounted for about 20 percent, while metals and glass accounted for about 10 percent each. Almost all of this waste material was disposed of on land, about 80 percent in sanitary landfills, about 10 percent in open dumps, while 10 percent was incinerated and a small amount is composted.

A major problem with solid waste disposal has always been that of finding appropriate sites for this use. The abandoned gravel pits and quarries that once provided convenient sites are mostly filled and, in many cases, are causing ground water pollution problems. Wastes are now hauled to disposal sites where their presence is not considered a public nuisance and where water runoff and seepage are collected and treated before they can cause damage to underground water resources. The sites are licensed and operate in accordance with state and federal regulations. Solid wastes are compacted, placed on impervious sheets, covered with soil and stacked until the fills reach full capacity, after which they may be resurfaced with soil to provide ski slopes or areas for other recreational uses. Decomposition is slow but after about 30 years of settling the sites sometimes have potential value for commercial and residential use.

Aside from the fact that many urban areas are running out of safe nearby sites for landfills, a problem that will entail higher transportation costs if wastes must be hauled to farther sites, the principal environmental problems associated with solid waste disposal involve the protection of ground water from contamination, avoidance of practices that may create public nuisances, and the handling of non-biodegradable wastes. Organic wastes soon decay and return to their place in nature. Metals, glass, plastics, and other non-biodegradables can often be recycled for possible future reuse and, if not, are lost for most practicable reuses.

Since the passage of the Pollution Prevention Act of 1990, considerable emphasis has been placed on policies to "reduce, reuse, and recycle" solid wastes. Some manufacturers and consumers have been persuaded to use biodegradable paper rather than plastics for wrapping purposes. Reuse has been furthered by the collection of food, used clothing, and other items for charitable distribution to the needy. Success also has been realized with the recycling of products, such as paper, glass, and aluminum that have considerable value for reuse. Cities can require household assistance in separating recyclable products from other garbage wastes. San Francisco goes farther by providing households with three waste bins, one for garbage that goes to landfills, one for unused food which can be either used to feed animals or composted, and one for products that can be recycled.

The burning of wastes at municipal landfills was banned by the EPA regulations during the 1970s. Numerous cities have since banned the burning of yard and other wastes on residential properties. Trash incineration can be handled, however, at municipal incineration plants that now account for the disposal of about one-seventh of the nation's solid wastes. Electric power is produced as byproduct of incineration at several plants. Methane gas, a byproduct of waste decomposition in landfills can cause fires and has adverse effects on the environment if released into the atmosphere. It also has potential value as a source of biofuel. A Landfill Methane Outreach Program, started by the EPA in 1994 to capture methane gas for commercial use, was used by more than 325 landfill gas-to-energy projects in 2001.

Disposal of Hazardous Wastes

A small portion of the total volume of solid disposable wastes involves items that are ignitable, corrosive, chemically reactive or toxic. These are the hazardous wastes that have a potential for doing considerable harm to the environment and that pose dangers to human and animal life. People have lived with some of these items for generations without understanding their hazardous nature. This has been true of the use of common products, such as asbestos for insulation, lead in paints, and of new manufactured products, such as DDT and the PCBs, that were regarded as a boon to humanity until we learned of their disastrous side-effects.

Congress took first notice of the toxic waste problem during the environmentally conscious 1970s when it passed the Federal Pesticide Control Act of 1972. This law required producers of pesticides to register their use with the EPA that had been charged with responsibility for setting standards for their labeling and use. The Toxic Substance Acts of 1976 expanded the power of the EPA to control their manufacture, distribution, importation, and processing. Additional authority for the EPA to track toxic materials from their "cradle-to-the-grave" was provided by the Resource Conservation and Recovery Act (RCRA) of 1976, which required identification of toxic substances, set standards for their use, and permitted prohibition of further production. The Comprehensive Environmental Response, Compensation, and the Liability Act (CERCLA) of 1980, also known as the Superfund Act, was enacted following discovery of a huge toxic site dump disaster at Love Canal in western New York. It provided for the EPA's identification of toxic dump sites, established liability for the costs of cleaning up these sites, and advanced funds for their cleanup.

The Emergency Planning and Community Right-to-Know Act of 1986 required the EPA to collect information and release annual Toxic Release Inventories and also established procedures for state and local government emergency response to toxic waste spills. The Pollution Prevention Act of 1990 created an Office of Pollution Prevention and Toxics in the EPA to promote the reduction, reuse and recycling of toxic wastes; and the Oil Pollution Act of

1990, passed after the Valdez oil spill in Alaska, established tighter rules covering oil spills.

Operating under the terms of the Superfund Act, the EPA identified thousands (12,781 by 1996) of hazardous waste sites plus an even larger number of hot spots on military bases on which clean-up operations should be undertaken. These sites varied in size from a single lot once occupied by a gas station that had a leaking underground storage tank to several block areas used by industries for the storage and land disposal of hazardous wastes. Progress was realized in cleaning these areas, but in 2001 EPA still had more than 1200 sites listed on its National Priorities List. Sites identified as toxic waste disposal sites are called brownfields and, because of their toxic nature, must remain unused for other economic uses pending their clean-up.

The EPA looks to the states for action programs for getting the brownfields back into economic use and virtually every state has a program for dealing with them. Most of the brownfields occupy valuable sites and cannot be simply abandoned. State programs vary in their details but usually use taxation, financing, and regulation concessions to encourage investors to proceed with necessary cleanup operations and make sites available for redevelopment. Where the contamination affects soil to a depth of several feet, the contaminated soil is removed, sometimes incinerated, and then hauled to places where it can be buried and pose less threat to society.

Hazardous wastes with low levels of toxicity are often disposed of in sanitary landfills with special precautions being taken to line the pits to prevent contamination of underground waters. They are sometimes injected into underground rock formations. Chemical detoxification can be used with some wastes but may leave problems of what to do with the residues. Once accepted with little question, the disposal of toxic and non-toxic wastes in ocean waters is now subject to control and sometimes prohibition, because of its potential for causing environmental damage.

A disposal problem of major significance arises with the case of radioactive wastes. Low grade wastes with limited half-life ratings can be held for a few years and then be treated like other hazardous wastes. The issue of storing and disposing of nuclear wastes that have half-lives of thousands of years, however, remains a major problem for which we still lack a fully satisfactory answer.

Zoning Ordinances

Zoning provides a foremost example of use of the police power to direct land use. It simply calls for the division of land into separate districts each of which may have its own regulations. It involves the designation of land use districts within which specific regulations apply concerning the uses that may be made of land; the height, size, and setback of buildings; and maximum densities of population. Zoning is a tool for carrying out a land use plan, not a substitute for planning; and its worth and effectiveness always depends on the character of the planning on which it is based.

Beginnings of Zoning

Land district regulations have been used sporadically in urban areas since ancient times. Fire districts permitting the construction of wooden buildings in some areas but not others were established at an early dates in many cities. Colonial villages in early American settlements banned the manufacture and storage of gunpowder from their built-up residential and business sections for fire protection and public safety reasons. Massachusetts had a law in 1692 that authorized certain towns to assign places considered least offensive for location of stillhouses and the currying of leather.

Zoning regulations were adopted in several California cities during the late 1800s, often as a means of restricting the location of Chinese laundries (which frequently were regarded as fire hazards, because of their flimsy construction, and as public nuisances, because of their practice of dumping washwater onto the streets). Police power measures also were adopted in several cities to protect residential neighborhoods from undesired environmental uses, such as slaughterhouses, brick kilns, dairies, livery stables, stone crushers, and carpet beating establishments.

Principal emphasis with the early examples of zoning was placed on public safety and control of nuisances. The nation's first use of zoning to give direction to land use came in 1904 when Massachusetts established two maximum building-height districts in Boston, MA. New York City (NY) adopted the nation's first comprehensive zoning ordinance a dozen years later in 1916. This ordinance had its beginning with the appointment of a Commission on Heights of Buildings in 1910 to investigate the impact of skyscrapers on community health and safety. A recommendation for regulations to control the height, bulk, and use of buildings in different parts of the city followed. Legislative approval was secured to permit the use of district regulations; and a special commission was appointed to prepare a districting resolution and map.

New York City provided a glaring, but typical example of the need for land use regulations at that time. As Edward M. Bassett (Zoning, p. 9, 1940) has reported:

> *"A building could legally rise to any height whatever, assume any form, be put to any use, and cover 100 percent of the lot from the ground to the sky. Tenement houses were the only structures that might not cover the whole lot. High office buildings not only covered their entire lots and had the same floor space on their top stories and their first stories, but cornices projected into the street from eight to fourteen feet. Buildings of this sort in the southern part of Manhattan made dark canyons of narrow streets, but what was perhaps even more harmful they produced chaotic building conditions. The first skyscraper to be erected in a block would cover the entire lot up to the roof and open its windows on neighboring lots. A high building so erected prevented other similar buildings in its immediate vicinity . . . [and thus] obtained a virtual monopoly of the light and air.*
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> *. . . Improper uses caused injury to homogeneous areas and were especially productive of premature depreciation of settled localities. One-family, detached home districts, possessing trees and lawns, were invaded by apartment houses occupying nearly their entire lots. These in turn were damaged by the building of stores, garages, and factories.*
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> *. . . Invasion of apartment houses by stores on their ground floors lessened the desirability of neighboring apartment houses, because of the increase of noise, vehicles, fire hazard, litter, and street congestion. Business streets lined with retail stores were invaded by factories, garages, and junk shops. Localities devoted to light industry, perhaps employing women and children were invaded by heavy industries producing noise, smoke, and fumes. No land owner in any part of the city could erect a building of any sort with assurance that in 10 or 20 years the building would not be obsolete by reason of an unnecessary and undesirable change in the character of the neighborhood."*

With this situation, it was obvious that the public welfare called for some system of regulations that would control the height, areas, and use of buildings and stabilize the land use patterns found throughout the city. Land and building-use regulations were suggested as appropriate means for achieving these ends. The use districting (later called zoning) regulations provided for height and area restrictions on new building construction and for reserving some areas for single-family dwellings; some for multifamily housing; and others for commercial, industrial, and other uses.

Questions were raised at this point concerning the constitutionality of the proposed regulations. Comprehensive zoning was a new thing; many lawyers were uncertain about the legality of its proposed use; and some argued that zoning called for a taking of property for public use that could best be accomplished through exercise of the eminent domain power. This alternative was rejected, because of 1) the high cost and "clumsy and ineffective" nature of the eminent domain approach; 2) the conviction that effective zoning could not be accomplished in this way; and 3) a feeling that there was more than an even chance that the courts would uphold comprehensive zoning as a legal use of police power.

A full decade passed following the adoption of the New York City ordinance before the legality of comprehensive zoning was finally established by the courts. During this decade, provisions were made for zoning in 43 states, plus the District of Columbia; zoning ordinances were enacted in some 420 municipalities; and several decisions, mostly upholding but some rejecting the constitutionality of zoning, were rendered by state courts.

The constitutionality issue was settled by the Supreme Court in Village of Euclid v. Ambler Realty Company (272 U.S. 365, 1926). In his majority opinion, Justice Sutherland observed that:

> *"The line which separates . . . the legitimate from the illegitimate assumption of [the police] power is not capable of precise delimitation. It varies with circumstances and conditions. A regulatory zoning ordinance, which would be clearly valid as applied to great cities, might be clearly invalid as applied to rural communities . . . A nuisance may be merely a right thing in the wrong place—like a pig in the parlor instead of the barnyard. If the validity of the legislative classification for zoning purposes be fairly debatable, the legislative judgment must be allowed to control . . . There is no serious difference of opinion in respect to the validity laws and regulations fixing the height of buildings within reasonable limits, the character of materials and methods of construction, and the adjoining area, which must be left open, in order to minimize the*

danger of fire or collapse, the evils of overcrowding and the like, and excluding from residential sections offensive trades, industries and structures likely to create nuisances."

Justice Sutherland indicated that the police power could be used to exclude industries "which are neither offensive nor dangerous" from designated areas. The real question as he saw it, involved "the validity of what is really the crux of the more recent zoning legislation, namely the creation and maintenance of residential districts, from which business and trade of every sort, including hotels and apartment houses, are excluded." After reviewing the impact of these establishments on fire, traffic, and noise conditions and their parasitic effect in destroying "the residential character of the neighborhood and its desirability as a place of detached residences," he concluded that "apartment houses, which in a different environment would not be entirely objectionable but highly desirable, come very near being nuisances."

Much of the dicta in his decision is phrased in terms of the law of nuisances. But the Court indicated that zoning can be used for a broader purpose than merely the control of nuisances. With its endorsement of this view, the Supreme Court opened the door for wide scale use of zoning as a tool for the effectuation of land-use planning.

The Zoning Process

The adoption of New York's comprehensive zoning ordinance in 1916 prompted several cities to adopt similar ordinances under their home-rule powers. These efforts were rejected by some courts that held that exercise of the zoning power called for specific state authorization. Appropriate enabling legislation was thus recognized as the first step in the zoning process. Laws, based on the model recommended by an Advisory Committee on Zoning that Secretary of Commerce Herbert Hoover appointed in 1921 to draft a standard zoning enabling act, were soon passed in most states. By mid-century every state had authorized zoning. Authority was also granted in many states for county and township zoning.

The details of the zoning process vary from state to state. As zoning should be seen as a means for carrying out the provisions of a city or community master plan, preparation of the zoning ordinance should logically follow preparation of a master plan. An independent planning commission, appointed usually by the elected legislative body, prepares the master plan and a draft of the zoning ordinance. In communities that do not have a planning commission and a master plan, the draft ordinance is prepared by a zoning board or zoning commission. When zoning was first adopted, however, ordinances were frequently formulated in the absence of prior planning.

Once appointed, the zoning board has responsibility for drafting a zoning ordinances and preparing a map that shows the boundaries of the districts or zones within which different regulations apply. Most ordinances now contain sections that provide 1) a statement of purposes that usually correspond closely with those listed in the enabling act; 2) general provisions, including definitions of terms, a clause prohibiting the construction or alteration of buildings or the use of land or buildings except in conformity with the provisions of the ordinance, and a recognition of the right of property owners to continue nonconforming uses; 3) a statement that identifies the classifications of districts—residential, business, industrial, agricultural, etc. and that either describes the boundaries of each district or establishes them as set forth on the zoning map; 4) a detailed description of the regulations that apply in each district; 5) provisions for special or conditional uses, such as planned unit developments; 6) provisions for administration and enforcement, arrangements for possible appeals, and a declaration that violations are misdemeanors punishable by fine or imprisonment; and 7) provisions for possible changes and amendments to the text of the ordinance or the zoning map.

After the planning commission has tentatively formulated its recommendations, it must hold public hearings at which affected property owners can voice their opinions. The commission then considers these opinions in its refinement of the proposed ordinance, map, and final report, which it submits to the local legislative body (the city or village council, township, or county board). This body is often required to advertise and hold a second set of public hearings. Following these hearings, local legislative bodies are free to debate and either accept or reject the proposed ordinances. Some enabling acts require citizen approval of ordinances by voters at a general or special election; and some provide for possible referendums on board approvals of ordinances.

Once a zoning ordinance is adopted, the planning commission has responsibility for advising the legislative body on proposed rezonings or text changes in the ordinance and for periodically reviewing the entire ordinance to ensure that it remains up to date and in tune with changing needs. While reviews and adjustments are needed from time to time, frequent changes can be a sign of poor planning or a weak and vacillating administration.

A different function is provided by the board of appeals, which is appointed following the adoption of the zoning ordinance to hear and decide on appeals made from the actions and orders of the administrative officials who enforce the zoning ordinance. This board can reverse the decisions of the enforcing officers and authorize variances and minor modifications of the rules to fit individual needs and properties with unusual characteristics.

Courts are inclined to question the legality of any zoning ordinance not adopted in strict conformance with the procedures specified in state enabling acts. Since this action is time consuming, communities have sometimes found that they could not zone fast enough to prevent imminent objectionable uses of land. Interim zoning, which permits the adoption of temporary ordinances, is authorized in many states as a means of dealing with this situation. This type of zoning can suffer from the imperfections of hastily adopted stopgap ordinances.

Zoning regulations typically prohibit uses not accepted by the ordinance, but cannot prevent continued operation of nonconforming uses that are in place at the time an ordinance is adopted. Some states authorize use of the police power to stop nonconforming uses that have significant negative impacts on abutting properties or if they constitute public nuisances, and some communities have taken steps to place time limits on their continued life or to purchase or condemn them. As a general rule, nonconforming uses can continue as long as they are not expanded or abandoned and as long as nonconforming structures are not altered, repaired, or reconstructed. They are normally regarded as established uses, which must be accepted for the time being but which will eventually be discontinued.

Zoning in Urban Areas

Zoning ordinances are now used in all but a few of the nation's large cities. As in the past, they are adopted to prevent undesired conditions, such as congestion, impacts of incompatible uses, and deterioration of neighborhood values. They are also used in a more positive sense to promote orderly development, stabilize and preserve desired land use patterns, and help carry out municipal master plans.

Four principal types of regulations are employed in the typical municipal zoning ordinance: 1) Regulations defining the uses permitted in different districts; 2) provisions concerning the size of lots and the proportions of their surface that can be covered with buildings; 3) height and bulk restrictions for buildings and other structures; and 4) population density requirements. Most municipal zoning ordinances recognize at least three classes of use districts—residential, business, and industrial—together with numerous subclasses. Additional classifications, such as highway service, recreational use, agricultural, or unrestricted may also be utilized when a city has area it wants to retain for these uses or to leave unrestricted until its future needs are more clearly defined.

Residential districts are ordinarily divided into several subclasses, such as single-family, two-family, and multi-family districts. Of these, the single-family districts are usually the most exclusive with all other uses being excluded. Provisions are usually made, however, for possible location of schools, churches, humanitarian institutions, parks, playgrounds, golf courses, and even farms in some cases. A two-family district typically allows all of the uses of a single-family district plus allowance for two-family units while multiple family districts permit all of the residential area uses.

Provisions are made in urban zoning ordinances for separate commercial zones that accommodate downtown or central business districts, local and regional shopping centers, and neighborhood stores or shops. Industrial districts may also designate areas for heavy industries, light industries, and the so-called clean industries. Apartment houses and new residential construction may be permitted in or be excluded from these areas. Special zones can also be provided for such uses as farming, open space, recreation, cemeteries, floodplains, or mobile homes.

Zoning ordinances in the past have often employed a cumulative approach that prohibited all except one specified use in the most exclusive zone (single-family housing) and then relaxed the prohibited uses one by one as they moved to each succeeding zone. With this approach, all types of housing were permitted in commercial zones and in industrial districts. This approach has not been conducive to good land use planning, as it has permitted single family residential uses to move into and preclude the planned development of areas zoned for heavy industrial or intensive commercial use. Designation of exclusive zones has been advocated as a means of avoiding this problem. Considerable attention is now being given, however, with the planning concepts of "new urbanism" and "smart growth" to the creation of livable integrated communities in which emphasis is given to walkability, resident convenience, and planned mixed uses rather than exclusive use zones.

Building-height regulations vary from city to city. A maximum height of two-and-a-half stories applies in many single and two-family residential districts. Higher structures are permitted with multiple-family, business, and industrial districts in most large cities. Building-bulk and setback regulations are used in combination with height regulations in many central business districts to prevent individual skyscrapers from infringing on the rights of other property owners for reasonable access to air and light. Building-height regulations are also applied in most areas adjacent to airports to ensure safe airplane landings and takeoffs.

Area regulations can be used to specify maximum densities of population. These regulations may limit the number of dwelling units housed per acre, require a minimum number of square feet of lot area or building space per dwelling unit, or require minimum lot sizes or frontages. Comparable area regulations may be used to prevent owners from building on more than some given proportion of their lot area; to require minimum building setback lines from the front, side, and rear of lots; to establish minimum sizes for inner or rear court areas; or to prescribe minimum off-street parking requirements.

Urban leaders have found that zoning is a flexible tool that can be applied in different ways to attain desired results. Some cities have substituted performance standards for land use-oriented regulations. These standards recognize that commercial and industrial uses of property can be compatible with adjacent land uses if they meet minimum performance standards concerning noise levels, smoke and odors, fire hazards, traffic, parking, landscaping, and generation of wastes.

Planning administrators also have found that they do not have a monopoly on good ideas about how areas should be developed. Private developers can submit innovative plans that can be implemented with relatively minor adjustments in zoning regulations to permit the development of a Lincoln Center or a United Nations plaza. Some ordinances have expanded the freedom of developers to better design their buildings by substituting floor-area and open space-area ratios and angle of light standards for more rigid requirements used in the past. Another arrangement allows developers to provide trade-offs in the form of desired open space or stricter building restrictions in other parts of a city in exchange for greater density or height allowances that permit fulfillment of their development plans.

Step or graded zoning has been used in some communities to facilitate management of expected future growth by programming the rate at which municipal improvements will be supplied. Cluster zoning has been used as a means of grouping housing developments to minimize water and sewerage costs, and optimize the reservation of open space and environmental areas. Planned unit developments (PUDs) are often permitted in which varieties of residential, commercial, and service uses can be provided for residents. Transfers of development rights and trade-offs also have been used to permit relaxation of zoning standards in some areas if developers agree to protect historical sites or sensitive environmental areas elsewhere.

The direction and control of urban land uses provided by zoning ordinances is supplemented in many communities with examples of private zoning implemented by developers and homeowner associations. A developer of a residential neighborhood, for example, can use deed restrictions and covenants with the lots sold to specify their permitted future use, set standards affecting the location and minimum size of houses built, and even require architectural approval of residential building plans.

Subdivision regulations. Although they are usually regarded as being separate from zoning, subdivision regulations involve a comparable use of the police power that local governments can use to direct the uses made of urban lands. Like zoning, legislative authorization is needed for their use. They differ from zoning though in that they give communities an opportunity to lay out rules concerning the size, shape, and configuration of lots before the conversion process takes place.

Subdivision controls are used to prevent developments in areas regarded as unhealthful, because of flood hazards, improper drainage, or other problems. They may require that subdividers conform to an overall street plan, provide right-angle intersections with through streets, or avoid jogging street connections. Minimum construction standards, maximum grades and definite widths are usually specified for streets and street rights of way. Lots of minimum size and depth are usually required. Regulations or administrative guidelines can also be used to discourage plats involving a single row of long, narrow, "rifle range" lots along an existing road, blocks of insufficient width to permit two rows of lots, dead-end streets that are more than 500 feet in length, or long blocks with infrequent cross-street connections to parallel streets.

Most subdivision regulations require that new subdivisions be surveyed by licensed surveyors, that plat maps be prepared to show the location and boundaries of every lot and the location of streets and other areas dedicated to public use, that the subdivision plat be approved by certain officials, and that it be officially registered. Plats must usually be approved by the local planning authorities and legislative body. Dedications of land for streets must be approved by the appropriate road authorities. Plats must be approved by county boards of health when lots are served by septic systems. Subdividers are often required to provide a complete water supply or water main connections to a municipal system if that is available. Sanitary and storm sewers must then be provided, and developers may be required to pave streets, provide sidewalks, street lamps, and plant trees along new streets. They may also be required to dedicate areas for parks or playgrounds. Cities usually control only those subdivisions located within their boundaries. Some states, however, give them extraterritorial rights to regulate subdivisions for varying distances outside their city limits.

Rural Zoning

Until recently, zoning has had somewhat less appeal and less application in rural areas than in cities, mainly because the land use pressures that give rise to demands for zoning have been less acute in these areas. But as cities have grown in size, their problems have spilled over into rural areas, and demands have emerged for the enactment of zoning ordinances. Most states now authorize rural jurisdictions to zone and Hawaii has gone farther to authorize a statewide system of land classification and districting that amounts to state zoning.

Two distinctly different types of rural zoning are now in use. Numerous counties and townships use a suburban type of comprehensive zoning that involves regulations very similar to those used in cities. Wisconsin pioneered this type of zoning with an enabling act in 1923, which authorizes application of comprehensive zoning measures. This type of zoning is popular in the suburban spillover areas around large cities. It differs little from city ordinances except that provisions are more frequently made for agricultural, forest, and recreation district uses.

A second type of zoning known as open-country zoning was also pioneered in Wisconsin when the state amended its county zoning authorization in 1929 to allow local governments to use zoning ordinances to "regulate, restrict, and determine the areas in which agriculture, forestry, and recreation may be conducted." The first open-country zoning ordinance was adopted in Oneida County, WI, in northern Wisconsin in 1933, largely as a means of preventing depression displaced city workers from moving back to cutover rural locations where they could place costly demands on local governments for the provision of public services. Numerous other counties, mostly in the northern Lake States, adopted similar rural zoning ordinances and soon found that rural zoning could be used both to prevent undesirable land uses and to lower the costs of local government.

The prospect of using zoning was viewed with considerable suspicion by numerous rural landowners at first. With passing time it has become more acceptable as more and more local residents have recognized that while it limits the rights of owners to do whatever they like with their land, it also protects them from the adverse actions of others and that it can help shape the futures of their communities. They have found that rural zoning can be used to save open space, keep farmland in agricultural use, prevent human residence in floodplain areas, control roadside environments, enhance community values, and prevent the rise of rural slums.

Rural zoning ordinances have sometimes specified minimum lot sizes of five or 10 acres as a means for protecting farm and open space areas from suburban development. These limits have usually been too low to achieve the intended results. Instead of preventing suburbanization, they have often contributed to the wasteful use of once open space areas. Other problems associated with the movement of exurbanites to rural areas have followed as families that have moved to enjoy the solitude of rural life have begun to demand facilities, such as urban water and sewer systems, that they had enjoyed in cities. They have also raised objections to the noise, odors, slow movement of farm equipment and drifting of dust and pesticides that come with farming operations. Right to farm laws have been passed to protect farmers from these complaints. Truly effective zoning for farmland protection, however, calls for 1) retention of large contiguous areas, perhaps as much as 50,000 acres or more, that are large enough to justify the continued operation of farm support businesses; and 2) provisions that establish exclusive agricultural zones.

Problems with Zoning

The power to zone can be and sometimes is abused. Cities on occasion have used it as a substitute for planning when it should have been treated as a tool for implementing a carefully designed master plan. With its proper use courts are inclined to accept a broad concept of zoning as long it involves reasonable regulations that protect or promote the public health, safety, morals, comfort, convenience, or welfare. But they have taken a strong stand against improper uses of zoning. They have objected to spot zoning and to the use of zoning for racial- and economic-class-segregation purposes. They have usually agreed that zoning cannot be used retroactively to prohibit already existing uses. And they have held that, though aesthetic factors, such as scenic beauty or architectural uniformity can be considered, zoning cannot be justified on aesthetic grounds alone.

Some zoning ordinances have been voided by courts as arbitrary and unreasonable for 1) excluding uses not regarded as nuisances; 2) providing use regulations that create monopoly rights for a few property owners; 3) restricting land areas to uses for which they are not suited; 4) creating small island districts that are more restricted than the properties around them; 5) excluding uses that are incidental to permitted uses and that do not conflict with the purposes of the zoning plan; and 6) permitting unfair or discriminatory administrative practices.

Most of our experience with zoning can be characterized as successful and desirable. On the discord side, many communities have learned to their regret that the decision to zone can be postponed too long if they hesitate to act until undesired situations arise. Some have zoned too little or too much land for particular purposes. Some have abused the concept of zoning by using it to freeze existing situations without really trying to plan for the best future use of their land resources. Many have seen the stability suggested by their ordinances whittled away as local officials have failed to take firm stands against demands for rezoning, variances and exceptions. And some have allowed special-interest groups to use or change zoning ordinances for selfish purposes.

Communities often face serious problems in keeping their zoning ordinances up to date and in tune with changing conditions. Zoning ordinances tend to be relatively fixed and inflexible. They lack built-in mechanisms for adjusting to changing conditions and the needs of a dynamic society. Attempts have been made to itemize all permitted and excluded uses, but these lists have often failed to allow for the unexpected. In facing up to this problem many communities have found that a periodic, perhaps once every five or 10 years, reexamination and reappraisal of their zoning ordinances provides a viable approach for keeping them up to date.

A review of the nation's experience with zoning shows that considerable progress has been realized in getting communities to use zoning more as a positive tool for securing better land use than just as a means for preventing undesired land uses. Continued emphasis should be given to using it as a feature of larger programs for securing optimum use of area resources. As this objective is pursued, it must be remembered that there is no magic in either planning or zoning. There have been numerous cases of good planning and also some that can best be characterized as inadequate or incompetent. It is not enough that zoning be tied to once and for all time land use plans. For optimum results, it must be tied to comprehensive, realistic area planning efforts that are geared to thorough and continuing analyses of a community's ore region’s resources, goals, and potentialities.

Equity issues with zoning. Zoning decisions can easily provide windfalls for some owners while wipeouts are suffered by others. Regrettable as this situation may be, it is little different than the case would be without zoning. With a prospect of winning, developers frequently request the rezoning of selected areas to more intensive uses and loud protests are heard if areas are down-zoned for less intensive purposes. There is nothing wrong with this, as individual operators are expected to seek opportunities for increasing their potential incomes. Questions can logically be asked, however, if zoning is fair. Why should owners of sites in the green area of a zoning map be awarded opportunities for future land income and values denied to owners of properties in the gray areas?

The fact that zoning specifies that some areas can be used for high value purposes while others cannot is seen by many disadvantaged operators as an unfair taking of what might otherwise be a property right. They argue that compensation should be paid under eminent domain for the taken rights, and in some cases that no taking should be permitted. As James C. Hite (Room and Situation: The Political Economy of Land-Use Policy, p. 29, 1979) has noted, proponents of a liberal view on takings argue that "ownership of property historically has never implied complete and unencumbered control over assets." The nation's courts were generally inclined to accept a liberal view of this issue during the middle 1900s (Bosselman et al., 1973). Many courts have since shown more inclination to question the legality of takings (Callies, 2000).

Another aspect of the equity issue arises with the planning of developments in hitherto open space areas. With this situation, every owner of a potential building site shares an equal chance with every other owner of having his or her site picked for a green area use. Questions about the fairness of a system that provides opportunities for some owners benefiting more than others may logically be raised. It is an old issue, however, that can be raised equally well in retrospect with reviews of past developments in which land use decisions were made by private operators motivated by self-interests.

The equity problem is one we will probably have to live with. Suggestions have been advanced for possible solutions. One solution calls for assigning a scale of development credits for different expected land uses, giving every owner of an area unit an equal number of development credits, and requiring developers to purchase the needed number of credits before they undertake developments. Proposals of this order can call for legal transfers of development rights from one property to another and, where workable, can provide an effective way for dealing with the equity issue (Hagman and Misczynski, 1977). Another version of this approach occurs, as will be discussed later, when cities allow developers to offset desired permission for building higher or larger structures than zoning ordinances permit in exchange for desired gifts of open space or building space in other parts of a city.

A common, but often ignored, aspect of the zoning equity issue is the problem of what to do with locally unwanted land uses (LULU's) (Popper, 1981). Courts have held that cities must make provisions in their comprehensive plans for the location of all legitimate land uses. Urban residents may wish that they could zone out uses that create noise, odor, or traffic congestion problems. They may want to rule out use of land within their boundaries for industries, new and used car lots, mobile home parks, and similar uses; but courts have held that designated space must be found for these uses if a demand for such sites exists.

A more complicated issue involves the question of where necessary but often locally unwanted uses, such as power plants, sewerage disposal plants, prisons, half way houses, homeless shelters, hospitals, and cemeteries should be located. Many people prefer not living near them and feel that lower property values are associated with their presence. "Not in my back yard (NIMBY)," is a frequent reaction when proposals are made for locating or relocating them in new neighborhoods. Officials prefer not to make unpopular decisions. Yet these are essential land uses that must be located somewhere, which means that some property owners suffer the consequences.

City officials often find it least upsetting to leave LULUs where they are. New developments and expansions of existing developments are often located in areas of low property values and can sometimes be located on new land outside city limits. Families that can afford to move away from these areas often do and in so doing leave the areas to become centers for low rent housing and possibly urban decay. Choice of low value areas in cities for the location of LULUs represents what many people feel is economic discrimination against the poor. The one trade-off that may result is that those families that are willing to accept the lack of amenities associated with living in these areas, and those that cannot afford to live in more costly areas, can benefit by paying lower rents and taxes. An additional trade-off could provide these areas with counterbalancing amenities, such as parks and playgrounds.

Area Renewal

Continuing change is a feature we expect with the unfolding of nature's flow of environmental gifts. Every day brings a new sunrise. Some plants go through their growth cycle from germination to maturity in a few short weeks while others, like the giant sequoias, live hundreds of years. Creatures have normal life spans ranging from a few days with some insects to decades in the case of elephants and man. Many of the changes we experience with nature come in predictable order as do the changing seasons. A different situation exists with man-made improvements. When forests are cleared to provide farms, or when we place urban improvements on bare land, it is often assumed that our developments will go on unchanged for generations. Yet we know this is not true. Farm fields over time may revert to forests or they may shift to urban sites. Buildings in cities may be replaced within a few months or years by bigger and more elaborate establishments or, if not properly maintained, may deteriorate and soon show signs of urban decay. The process of reclaiming already developed areas for redevelopment involves area renewal.

Area renewal is involved when conscious efforts are expended to upgrade the use of properties by renovation measures or by complete replacement of their man-made improvements. It is a process most often associated with urban neighborhoods but can affect rural areas as well. It may involve the action of an individual who tears down an existing structure to replace it with a bigger or newer one. It often involves the activities of developers who acquire whole neighborhoods of older structures to provide space for new developments, such as a Lincoln Center. Governments also have used the approach to acquire, clear, redesign, and redevelop large areas in cities.

Area renewal has been going on for thousands of years. It was the process Sir Christopher Wren used when he redesigned London after its great fire of 1666. It was the process Baron Hausmann employed when he transformed the center of Paris in the 1850s and 60s to make it the beautiful city it is. It is the process many governments have used to assemble lands for military installations. And it is the process several European cities used as they cleared and redesigned areas devastated by bombing during World War II. But little thought was given to its possible use as a means for rebuilding older and worn out areas in America's cities until the 1940s.

Urban Renewal in the United States

It is a common observation that the quality of the residential housing and associated commercial developments found in poor highly populated urban neighborhoods tends to decline as the buildings and attendant urban infrastructure ages. If properties were better built and owners followed a continuing process of repairing and renovating their properties, neighborhoods could retain and even upgrade their attractiveness. When neither of these requirements is met, properties soon show the effects of age and the quality the local living environments suffer. Larger units are subdivided to provide housing for more people and needed maintenance goes unheeded. Individual owners or tenants who could stem the tide are reluctant to provide improvements if their neighbors do not. When they see no prospect of change they give up hope and move to other areas. Only the poor who cannot afford better quarters remain, and the deterioration process continues as what were once wholesome neighborhoods become slums.

After two decades of depression and war, most of America's large cities had neighborhoods that showed signs of neglect, where crime and congestion were common problems, where buildings were old, often unsanitary, constituted fire hazards, and where residents lacked much incentive to conduct programs of repair and modernization. Congress recognized this problem and the need to assist cities in carrying on urban renewal and environmental improvement programs by passing the Housing Act of 1949. Matching funds were provided to help cities identify areas needing renewal, relocate their residents, acquire sites and demolish structures, provide new urban infrastructure, plan redevelopments, and sell the cleared properties to private developers for the anticipated new developments. This ambitious program continued with some modifications for the next 25 years during which good results were reported in numerous cities. Pittsburgh's Golden Triangle was considered a shining example.

Successful though it was in many cases, urban renewal had its problems and some major disappointments. Critics argued that local officials were hampered by federal restrictions, that viable neighborhoods were sometimes destroyed, that insufficient places were found to which poor residents could move, sometimes there were no buyers ready to redevelop the cleared sites, and it was charged that some buyers benefited more than they should from the programs. Congress met these problems by passing a new Housing Act in 1974. Prior to that act the U.S. Department of Housing and Urban Development made category grants to cities for specific purposes, such as urban renewal, model cities, water and sewer facilities, and code enforcement, each grant being subject to federal regulations and oversight. The new law shifted emphasis to a new community development block grant (CDBG) program.

The block grant program extended the availability of federal financial assistance to smaller cities and suburban communities. Emphasis was given to community development. Communities were given more flexibility about how and for what purposes funds could be spent. Outlays for urban renewal were still possible but so too were federal assistance for small community projects, such as providing new urban parks. With assistance from the Small Business Administration, local governments could now follow a model used in Great Britain that emphasized the development of enterprise and empowerment zones. Federal aids could also be mixed with funds from other sources to secure desired local developments.

State programs also provided assistance for urban renewal efforts. A program used in some states allows local agencies to secure needed financing for their projects by using tax increment financing arrangements that allow them to borrow up to 40 years value of the difference between the property taxes paid and what is expected will be paid by the redeveloped properties.

Another arrangement, known as land banking, has been used by several cities to deal with the problem of abandoned properties (Alexander, 2005). Funds from the sale of abandoned properties are made available to communities for management of their inventories of tax foreclosed lands. Land banks are authorized to take title to abandoned properties, manage the better properties, and apply brownfield restoration measures to facilitate their return to the tax rolls. Successful use of this approach has been made in Atlanta, Cleveland, Flint, Louisville, and St. Louis.

Rural Area Renewal Programs

A program somewhat comparable to urban renewal arose in some parts of France and Germany during the early 1900s. High demand for agricultural holdings combined with inheritance practices that had led to parcellation and reparcellation of individual holdings brought a situation in which some communities had hundreds of separately owned small fragmented units. Operators lived in villages and farmed sometimes a few, sometimes 20 or more widely separated patches of land, some involving strips only two or three meters in width. Operator time was wasted in going to and from their various tracts, small sizes discouraged the use of modern farming equipment, and inefficiencies resulted from operation of contingent tracts for different uses.

A logical program for improving the situation called for reuniting the fragmented parcels and reallocating ownership rights. Area renewal brought enlargement of fields, relocation of roads and canals, and some moving of buildings. Once the ownership units were put together, arrangements were made to give owners compact holdings equal in size to what they had given up. The renewal effort provided all owners, except those who had only single tracts, with holdings of more efficient size; but few owners, of course, were ever willing to admit that they had received better lands than they had given up.

A second example of rural renewal occurred with the programs that were used to cope with the cutover forest lands problem in the northern Lake States. During the late 1800s and early 1900s, the northern portions of Michigan, Minnesota, and Wisconsin supported a thriving timber harvesting industry. Operators generally assumed that their cutover lands would shift into agricultural uses so no action was taken to reforest them. During the 1920s and 1930s, 15 million acres of mostly cutover land tax reverted to the states and counties. There was no program other than the usual tax sale procedure for getting them back on to the tax rolls or back into productive use.

With no demand for their use in agriculture, private economic interests called for clear cutting the remaining timber and abandoning the land for such use as nature might warrant. Need for protecting the economic viability of local communities called for public assumption of responsibility for getting the forests back into production. Special taxation laws were passed to facilitate long-term private management of forest holdings and action was taken to shift large areas into federal, state, and local forests that benefit from professional management. With these programs, much of the "land that nobody wanted" now has prime value for timber production and as sites for recreational and second home use.

Saving Open Space

Saving open space within and around cities is one of the principal reasons advanced for zoning. Open space, when it is found in gardens, parks, and outdoor recreation areas, provides relief from the congestion of compact cities. It has psychological and social values for urban residents. Its interspersion in urban development patterns is thus a highly regarded feature of urban land use plans.

Large open spaces, such as Central Park in New York (NY), the Mall and Rock Creek Park in Washington, D.C.; the Boston Commons (MA), Chicago's Lakefront (IL), and San Francisco's Golden Gate Park (CA), provide these cities with some of their most attractive features, but the presence of small parks and garden areas can be equally important. Unfortunately, provisions for their reservation have often been forgotten as new subdivisions have been added around central cities.

Most people like to have more open space located within walking distance of their homes than just that provided by public streets. This together with the fact that suburban growth has greatly extended the distances one must now drive to get from urban areas to open country has prompted interest in policies that hopefully will discourage losses of open space around cities and permit the creation of new open space areas within cities. Closely related to this interest is a concern about need to save farmlands from urbanized development.

Saving Farmlands

Saving farmland from potential urban development became an issue of notable concern during the late 1900s. Much of the concern stemmed from the appreciation people have for the open space views farmland provides and for the feeling of getting back to nature they can enjoy when driving through open country. Justification for this concern was further supported by fear that the nation was running out of farmland and that this might have adverse effects on future food supplies.

Those who argue for protection measures see alarm in the fact that the number of farms in the United States declined from 5.4 million in 1950 to 2.1 million in 2002 and that rural lands were shifting into urbanized uses at a rate of 50 acres a day throughout much of this period. They also note that the lands lost involve some of the nation's most productive farming areas.

Many cities started as service centers for surrounding areas of prime farm land and are now nibbling away substantial chunks of these areas as they grow in size. The fertile areas around cities are valued by developers in preference to alternative areas, because of the valued infrastructure they provide in the form of roads, power lines, telephone service, schools and other community facilities.

Developers see their activities as a normal functioning of the economic shifting of land areas from lower to higher uses. They can also point out that the area reported as cropland harvested in the United States declined from 344 million acres in 1950 to 303 million acres in 2002, that the decline in number of farms has been associated with a doubling of the size of the average farm, and that the nation has enjoyed a substantial increase in crop and livestock production.

Sentimental attachments account for much of the concern people have for saving farmland. Other logical arguments, however, can be advanced for their protection. Consumers enjoy opportunities to buy locally grown products in farmers markets. Viewing vistas of thriving farms with their crops and animals as one drives through the open country has a psychological value in reviving the ties many people have to their roots in the land. Wide distribution of cropland production also provides a measure of supply protection in the event that weather or other disasters disrupt the supplying of food products from other areas. Common sense also argues that prime farm lands should be retained in their present use if areas of lower agricultural potential value can be substituted for them at no greater cost.

The first public programs to help protect farmlands dealt with arrangements to reduce property taxes. Proximity to growing cities gives farmlands near cities higher development values than those located at greater distance. In highly populated states, such as Connecticut and New Jersey 80 percent or more of the average value of farm properties can be attributed to their developmental value for urban uses (Adelaja et al., 2009a).

Higher ratios of development to agricultural value are frequently found with properties lying next to expanding cities. When these lands are taxed on the basis of their assessed value for development, owners have little incentive to retain them in agricultural use. Owners can hardly be blamed for cashing in on their sale opportunities in situations of this order. Ownership problems can arise, however, when assessment values are increased for numerous properties when demand exists for shifting only a few to higher uses.

Use-value assessment, assessment of farm properties on the basis of their agricultural production values only, was pushed as a means of protecting farmers who wanted to continue farming from taxation pressures to sell their properties. Maryland pioneered the acceptance of use value assessment of farmland in 1956. Nearly all states followed by adopting similar measures. The typical arrangement calls for farm owners entering into contractual arrangements with the states in which they agree to keep their land in agricultural use for a period of 10 years or more during which their lands will be taxed at no more than their value for continued agricultural use. Arrangements vary from state to state and some states provide fiscal payments to local governments to compensate for losses of tax revenues. The taxing agreements usually permit owners to secure release from their contracts by paying specified penalties.

Adoption of use-value assessment was accepted by agricultural interests in many states as a much warranted achievement and is widely used as a tax saving opportunity. Experience with these laws as a farmland saving device, however, has been generally disappointing. The tax savings opportunities are often utilized on farm properties that are not under imminent pressure for being developed. Owners sometimes use the program to keep their lands at low tax levels until offers are made for their development, at which point they request release from their contracts. While the programs provide farm owners with much deserved tax relief, the lesson learned is that it takes more than the promise of a few years of tax abatement to keep farmlands in agricultural use when opportunities for shifting to higher uses exist.

Zoning has provided another technique that can be used to save farmlands as open space. Ordinances cannot forbid the shifting of farm and other open space areas to suburban or rural residential uses; but they can establish exclusive agricultural zones. Some ordinances use large minimum lot size requirements to achieve this effect. The rationale for this approach assumes that potential buyers who want a half acre lot for building a house in the country will not do so if they have to acquire substantially larger acreages. It was assumed that minimums of five or 10 acres could provide deterrents to scattered rural housing developments that often cost local governments more in demands for public services than they pay in taxes. These limits have had some effect but have not prevented buyers from building houses and leaving the unneeded extra land areas to lay idle. The result has been what some regard as a wasteful and disruptive use of rural lands. California and Oregon now require minimum lot sizes of 40 acres or more with rural zoning of lands for agricultural use, the assumption being that these minimums are large enough to make it economically viable to keep the land in agricultural use if it is suited for that purpose.

Congress passed a Farmland Protection Policy Act in 1981, which was designed to slow the shifting of farmlands into federal agency projects. Very little farmland has been saved under this law, all at a time when federal aids for highway and urban water and sewer projects and subsidies for residential mortgages have contributed to the shifting of millions of acres of farmland to suburban use. A Farmland Protection Program started in 1996, however, provides federal funds to assist state and local agencies and land trusts in their programs for purchasing development rights to farmland. The Farm Bill of 2002 granted almost a billion dollars to be spent for this purpose during the following 10 years.

A basic problem with programs designed to save farmlands springs from the fact that the objectives of these programs are often most opposed by the people they are designed to help. While there are many farm owners who want to keep their farms and the farms around them in continued agricultural use, there are thousands of others who see their farm holdings as their most valuable asset, as the personal savings accounts they can draw upon when they are ready to retire from farming. They welcome the opportunities that the higher land values associated with possible shifts to suburban uses bring. Their motive in hoping to magnify the value of their investments is understandable and is shared by investors in non-farm properties. Lack of consistency between these views complicates the problem of saving farmland from development in areas where pressures exist for its development for other uses.

Acquisition of Development Rights

Outright acquisition of development rights provides a highly effective, albeit usually more expensive, alternative to the employment of use-value assessments and other contractual arrangements for keeping farm and other lands in agricultural and open space uses. The right to develop property for other uses is one of the sticks in the bundle of property rights. It can be separated from the bundle by sale, gift, devise, or government seizure and thereafter leave holders of the other rights with no right to shift their properties to other uses.

Programs for acquiring development rights now take two forms. When they are acquired by purchase (or possible gifts), they are described as purchased development rights or PDRs and sometimes as conservation easements. When they are used to transfer rights to develop from one property to another, they are known as transferred development rights or TDRs.

Purchase of Development Rights

Purchase of Development Rights (PDRs), or conservation easements as they are also known, can be used for a variety of purposes. The National Park Service used this approach during the 1930s to acquire conservation and scenic easements that restricted the rights of owners to erect billboards or to use their land for non-natural scenic uses along the Blue Ridge Parkway and the Natchez Trace. The U.S. Fish and Wildlife Service has used it to acquire easements to protect prairie potholes and wetlands around national wildlife refuges. Private trusts, such as The Nature Conservancy, make extensive use of it as a means for acquiring areas by gift or purchase that can thereafter be retained in their natural undeveloped state.

The PDR approach for conserving open space areas has come into popular use in many states since the 1970s. The New Jersey Blueprint Commission recommended its use in 1973 as a means of saving the one million acres of farmland that remained in the state from non-farm development. Suffolk County in New York undertook a comparable program in 1974. Since then nearly every state has authorized local governments and private land trusts to undertake programs for acquiring development rights to keep open spaces and farmland in their current uses. Use of these programs has been most evident in the Northeastern States where 198,276 acres in Maryland and 224,406 acres in Pennsylvania were reported as being in PDR projects in 2002 (Farmland Preservation Report, p. 3, April 2002).

The PDR acquisition process calls for valuing land both with and without development rights. Owners are paid the difference between the two values. The process makes it possible for land owners to cash in on part of the value of their land without selling it. Ownership of the development rights then passes to the administering governmental unit or to the private land trusts that have been established in some states to handle them. Land owners retain their rights to use their lands after they sell their PDRs and can be expected to apply sound stewardship principles in their management.

Participation in PDR programs has attractions for farm owners who want their land to continue in its current use. It offers a monetary premium for giving up development rights they do not need. It provides a means for "keeping a farm in the family." If their property is located in the midst of an agricultural area of critical size, which is committed by zoning or other PDR purchases for continued agricultural use, it provides assurance that farming can continue without pressures for shifting its land base to so-called higher uses. Should owners donate their development rights or grant conservation easements, they may also qualify for federal income tax reductions in the form of credits against their adjusted taxable gross incomes.

As one might expect the cost of acquiring PDRs is much higher on an acreage basis on parcels of land located near a city's fringe than on land 100 or more miles away. With limited funds available for buying PDRs, important administrative decisions accompany the choices made. Purchase of 40 acres near a city may take all of the funds available for this use in a given time period and provide an island of open space that a few years hence will be surrounded by urban development and no longer have value for agricultural use. Expenditure of the same funds miles away may permit acquisition of the PDRs rights for large areas for which there is little prospect of pressure for development.

Purchase of Development Rights programs can play an important role in saving open space and farmland. It is pointless to speak of using them to save all open space. Most of our population now lives in cities or their suburbs and, much as they appreciate open space, large areas of land will be needed to provide them with living space for their houses, schools, businesses, and jobs. Programs for their expanded use call for careful marshalling of the funds available for purchases and also for overall planning efforts that can help direct the spread of future development. With this planning, it must be recognized that while isolated areas can be saved as parks and recreational areas, saving farm land calls for saving large contiguous blocks of farmland of sufficient size to support the continued presence of agricultural service establishments.

Transfers of Development Rights

Transfers of development rights, or TDR, provide an intriguing alternative to the use of PDRs. This system is more complicated and harder to administer than PDRs, but nevertheless has been accepted by more than 100 local governments as a logical means for protecting farm and forested areas, historic sites, scenic areas, and wetlands from more intensive development.

The successful operation of TDRs calls for careful planning and zoning of areas before they are opened for intensive development. Planners determine on the basis of their studies which tracts should be designated as "receiving areas" on which development can best take place and those which should be classified as "sending areas" where suburban development should be limited.

The receiving areas have or are expected to have public sewer, water, paved roads and other public services that can accommodate higher density or intensity of use when developers 'cash in' the purchased development rights. Sending areas are usually sensitive lands like wetlands or renewable resource areas like forest land that the community wants to preserve as open space.

Once the areas are classified, development credits are issued to the various owners on an equal value per land area unit basis, a market is opened for the sale of development credits, and prospective developers have to acquire the necessary number of credits associated with their sites before they can proceed with their developments. Owners of the development credits are free to sell them for whatever prices the market will bear.

The TDR arrangement makes it possible for all landowners to share the higher property values that will be associated with some sites within the total area and at the same time shifts part of the cost of withholding protected lands from development to owners with land holdings in the receiving areas. For the system to work equitably there must be a good real estate market in which owners can expect to find buyers for their credits if they do not choose to use them themselves. Optimum use of the publicly provided infrastructure and a minimizing of the problems that often come with suburbanization can come with fulfillment of the TDR plan. With developers paying for the credits issued to landowners, the plan can operate without dependence on public funds.

The experience of Montgomery County, MD, which is located adjacent to the District of Columbia, provides a notable example of the successful use of TDRs. Robert A. Johnston and Mary E. Madison ("From Landmarks to Landscapes, A Review of Current Practices in the Transfer of Development Rights," 1997) report that this County has preserved over 42,000 acres involving more than 6,000 transactions since the program started in 1982. The County started by downzoning 90,000 acres where permission had existed for locating one dwelling per five acres to one dwelling per 25 acres and giving owners a development credit for every five acres they owned. Developers were authorized at the same time to put one additional dwelling per acre at sites located in the receiving areas for each development credit they bought. A lively market for development credits followed and credits that had a market value of about $3,000 each when the program started were selling for $50,000 to $60,000 in 1997.

Comparable TDR arrangements are used in association with the enforcement of zoning restrictions in a number of cities to secure mutually desired results. New York City, for example, allows the use of trade-off arrangements that permit developers to add height or additional floor space per story to their buildings if they in turn can provide the city with development rights of comparable or higher value that will secure desired open space or reductions of the building rights associated with other properties. Though not yet extensively used for this purpose, TDRs offer a market-driven approach that communities can use under certain circumstances to secure desired land use developments while compensating owners for possible "wipeouts" associated with zoning.

Protection of Endangered Ecological Resources

Alongside the increasing concern society has shown since the mid-1900s for protecting open space is a parallel concern it has for protecting resources of particular ecological significance. Important among these are the concern we attach to the protection of wetlands, coastal zones, endangered wildlife species, and wilderness areas.

Wetlands

Wetlands are highly regarded today by sportsmen, because of the fish and game they harbor and by ecologists for the important role they play in helping to maintain balance in nature. Most of this respect is newly earned. Prior to the mid-1900s wetlands were generally regarded as barriers to progress, as areas that should be drained or filled to provide surface land for development. As settlers streamed westward across the American continent, they found that large areas of seemingly productive land stretching from Michigan in the north to Louisiana in the south were covered with water for a good part of every year. High priorities were soon assigned to the provision of drainage ditches to carry off excess water and levees to shield areas from possible floods.

Congress took note of the problem by passing the Swamp Land Acts of 1849 and 1850 that ceded 64 million acres of what was called swamp land to the states to facilitate their drainage. Drainage laws also were enacted in all of the humid area states. Altogether, it is estimated that the nation has only about 100 million acres of wetlands left of the approximate 217 million acres it once had.

A change in our attitudes about wetlands came when ecologists called our attention to the vital role they play in maintaining an ecological balance in nature. In addition to the values they supply as open space and as a habitat for fish and wildlife, they absorb storm waters, help to control floods, play a filtering role with pollutants and sediment, act as a carbon sink, and remove vast quantities of biological oxygen demand (BOD) from water that leaves more oxygen available for fish and wildlife.

Federal interest in wetlands protection started with provisions in the Clean Water Act Amendments of 1972 and 1977 that required the Army Corps of Engineers to review and license permits for the dredging or filling of areas of three or more acres of wetlands. Licenses can be secured but the Corps requires certification by state agencies and most states have programs that protect wetlands from development. Going farther, in 1989, the federal government adopted a policy of denying approval for any net losses in wetlands and prevents operators from dredging or filling wetlands unless they arrange to create equal or larger areas of wetlands.

Additional federal legislation supporting the protection and creation of wetlands came with the Swampbuster provisions in the Farm Bill of 1985, the Wetlands Reserve Program established by the Farm Bill of 1990, the North American Wetlands Conservation Act of 1989, the Coastal Wetlands Planning, Protection and Restoration Act of 1990, and the Conservation Reserve Enhancement Program started by the U.S. Department of Agriculture in 1996. Important wetlands protection programs also have been undertaken in several states, a notable example being the Florida Everglades where restoration efforts are expected to affect a 4,000 square mile area.

By 2002, more than a million acres were enrolled under the Department of Agriculture's Wetlands Reserve program and 368,000 acres under its CREP program. Both of these programs involve cost sharing contracts with farmers. Meanwhile, 8.5 million acres of wetlands were restored and protected for migratory birds through cost-share grants to state and local governments under the terms of the North American Wetlands Conservation Act.

Comparable wetland protection measures are much needed on the world front. Wetlands in several tropical areas, such as the flood basin of the Amazon river are currently being exploited in a manner that may well have serious ecological repercussions, including adverse effects on the world's climate. Sound ecological management in these areas calls for keeping areas wet and coupling timber harvesting operations with programs that require the restocking of cutover areas so that new growth can quickly replace the timber harvested.

Coastal Zone Management

With half of the world's peoples living within 200 kilometers of the sea, questions of how coastal waters and the adjacent shores can best be used have long been matters of public concern. Huge investments have been made in providing breakwaters, dredging harbors, and providing port facilities for promotion of ocean commerce. Comparable investments have gone for the building of dikes and seawalls to keep the ocean out and permit the development of polders for agricultural and other uses. And in today's world large investments are made to enhance recreational and residential values of shoreland areas by providing means to prevent beach erosion, water pollution, and to prevent inappropriate developments.

Recognition of the need for coastal zone protection in the United States led to the adoption of the federal Coastal Zone Management Act of 1972 and the Maritime Protection Research and Sanitation Act, also known as the Ocean Dumping Act, of 1972. It was recognized at the time that much of the responsibility for carrying on coastal zone protection programs was vested in the states. Responsibility, nevertheless, was assigned to the National Oceanic and Atmospheric Agency (NOAH) providing leadership and guidance for cooperative programs carried on by the 35 states that have coastal waters.

The Office of Ocean and Coastal Resource Management (OCRM) was established within NOAA (which also administers the National Estuarine Resource Reserve System) to work with problems that range from those of the rocky coast of Maine to the coral reefs and mangroves of Florida and from the wetlands of southern Louisiana and California's sandy beaches to the sand dunes of Lake Michigan. Program emphasis is given to such diverse issues as aquaculture, control of beach and shoreline erosion, coast hazards (hurricanes and flooding), energy and other industrial plant siting, ground point and other water pollution, marine debris, national defense considerations, ocean governance, public access, and wetland protection.

The OCRM works with several federal agencies on particular problems, such as the Soil Conservation Service on control of ground point water pollution, with the Army Corps of Engineers on control of beach erosion, and with the Federal Emergency Management Administration on response to flooding and hurricane damage, with EPA one water quality standards, and with the U.S. Park Service on the management of national seashores.

Several states have developed effective coastal zone programs that provide significant contributions to good area management. An outstanding example is provided by the California Coastal Commission that was established in 1972 to protect the marine resources of 1,100 miles of coast line, ensure the public's access to their use, and to make sure that their use for commercial, industrial, residential, and recreational purposes be properly planned. Another notable example is provided by the program administered by the Chesapeake Bay Commission in the interests of Maryland, Virginia, Pennsylvania, and the District of Columbia.

Global warming brings with it a threat of serious problems in coastal zone management. If ocean levels rise only a few feet the problems may be easily handled. Should they rise as much as 20 to 25 feet, as some writers suggest, tremendous challenges will occur as thousands of acres of lowlands will be under water or become ocean side swamps. Higher sea levels may be handled in some cases with the building of dikes and seawalls that will call for facilities to pump excess waters into the sea. With the flooding of low lands, ocean wave action can be expected to result in the building of new beaches farther inland. Rising water levels together with the damage caused by flooding and hurricanes will also bring abandonment and destruction of much of the housing and non-housing development now found along ocean shores.

Wildlife Areas

Throughout most of human history, people have often tended to treat wildlife as a contender with man for use of the earth's resources. During the hunter economy phase of civilization's growth, wild animals were seen as a major source of food supply. Dogs, cats, horses, cattle, sheep, swine, and chickens were domesticated during this period and made part of our family operations. With the shift to our present agricultural and industrial economies, a two-fold relationship developed between people and wild animals. We still looked to creatures, such as deer and ducks for food, to beaver and mink for furs, and we retained an interest and respect for elephants, lions, and tigers, while we regarded many of those species that wanted to share the produce of our gardens and fields as varmints that deserved extermination.

Our attitude about accepting coexistence with many species of wildlife has changed considerably during the last century. We are now generally more willing to accept them as necessary participants in the natural order. We want to see birds in the sky. We still place values on some of them for hunting and trapping purposes, and we place recreational and educational values on seeing many of them. But while we cherish their existence, we want to keep many species at a distance. Farmers have little love for rabbits in their gardens, foxes in their henhouses, wolves in their sheepfolds, or deer in their corn rows.

Hunters and trappers were among the first to recognize the importance of protecting our wildlife resources. They were joined later by ecologists, such as Aldo Leopold, who saw need for maintaining biodiversity in our ecological ties to nature. The Fish and Wildlife Service (FWS) was established at the federal level in 1905 and the function of managing wildlife resources was soon turned over to departments of conservation in most states.

The FWS manages the National Wildlife Refuge System, which operates 530 wildlife refuges covering 93 million acres. Several states also have wildlife protection programs. Wildlife protection is one of the multiple-purpose objectives stressed in the management of the national forests; and it also is a major concern of conservation groups, such as the National Audubon Society, the Izaak Walton League, the National Wildlife Federation, and The Nature Conservancy. The Nature Conservancy has over five million acres in nature preserves, enlists management contracts with private landowners, and purchases wildlife sites for later conveyance to state agencies.

Some of the most pertinent problems in wildlife management occur at the fringes of intensive human settlements. Small animals, such as rats, rabbits, gophers, possums, raccoons, beaver, and foxes, persist in living near human settlements and often become nuisances. Animal protection societies sometimes offer services for capturing and removing them. Larger animals, such as deer and bears, together with ducks and wild geese, have value for hunting, as well as scenic purposes and can be taken under proper licensing conditions into private ownership. New problems have emerged with the effort of ecologists to reintroduce predatory animals, such as wolves. There is little question as to the importance of the role they played in the wild in helping to maintain a balance of nature by preying on other animals. The potential hazard their reintroduction poses for cattle and sheep ranchers if they wander beyond their natural reserves is an understandable concern.

On the world scene, wildlife creatures of many sorts still roam at will over parts of Africa, Asia, and the Americas. Concerns for the protection of human lives together with a market demand for ivory and hunting trophies have brought reductions in native populations of some species. Public interest in their value for tourist observance, however, has led to the creation of large wildlife reserves and to a tightening of the rules concerning public hunting.

A major aspect of the programs to protect wildlife has come with efforts to protect endangered species. Most species of flora and fauna have remarkable abilities to propagate and perpetuate. New species or subspecies, most of them slight modifications of earlier existing species, are created every day as evolution plays its role with species regeneration. Some ecologists argue that every species should be protected. Critics might contend that examples, such as mosquitoes and smallpox, could well be eliminated. Others question the need to protect members of every variation of a species if plentiful numbers from the same seed stock remain. Regardless of the position one takes on this ticklish issue, it is known that some creatures, such as the bald eagle and the American condor, have faced the prospect of possible extinction.

Concern over the possible extinction of important species led to enactment of the Endangered Species Act in 1973. This law prohibits the willful taking by killing, hunting, harming, capturing, or collecting of any creature or plant designated as an endangered species.

Prescribed penalties involve stiff fines and possible imprisonment. The law is administered by FWS and the National Maritime Fisheries Service both of which have responsibility for identifying species of plants and animals that are threatened by extinction. Totals of 1,076 species of animals and 746 species of plants were on the national list in 2002. States also have lists of endangered species that may include species not on the national list. Once listed, species, such as the bald eagle can be removed from the list if restoration efforts warrant.

Some land and water areas are far more suited for wildlife than for human use and it is generally accepted that these areas should be protected for wildlife use. Controversy is bound to continue, however, on questions about how far mankind should go in giving up what appear to be justifiable uses of earth resources to placate the perceived survival needs of seemingly useless animal species. Should timber harvesting be curtailed and jobs lost in the Pacific Northwest, because it is argued that 2,000 acres of mature old growth timber must be withdrawn from use to protect the nest of a spotted owl? Should water use be curtailed along the Rio Grande, a river that runs almost dry during arid seasons, because a federal court has ruled that 170,000 acre-feet of water must be reserved to protect the habit of a rare silvery minnow?

Questions of this nature will continue to plague us as we seek answers concerning the extent of the resource base that must be retained for wildlife use.

Wilderness Areas

With the growth and spread of civilization, lands beyond the fringes of settlement were usually considered as wilderness. These were lands that belonged to no one, lands of mystery, because no one really knew what features they might offer. They were lands that adventurers could go into intent on exploration and lands that others visited to enjoy the solace of nature. More than a dozen decades passed before people from the first settlements along the Atlantic coast began to cross the Appalachian chain to find treasures in the lands beyond. Two centuries passed before the Lewis and Clark expedition finally crossed the continent to the Pacific. The vast wilderness of the West encompassed fertile plains and prairies, barren deserts, thick forests and rugged mountain country. The expanse seemed so large that even Thomas Jefferson thought it would take 500 years for settlement to reach the Pacific waters.

Once the tide of western settlement gathered momentum, settlements moved rapidly westward. By 1900, most of the better lands were in private ownership. The government was left with several million acres of bypassed lands that no one had wanted enough to homestead or buy. The area that was left became the nucleus for the nation's present holdings of forests, grazing, and recreation lands. As management plans were developed for these areas, environmental groups, such as the Sierra Club, lobbied for designation of some of the residual areas, often rough mountain or otherwise primitive areas, as wilderness areas that would be withheld from future disposition and from intensive use so that they might be visited by people who desired a wilderness experience.

Wilderness is defined in the Wilderness Act of 1964 as areas "where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain." An area of 34 million acres within the national forests plus 13 million acres within the national parks were assigned to the wilderness system during the 1960s. An additional 56 million acres in Alaska were added under the Alaska National Interest Lands and Conservation Act of 1980. President Clinton in effect added another 58.5 million acres to the total in 2001 when he ordered that this area within the national forests be treated as "roadless areas" that would be off limits for grazing, timber harvesting, and mining uses. Some states have also designated smaller wilderness areas on state owned lands within their borders.

The federal wilderness areas are administered by the U.S. Department of Interior. Management of these areas is geared to encouraging their limited use by wilderness lovers. Hikers are instructed to leave no non-biodegradable refuse behind them. Modern transportation vehicles and aircraft are excluded although canoes and primitive watercraft can be used in areas that have lakes and streams.

Wilderness areas and the opportunities they provide are an important amenity that is enjoyed by a small, but highly vocal, segment of society. With others, their chief value lies in awareness of the fact that there are still some small portions of the nation that have not yielded to modern development. While it is hoped that these areas can retain their wilderness status for an endless time, it must be recognized that some can shift to higher uses if valid need for shifting exists. Meanwhile, the nation has enough other land to care for its needs and can well afford to leave the wilderness areas as they are.

Chapter 18: Issues with Water Resources

"Among these treasures of our land is water—fast becoming our most valuable, most prized, most critical resource. A blessing where properly used—but it can bring devastation and ruin when left uncontrolled."

~ Dwight D. Eisenhower

Most of the world's surface is covered with water found either in its liquid form or in solid ice. Overall, the earth has plentiful supplies of fresh, as well as ocean water and the workings of the hydrologic cycle will provide a continuous flow of fresh water in the future. But the supply of fresh water is not distributed uniformly. Large areas across the globe suffer from less than adequate supplies of fresh water. Droughts and desertification pose constraints against development in these areas. Some other areas cope with problems of too much water. And almost the entire world faces menacing pollution problems that can have adverse impacts on plant and animal, as well as human lives.

Four issues in water resource management are addressed in this chapter. First emphasis is given to the productive role water plays in today's economic life and to the supply and management issues associated with its most important uses. Attention is then focused on the problem of water pollution and its control; after which consideration is given to issues that arise in dealing with too much water and the implications associated with global warming.

Uses of Water in Production

Prior to the mid-1900s, the subject of water resources was treated much as an unwanted orphan in economics. Virtually no mention of it appears in the writings of the classical economists. The term <u>water</u> is rarely mentioned in histories of economic thought. Its need has always been recognized but until recent decades it has been regarded mostly as a free good associated with the nature-given land resource.

From time immemorial, water has played a vital necessary role in normal life. It is necessary for human existence and survival. It is needed for the production of plants and animals. It has a wide variety of domestic uses; for drinking, for processing and cooking foods, and as a personal and household cleaning agent. It is used to irrigate crops; it provides a low-resistance medium on which cargo can be transported; people, towns, and industries use it to dissolve, dilute, and dispose of their wastes; it provides an attraction and a fluid resource for recreational pursuits; and it is a source of esthetic gratification for millions of people. Water also is an essential input in most productive processes where it is a necessary ingredient of some products and where it is used as a solvent, for washing purposes, and to generate needed power. Fortunately, there is usually a plentiful supply of water to care for its many uses. But when the supply is limited, it can quickly become the limiting and strategic factor around which production decisions must be made.

Household and Municipal Uses

Our most basic need for water centers in its use for drinking and other household uses. Human settlements have always called for locations that offered access to adequate supplies of potable water. Early settlers looked for locations along springs, streams or lakes. Where such sites were not available they sought sites where water could be secured from shallow wells. Dry areas where deep wells were needed were avoided, because of their cost, and because time and bother were involved if water had to be hauled from distant sites of availability. Closely related to the availability of water were the matters of reliability of supply and water quality. Wells and streams were of questionable value if they were dry for even short periods and quality was important, because people wanted cold water without disagreeable odors and flavors.

As Table 18–1 indicates, public withdrawls of water for urban residential and commercial uses accounted for 10.5 percent of the water used in the United States in 2000. These needs are like those of individual users except that they must be met on a larger scale. Most early cities were located along watercourses from which they drew their water supplies. With population growth many cities have found it necessary to reach far beyond their original sources to meet their burgeoning needs. New York City is now largely dependent on water supplies trapped and stored in the Catskill mountains, Detroit depends on water pumped from Lake Huron, San Francisco secured needed supplies by acquiring and damming the water flow in Hetch Hetchy canyon, a scenic wonder rated by some as comparable to Yosemite National Park, and Los Angles draws water from Owen valley and from the Hoover Dam on the Colorado river.

Table 18–1. Estimated Withdrawals of Water for Use, United States, 1950 and 2000 (billions of gallons per day)

	1950	2000	Share in 2000
Total Withdrawals	180	408	100%
Irrigation	89	137	33.6%
Public Uses*	14	43	10.5%
Rural Uses**	3.6	9.2	2.3%
Industrial	37	23	5.6%
Steam Electric Utilities	40	196	48%
Average Gallons per Day per Capita	1.185	1.43	

Source: U.S. Geological Survey, Estimated Use of Water in the United States, 2000.
*Municipal withdrawals for residential, commercial, and municipal uses.
**Use for farm and rural residential uses.

The water taken by private users and by cities from streams, lakes and wells was used in its untreated state for a long period before bacteriologists identified use of untreated waters as the primary cause of the cholera and other disease epidemics experienced almost every summer in many cities. Summer outbreaks of the plague, for example, were a common feature in Chicago, where municipal water supplies were pumped from Lake Michigan where the city disposed its wastes. Diversion of its wastes away from the lake in 1889 brought immediate improvements in public health conditions.

Local and state governments and Congress at the federal level took various actions during the 1800s and early 1900s to deal with quantitative aspects of water resource management. They looked for ways to provide water supplies for municipal uses and for irrigation, ways to deal with drainage and flood control issues, and ways to improve navigation. The issue of water quality was first addressed by Congress with its passage of the Water Pollution Control Act of 1948.

Stronger action followed with enactment the Federal Water Pollution Control Act, usually called the Clean Water Act of 1972, which called for restoration and maintenance of "the chemical, physical, and biological integrity of the nation's waters." Responsibility for setting water quality standards was turned over to the states. Waters were classified on the basis of quality under this law into five classes: class A includes water of suitable quality to be used for public water supplies; class B involves water suitable for bathing, swimming, irrigation, fish habitats and for public water supplies if filtrated and disinfected; class C waters are suitable for recreational use, irrigation of crops that must be cooked, habitat for fish and wildlife, and industrial uses; class D are suitable for navigation, hydroelectric power generation, and some industrial uses; and class E waters that carry untreated sewage and other pollutants and are unfit for other uses.

Congress gave special attention to the Class A waters in its Safe Drinking Water Act of 1974 (with amendments in 1986, 1988, and 1996). These laws emphasized the need for better management of municipal water supplies that, in most cases, require the installation of special water treatment facilities. Coupled with the administration of these laws is the need most growing cities have for finding additional sources of water supply. This need has been met in the past by sinking deeper wells and by creating reservoirs, a practice now opposed by many people on environmental grounds.

Governmental grants and aids have been advanced in numerous cases to help finance the costs of providing improved municipal water and sewerage treatment plants. The result has been a subsidizing of costs not passed on to users. Critics argue that the prices most consumers pay for water do not represent a true measure of its cost. Some cities, such as New York City, do not gauge the amounts of water it delivers, and those that do often have non-conservational rate structures that offer lower unit prices to consumers of larger volumes of water. Another questionable economic practice allows users who benefit from the extension of water lines to new areas to pay only the average citywide prices for the water they receive rather than the marginal costs associated with its delivery.

Transportation Uses

Water provides an ideal medium for transporting raw materials, finished goods, and people from one place to another. The fact that craft loaded with cargo can float on water, be caused to move by wind, gravity flow, paddles, or propellers and that navigable water in the oceans, lakes and streams is available for use makes it a boon for mankind. It permits a non-consumptive use or water. And water transportation provides opportunities for savings of energy and effort that would be required with transportation by land.

Billions of tons of raw materials and finished products are shipped every year in world commerce. Much of this material is shipped in huge container vessels, oil tankers, and as other freight. A considerable tonnage also is carried on barges towed by tug boats. Almost 3.5 billion tons of cargo was carried by these means in United States waterways in 2004. In addition to these shipments, large volumes of fluids and gases are transported though aqueducts, pipelines, canals and tunnels.

Prior to the development of railroads and trucks, waterborne transportation carried all but a fraction of America's products to and from market. Its importance was such that every large city in the nation owed its growth to its location along navigable waters. Railroads and trucks now carry much of the cargo load, but water borne transportation still provides a less expensive though somewhat slower means for moving a goodly portion of the nation's cargo.

Parts of Western Europe have elaborate systems of interconnecting canals that were constructed to facilitate the transportation of products years before railroads and trucks took over much of the task. America also had its period of high public interest in canal building. With the opening of the Erie Canal in 1825, the carriage cost of carrying products from Buffalo to New York City dropped from $120 to $14 a ton, an event that made it possible for western farmers to produce products for eastern markets. Congress granted 4.6 million acres in canal grants to Ohio, Indiana, Illinois, Michigan and Wisconsin between 1827 and 1856 for building canals. Ambitious building projects were launched in Maryland and Pennsylvania to permit travel west across the Appalachians to Ohio; and the biggest project of all came with the construction of the Panama Canal.

The importance of water transportation was noted in the Constitution with its vesting of control over interstate commerce with Congress. Congress quickly took over the responsibility for providing lighthouses, dredging harbors, removing barriers to water traffic, and deepening waterways. The Army Corps of Engineers administers a program for furthering the interests of commerce in ocean ports, coastal waterways and the navigable portions of the nation's rivers. It has deepened harbors, cut new channels to accommodate shipping, removed obstacles to river traffic, and deepened the channels of rivers to permit navigation farther distances upstream. Dams with locks to permit passage also have been built to hold back flood waters and to maintain river channels of navigable depth.

Problems concerning the priority given to interstate commerce arose when road builders wanted to build bridges across navigable streams. Bridges were permitted when they rose high above the sails and smoke stacks of river traffic. At lower level locations, provisions had to be made for installing drawbridges that could be opened for the passing of river traffic.

Agricultural Uses

Approximately a third of the water withdrawn from the nation's supply of fresh water is used by farmers and ranchers to irrigate crops and for watering their livestock. Some of this activity takes place in areas where the riparian doctrine governs the use of water taken from lakes and streams. This doctrine gives operators the right to use waters for a variety of uses of which consumption for household and livestock watering are the only ones that do not require return to the lake or stream of the full volume of whatever water is taken. With the modified riparian interpretation of this doctrine, some water can be diverted from streams and lakes as long as its diversion has no adverse effects on other riparian owners.

Few problems arise with diversions in riparian states under normal circumstances. Problems can arise, however, when farmers wish to divert considerable quantities of water to provide supplemental irrigation for crops during dry seasons, when opportunities exist for taking water for commercial uses elsewhere, and when diversions during dry seasons impact on the quantity and quality of the remaining supply of water left for recreational uses and environmental enjoyment. Legal issues can be raised in each of these situations; and strong opposition is normally roused by proposals that water resources be transferred for uses outside their normal watersheds.

A somewhat different situation applies with the use of water for irrigation in the more arid regions of the West where climatic conditions call for acceptance of the appropriation doctrine of water use. This doctrine with its emphasis on priorities in appropriation rights has worked reasonably well. With water often playing a limiting and strategic role in determining what operators can do, farmers frequently find it best to organize their variable inputs around their available inputs of irrigation water. Their goals in production remain the same as those of operators in less arid regions. In both cases they find it economically desirable that they push production to the points at which the marginal factor costs associated with their most fixed factor equals their marginal value products ($MFC = MVP$), the difference being that on numerous occasions it is the scarce supply of water rather than a limited land area that now becomes the fixed input factor in their analyses.

Holding back on the use of water for irrigation is not a problem when an operator has plenty of it. During dry seasons when water supplies are limited, however, operators must decide how they can put the supplies they have to maximum benefit. This means that they may choose to water their most profitable crops at the expense of the less profitable. With gravity flow irrigation, they may choose to use their water in fields of level terrain where water can flow down long rows without having to pond up in low spots to gain enough head to irrigate areas located farther from one's ditches. It may mean that they irrigate less often or that they allow water to run into fields for shorter periods of time. When operators can choose between gravity flow and spray irrigation, they may decide to invest in spraying equipment, because it can require the use of less water while providing more uniform watering of their fields.

The appropriation doctrine is applied with ground waters, as well as with surface water. Overall, its application has supplied a reasonable solution to uses of water for agricultural purposes. Problems have arisen, however, with the passage of time. Operators enjoy water use rights on a "first in time, first in use" basis. Their rights also are supposedly conditioned by the assumption that they put water to beneficial use. Observations show that while most operators use their supplies of water in a judicious manner, operators with high priorities often lack incentives for avoiding wasteful use practices. There are no built in controls in the system that require efficient use of the water resource. Depriving owners of their priority rights happens only in the most grievous cases. With an accepted rule of "use it or lose it," operators have an incentive to put their full quotas of water to uses of varying value, because it is theirs to use as they wish. This practice makes economic sense to holders of water rights. From a social point of view, however, it ignores the equimarginal concept that would limit uses to those that have the greatest overall production potential.

Early legislation passed in several states specified priorities in types of use that were to be stressed in the granting of water rights. This assignment of pecking order usually gave top preference to agricultural uses. This factor together with the rapid allocation of prior rights among agricultural users has complicated the water needs problems of urban residents, commercial and industrial developers, and municipalities that did not arrive on the scene until after most of the water was taken. A remedy for their problem lies in the right of appropriators to sell their water rights to others. This possibility has been exercised in several cases primarily by developers and municipalities that have purchased rights to secure needed water supplies for residential and other urban uses. The development of a market for buying and selling water rights, however, is complicated by rules, such as those that govern the points at which water must be taken. Some observers feel that the system of prior appropriation should be reviewed for the twin objectives of limiting use of scarce water supplies to beneficial purposes and implementing a shifting of water rights from low to higher and better uses.

The workings of the appropriation doctrine have given rise to some conflicts of interests between states concerning the waters of rivers that have their beginnings in the Rocky Mountain region and flow eastward to more humid regions. Appropriations in the west in these cases have sometimes taken much of the flow of streams before they reached more humid areas where earlier settlers had used their waters on a riparian rights basis. Another interstate problem arose with the seven states plus Mexico that share rights in use of the waters of the Colorado River. A Colorado River Compact was agreed to in 1922 under which each party was assigned a given share of the river's expected flow. Problems in administration have risen, because the parties now have larger needs than their quotas provide.

While the responsibility for dealing with water problems resides mostly with the states, the federal government has played an active role since the passage of the Reclamation Act of 1902 in providing water for agricultural and other uses. Huge dams, such as the Hoover Dam on the Colorado River and the Grand Coulee Dam in Washington, are valued primarily for the electrical power they generate; but they, and a considerable number of smaller dams throughout the 17 Western states, provide water for a network of irrigation projects. In California alone, they provide water for irrigating nine million acres of some of the nation's most intensively used farm lands.

The era of reclamation dam construction is probably over, partly because the most logical sites have already been built upon, and also because *B*/*C* problems would arise with further construction. While many projects built in the past yield dividends, some have been of questionable feasibility. A second criticism of these projects involves the subsidized pricing of the water supplied to farm irrigators. Low-cost water was available to farm operators in federal project areas in California for only the first 160 acres held in a single ownership until 1982 when the rule was for all practical purposes eliminated. Meanwhile, farmers were receiving water from the Bureau of Reclamation in 1999 for $14 per acre-foot in California's Imperial Valley, while the Metropolitan Water District of Los Angeles was paying $350 per acre for untreated water. (Field, 2000.)

Industrial Uses of Water

Hydroelectric power and other industrial uses of water accounted for around 54 percent of the 408 billion gallons of water per day that were used in the United States in 2000. The generation of hydroelectric power calls for the continuous flow of given quantities of water each day. Other industries are heavily dependent on water use but in most cases can adjust to conditions of relative scarcity.

Every industry uses water at least to some extent. It is a necessary ingredient in the final product of several goods, such as soft drinks and canned peaches. Numerous industries need it for solvent and washing purposes. It is needed for the production of steam and also for cooling purposes in power plants. And many industries are heavily dependent on it for the movement and transportation of raw materials and finished products.

The economic use of water by industries is not unlike that in agriculture. In both cases, operators try to maximize their economic returns by organizing their operations so that they move to points at which their *MFC*s equal their *MVP*s. When water resources are plentiful, operators feel free to make lavish use of it in their operations. When water supplies are curtailed, industries economize in their use of water. During short run periods they may cut back on washing and watering processes. Over time, industries have tended to locate at sites where water supplies are ample and among the least expensive of their operation costs. As scarcity problems develop, they can economize to some extent on their uses of water. Points can be reached, however, beyond which they must either find new sources of water supplies or move to places where the water they need is available.

In times past prime sites along streams were often sought as good locations for gristmills and sawmills. The early rise of industry in New England was directly associated with the availability of millpond sites that could be used to supply the power needed to drive industrial equipment. The development of steam and electric power made it possible for industries to thrive at other locations. Meanwhile, public policy has used huge water resource development projects to make some of its most notable contributions for promotion of commerce and industry. The public power generated and water resources provided for other uses by projects, such as the Hoover Dam, the Tennessee Valley Authority, and the Grand Coulee project, have had tremendous effects in stimulating economic and industrial growth in nearby areas.

Support of Fisheries

Water resources have a major use in the support they provide for commercial and sports fisheries. The basic problem that arises with their management is that of expanding, where possible, the opportunities fishers and sportsmen have for catching fish while at the same time limiting their on-going taking of the resource to its sustained yield limit.

Pursuance of this objective with fishing in inland waters has called for the designation of state agencies that can grant licenses to anglers to fish during prescribed seasons. Their licenses may also prescribe maximum sizes of catch, limitation of types of equipment used, and prohibit the catching of protected species, such as sturgeon. The same public agencies have responsibilities for planting nursery stock in public waters, conducting needed research, possibly introducing new species to local waters, controlling possible diseases and contesting invasion of local waters by unwanted species. An example of this protective responsibility is provided by the experience of the Great Lakes where the future of its domestic fishery was threatened by the invasion of the lakes by the alewife, sea lamprey, and zebra mussel following the construction of the Welland Canal that opened the lakes for international commerce. These invasions have necessitated adoption of expensive control programs needed to minimize their destructive impact on the domestic fishery.

The control of fishing in inland waters is further complicated in some states by need to consider the conflicting interests of sportsmen, commercial fishers, and Indian tribesmen who enjoy exemptions from state regulations under the terms of the cessions of Indian lands to the government. Amicable arrangements have been made to minimize these conflicts. Commercial fishing is now limited for the most part to the larger lakes. Considerable commercial activity takes place, however, on fish farms. Catfish and rainbow trout are the principal products from these farms in the U.S.

Fish farming in coastal waters also is becoming an increasingly important source of supply for Atlantic salmon and some other fish species, as well as for other maritime products, such as oysters, clams, crabs, mussels, shrimp, and lobsters. All of these products are still available as open access resources that can be harvested by anyone in ocean waters. Individual operators have found, however, that they can profit from privatization of the resource if they can fence off limited coastal waters from which use by others can be excluded, and on which they can apply intensive management practices. Operators of salmon farms, for example, have used netting to keep their fishery stock under their control and have been able to use feeding and breeding programs to produce a larger marketable product in less time than with salmon that are free to roam the ocean.

Some of the most valued species of fish, such as cod, halibut, mackerel, and tuna, are not good candidates for fish farming. Their production calls for freedom to range over the oceans. Until recent decades their supply was often regarded as unlimited. Without effective national and international controls, their fishing potential provided an excellent example of Hardin's Tragedy of the Commons. The fisheries were treated as a commons resource. No one was denied the right of entry; there was no limit on the amount of fish one might take; and every fisher saw it to his advantage to take all the fish he could.

The need for international action to protect the world's fisheries from further depletion was noted by the 1958 United Nations Conference on Living Resources of the High Seas. Later meetings were held but it was not until 1995 that agreement was reached for the use of constraints to prevent further exploitation of migratory fish stocks, such as tuna. International agreements and protocols have since spelled out several controls on commercial fishing in international waters.

The agreement on tuna has a parallel in an earlier effort to control the killing of whales. An International Whaling Commission (IWC) was established in 1946 for that purpose; but little action followed until a United Nations Conference in 1972 called for a 10-year moratorium on whale hunting. The IWC voted in 1982 to ban whaling after 1985 with three nations—Japan, Norway, and the Soviet Union—objecting.

Congress recognized the nature of the ocean fisheries problem by passing the Magnuson Fishery Conservation and Management Act in 1976. This law called for a program that would conserve the fishery and protect the interests of the nation's commercial fishing industry. Action was taken in 1977 to further extend the nation's claim of sovereignty over its coast waters from the 12 miles claimed in 1966 to 200 miles.

The National Marine Fisheries Service was established within the National Oceanic and Atmospheric Administration (NOAA) and procedures were developed for conserving and managing the fishery resource within the nation's waters. During its first years of operation its attempt to limit fishing by shortening the length of the seasons for catching specific species and by banning the use of various fishing techniques was counterbalanced by operators shifting to the use of larger ships and improved techniques that allowed them to take more fish in less time. As Tom Tietenberg has noted, these measures had "no effect on the incentive of individual fishermen to increase their share of the take" (Tietenberg, 2006).

The 10 years between 1980 and 1990 was a period of considerable technological change in the fishing industry. John M. Gates reports that Canada's fishing fleet increased its take during this period "by 30 percent per annum to the point that almost fifty percent more halibut could be harvested in one-tenth the time" (Gates, 2005).

Developments of this order brought calls for a tightening of fishing regulations, regulations that brought new inefficiencies. The halibut taking period, for example, was cut from the normal eight month season during the year to a single 48-hour period. As a result, a multitude of ships were present with crews that worked frantically during those two days to secure as large a catch as possible. Several crew members were injured as they tried to work without rest. Their practices also proved wasteful as crews, in their effort to save precious time, cut away and discarded twisted nets filled with fish and frequently failed to return small fish to the sea.

The NMFS changed its tactics in 1995 and shifted to the use of fishing quotas that can be bought and sold and now administers a program that allows large annual harvests, while conserving the fishery resource for long time productive use. It operates with eight regional councils, each of which is charged with the management of the fisheries in an exclusive economic zone (EEZ). The North Pacific Management Program, for instance, has been able to require permits and establish quotas for taking various species, establish seasons for their taking, and ban the use of equipment, such as drift nets. Enforcement of its regulations is provided by planes and ships manned by the Coast Guard and catches are monitored by observers both on board fishing vessels and at receiving ports.

A considerable portion of the world's fishery lies in ocean waters outside the 200 mile EEZs of individual nations. The management of many of these areas is handled by treaties and protocols negotiated by pairs and groups of nations. With world demand for fish and other marine products still increasing, the problem of managing world fisheries in ways that can provide a sustained yield of quality species will remain a challenge. Privatization measures that assign enforceable rights to individual operators for taking prescribed quotas of various species within season and subject to acceptable limitation measures offers a practicable means for dealing with the problem. Such a program cannot operate with success without the combined support of national and international agencies working together for the sustenance of the fishery resource.

Recreational Uses

Water, whether it is found along coast lines, in lakes and streams, or in a backyard swimming pool has a special value for recreational use. We enjoy our contacts with it in wading pools, frolicking in the surf, swimming, snorkeling, and gliding on its surface. In its frozen form we like building our snowmen, skiing on snow covered terrain, or skating on smooth ice. And we prize the view of water whether it is a rippling stream, placid lake, or a crashing waterfall. Most of our business activities in day to day life take place on solid land, but when it comes to enjoying the amenities of life thousands of people pay premium prices to be at places that offer a view or access to some form of water as their major attraction.

The recreation and amenity values people associate with water has a considerable effect on property values. Hundreds of urban families have second homes, mostly used only on a limited time basis, that are located along or within view of lakes or streams. Long stretches of coastal roads, like Florida's Highway A1A, are lined with multistoried condominiums and expensive homes that are located where they are rather than a half mile inland, because of their proximity to ocean beaches. Some indication of the value of water for recreational access or just for visual appreciation is found in the prices at which these properties sell. The recreational value of water, however, is hard to measure, because it is usually available as a free resource. Elaborate procedures are sometimes used to place a value on it for benefit-cost analyses.

Enhancement of the recreational opportunities associated with water use is a recognized objective of public policy at the federal, state, and local government levels. Public parks are provided at all three levels and numerous cities have constructed municipal swimming pools and water parks for the enjoyment of their residents. Specific emphasis on the recreational use and enjoyment of water resources was noted by Congress in the Wild and Scenic Rivers Act of 1968, the Clean Water Act of 1970 and its amendments of 2000, the Coastal Zone Management Act of 1972, and the Beach Environment and Coastal Health Act of 2000, and by the National Park Service's action in designating 10 national seashores.

Desalination

Until comparatively recent times, "water, water everywhere but not a drop to drink" was a haunting problem for travelers at sea. Ships had to carry enough water to care for the needs of their passengers and crew for entire voyages; stops at unusual ports were often needed to replenish supplies; and water supplies frequently became polluted and unfit to drink before new supplies could be found. Desalinization developments during World War II that permitted the processing of brackish and ocean water into potable water provided a solution to this problem both for large ships and for some ocean front communities.

Once the possibilities for desalination were demonstrated, there was immediate speculation about the fruitful future it promised for areas where fresh water was scarce or not attainable. Some observers speculated that water would be processed to irrigate the desert plains of Saudi Arabia and that coastal cities, such as Los Angeles, could soon draw their water supplies from the ocean and, thereby, relinquish their claims to waters from inland sources that could then be put to other uses.

The high hopes held at first for desalination proved disappointing. It provided a workable process that could be used on ocean liners, battle ships, in coastal resort communities and green-houses, but the cost of converting even brackish water into potable water was too high to warrant its wide scale use. Technological advances have brought a change in this situation. A World Bank report (Regional Desalination Study for the Middle East, North Africa and Central Asia, 2004) indicates that desalination costs dropped from 2.5 cents per cubic meter in 1980 to only one cent per cubic meter in 2000.

Current costs vary over a wide range depending on the salt content of the water processed, the desalinization methods used, and on how they are financed. Lowering costs has made desalinization an attractive alternative to reliance on other sources of water for municipal and other high values uses in some coastal communities in Arabia, the Caribbean, North Africa, China, and California. Costs are still too high for low-valued uses, for poor communities, and the added pumping costs make it an economically impracticable source of water supply at high elevations and at sites located far inland from the sea. Its expanded use may also be slowed, because large inputs of energy are needed in the conversion process at a time when world energy prices are more apt to rise than decline.

Control of Water Pollution

Water resources have long been used as a natural sink for carrying away family, municipal and industrial wastes. They have a much regarded ability to absorb and carry away wastes, and in the case of organic wastes regenerate their quality, that has made them a valued resource for washing bodies, appliances, buildings, and industrial products and equipment, and to carry away waste products. Since most of the grime, silt and refuse it absorbs or floats away involve biodegradable items that do not have lasting undesirable effects on water quality, streams have usually been able to carry away substantial burdens of waste, dispose of them within a few miles, and then been ready to repeat this task time and time again while on their way to the sea.

This self-restoration facility has always worked better with flowing streams than with wastes deposited in ponds or other still waters. In both cases, problems arise when the biodegradable oxygen demands (BOD) associated with water approach or exceed its capacity to deal with wastes and still regenerate its quality. The BOD problems are aggravated with thermal pollution, increases in water temperatures; but with or without heating, high BOD has adverse effects on plant life and on the algae, plankton and small fish that live in water. With still waters it gives rise to the growth of weeds, discoloring of the water, unpleasant odors, and ugly scum.

Water quality problems arise when waters are expected to care for quantities of wastes that tax their resource cleansing capacities. Streams that could easily absorb the wastes of a few families living along their banks can be horribly polluted when the wastes of entire cities are discharged into them. More serious issues occur when water supplies are contaminated by the presence of bacteria and viruses that cause water borne diseases and when they contain chemicals and non-biodegradable wastes that are harmful to human health. Problems of this nature have made pollution control and the provision of safe drinking water a prime matter of public health concern.

Tools for Controlling Pollution

Widespread agreement exists on the need for controlling the pollution of our water, air, and surface land resources. Attitudes about what should be done, however, have changed with passing time. As villages became cities, the mounting problem of disposing of sanitary and household wastes brought provision of public sewers and waste disposal systems. But the problem of dealing with other pollutants was ordinarily left to the private sector to police. Pollution was accepted a necessary aspect of doing business and tolerated as an inconvenience caused by people living together.

This situation changed during the mid-1900s as more and more people started to see further pollution as a threat to public health and as a cause of environmental degradation. Action programs were demanded to care for these problems and attention was focused on possible uses of government regulations to secure effective control of the water pollution problem.

Alternative approaches could be used for this purpose. At one extreme, governments could choose to do nothing, which was clearly no longer an acceptable alternative. At the other extreme, they could declare pollution illegal and provide that polluters be persecuted and fined or sent to prison. Declarations were made that certain given practices, such as the discharging of untreated household and industrial wastes into streams, could no longer be tolerated. With many others it was recognized that complete elimination of pollution was impossible if operators were to provide for the needed uses of society.

It was also recognized that while attempts to secure elimination of 60 percent of the pollution associated with the production a given product might be attained at a reasonable cost, efforts to eliminate 98 percent of the pollution could entail prohibitive costs. This situation called for the careful determination and setting of workable standards for the levels of pollution that could be allowed with the processing of different substances.

The establishment of standards always involves a compromise between no pollution and the amounts of pollution accepted in past production. At any given time, they should reflect evaluations of how high standards can be set in light of current pollution control technology. In an economic sense, setting standards involves determinations of the levels of acceptable pollution at which social benefits can be assumed to equal social costs. In practical terms they indicate, or should indicate, the levels of pollution society is willing to accept and still get what it wants in production.

Once the standards for allowable pollution are established, choices must be made between alternative means for securing the pollution control goals. Four different approaches have been considered. Pollution rights could be sold to producers. Subsidies could be paid to operators to reduce pollution. Environmental taxes could be used to give operators an incentive for reducing pollution, and tradable permits to pollute can be issued to operators.

The first two of these alternatives are usually rejected. Sale of pollution rights would provide buyers with fee simple ownership rights over which governments probably should retain considerable control, and which governments would find difficult to limit should improved pollution control technology become available. It might also discriminate against late comers and the less financially able operators by giving competitors, who are currently able to raise the capital needed to buy large blocks of rights, opportunities to exercise monopoly privileges.

Payment of subsidies to operators for reducing their pollution levels would represent another example of public use of the carrot approach to secure program compliance. Use of the approach in this case is opposed, because it could prove costly to governments, and because it would involve paying operators to do what many people feel they should be doing voluntarily.

Use of environmental taxes, also known as Pigovian taxes (named for Arthur Pigou, the economist who proposed them) and as carbon taxes, because they are most generally advocated as a means for controlling emissions of carbon dioxide, has been widely advocated as a pollution control device. With this approach, taxes would be levied on pollution-causing operations and add enough to the market prices of their products to bring significant reductions in market demand for the products. Levying the tax and the consequent shrinking of the size of the market for their product would send messages to producers that they should adopt improved pollution control technologies, which would allow them to operate with lower taxes and less pollution (Harris and Codur, 2008).

Pigovian taxes are more often associated with the control of air pollution than water pollution although they can be applied with the use of either resource. With the limited use that has been made of them for environmental protection purposes, little is known about how high tax rates would have to rise before the desired levels of pollution control could be reached. With the use of gasoline for motor travel, for example, would a tax of 50 cents a gallon or even $5.00 a gallon be enough to cause users to turn away from its current use to the substitution of non-polluting alternatives?

Another problem concerns the timing of the tax's impact on operators. Levying the tax would find taxpayers operating with equipment and facilities of varying levels of technological efficiency. Some, who are ready to replace obsolete facilities, may be ready to shift to use of the newest technologically efficient equipment while others would need added use time to justify their investments in equipment. A partial solution to this problem can be provided if provisions are made at the time the tax is levied to start with a modest tax rate in the first year that will be raised in each succeeding year until the rate is high enough to accomplish its objective. Environmental taxes are in use in many jurisdictions at the present time, but mostly involve low rates of taxation to provide revenue for specific purposes, such as highway maintenance and repairs.

Issuance of tradable permits or licenses that prescribe ongoing rights to conduct pollution causing industries provides the principal means used in the United States to control water and air pollution. The operation of these programs is described in the next chapter. Another technique, the required posting of performance bonds, has its place in regulation arrangements when polluting industries have a potential for causing problems that may require expensive cleanup operations should individual operators go out of business.

Pollution Control Legislation

Pollution control was an area of responsibility left to the states and they for the most part did nothing about it until the last half of the 1900s when the relationship between water pollution and public health came front and center as an issue that could no longer be ignored. Early state legislation was limited to a few matters, such as disposal of municipal sewerage, and the only action taken by Congress was a provision in the Rivers and Harbors Act of 1898 that limited the dumping of refuse and other wastes in navigable waters.

The real beginning of public action to control water pollution in the United States came with the enactment of the Federal Water Pollution Act of 1948. This act and its amendments in 1956 and 1961 provided for technical assistance to agencies working on water pollution issues, for grants to the states, and for construction grants for municipal waste treatment facilities. Pollution abatement was treated primarily as a public health problem; and since the power to control water resources is regarded as a power reserved to the states by the Constitution, actual enforcement of the pollution abatement orders was left to the states, though provision was made for some federal back up enforcement authority.

A second phase followed with the passage of the Water Quality Act of 1965. This act provided for the establishment of ambient water quality standards for interstate and intrastate waters. The states were called upon to develop water quality standards for interstate waters that, after review, could be accepted by the secretary of the Department of Interior as federal standards. Primary responsibility for enforcing the standards was again left to the states; but if states failed to act, the secretary was empowered to establish and enforce water quality standards for them. Water quality standards were soon established for all states.

Congress moved farther with its control authority with the passage of the Clean Water Act of 1972. Emphasis was now shifted from mere provision of ambient water quality standards to the prescription of waste discharge requirements. Municipal waste treatments plants were required to provide secondary treatment of wastes by 1977 and to adopt the "best practicable waste treatment technology" by 1983. The program sought early elimination of discharges of wastes into navigable waters. Distinction was made between "point" sources of pollution, such as that caused by industries, feedlots, and municipal waste treatment plants, to which the most stringent regulations applied, and "nonpoint" pollution from sources, such as farms and golf courses that were also subject to regulation.

Implementation of the federally prescribed programs was left to the states. Pollution control agencies were established in every state to effectuate and enforce the quality standards; but while they always acted with state authority, their actions were always subject to compliance with federal guidelines and back up enforcement authority. The states have displayed willingness in carrying out their pollution control programs and have resorted when necessary to use of court orders and the levying of fines to secure compliance with their regulations.

Much of the responsibility for providing leadership and guidance for the control of water pollution was assumed by the Environmental Protection Agency (EPA), which was established with the enactment of the National Environmental Protection Act of 1970. This agency soon found that its initial goal of securing zero levels of pollution was economically infeasible and physically unattainable. Recognizing this difficulty, the EPA chose to establish emission standards for different sources of pollutants. Differences were allowed between categories of pollutants, but uniform standards were applied to all sources of pollution within categories. These standards were challenged in the courts as soon as they were issued. Modifications and refinements followed. The EPA then shifted its emphasis to controlling toxic pollutants. By 1980, it published emission standards for 65 classes of pollutants. Best available technology standards were prescribed for nine primary industries.

Along with the new emission standards, financial assistance was provided for upgrading community waste treatment facilities. This aid facilitated the construction and remodeling of waste disposal plants but provided no funds for their operation. The problem of dealing with toxic wastes at sites at which past haphazard disposal of toxic wastes, often through on site burial, posed health issues for local residents was addressed by the Superfund Act of 1980. It gave the EPA authority to identify hazardous waste sites, maintain a national priorities list of sites needing cleanup, and to require their cleanup. Other provisions affecting the control of water pollution were contained in the Federal Environmental Pesticide Control Act of 1972, the Marine Protection, Research and Sanctuaries Act of 1972, the Ocean Dumping Act of 1972, the Safe Drinking Water Act of 1973, the Toxic Substance Control Act of 1976, the Resource Conservation and Recovery Act of 1976, the Surface Mining Control and Reclamation Act of 1977, and the Oil Pollution Act of 1990.

First attention in the application of pollution control measures was given to the point sources of pollution. Once a measure of control was established with them, added emphasis was given to the need to reduce pollution from nonpoint sources. The principal issues with them involved reduction of sedimentation caused by soil erosion on farms, logging operations, and road building activities; reducing the quantities of chemical fertilizers and pesticides washed away from farms, lawns, and golf courses; controlling acid drainage from mines, and limiting the discharge of oil, gasoline, antifreeze, and salt from streets and other impervious areas into public waters.

Enforcement Problems

It is far easier to enact laws than it is to secure the legislative results desired. Such has been the case with water pollution control. Operators have economic and labor-saving incentives to use water to discharge their wastes if they can do so without breaking the law. Negative externalities may be involved; but when operators have used water as an inexpensive and easy means for getting rid of their wastes for several years or see that others are doing so, they have a natural inclination to resist changes that can only add to their production costs. This is the predicament in which hundreds of operators found themselves during the first few months after new pollution control regulations were instituted. Some operators resisted compliance. Others took legal action to question interpretations of regulations. In general, however, the new regulations were accepted with far less opposition than could have been expected.

A common problem in accepting new controls has been the cost of acquiring and installing new effective technology. This problem has been met, in part, for municipalities by providing them with aides that cover part of their costs. Industrial plants have problems in that they must replace existing facilities. Time is needed for these changes and recognition needs be given to the fact that they have good reasons to spread their renovation efforts over time as they retire and replace their least effective equipment first. Coupled with these problems is the need to recognize that systems designed to work effectively during normal weather may be swamped when storms cause sanitary sewers to overflow.

The critical nature of the problem of trying to maximize social benefit values by setting pollution control standards at a high level while holding down social benefit costs was illustrated by an the EPA estimate in 1972 that removal of 85 to 90 percent of the nation's industrial and municipal pollutants during the 1971–1981 decade could be accomplished at a cost of $62 billion while removal of all would cost $317 billion (Tietenberg, 2006). Zero pollution is a desirable goal, but considering the practical impossibility of attaining it, compromises must be accepted in establishing the standards at which our desire for freedom from pollution matches our willingness to pay the costs for its prevention.

Emphasis has rightfully been placed on enforcing strict emission standards involving toxic wastes, because these wastes are typically non-biodegradable, and because they pose significant threats to public health. Discharges of products, such as arsenic, cadmium, and mercury, have been demonstrated to have adverse effects in causing cancer, miscarriages, and other health problems. Decisions as to the precise levels of tolerance to be permitted with these substances should be based on medical and scientific evidence.

Failure to comply with regulations affecting water pollution can lead to arrests and court actions. Penalties ranging in the thousands of dollars per day can be assessed for non-compliance by industries under criminal law and can lead to jail terms for polluters in stringent cases. An important additional means for securing enforcement involves the common law rights of individuals and groups to seek compensation for any losses they suffer, because of the actions of others. Negligence law permits suits for damages if it can be proved that losses caused by contamination brought damages to plaintiffs.

A classic example of the successful use of a civil suit to secure damages for water pollution is provided by the case of Anderson et al. vs. Pacific Gas and Electric Co. (PG&E), which was featured in the movie "Erin Brockovich." The PG&E was held responsible in this case for discharging cancer-causing chemicals into the water supplies provided for the residents of Hinckley, CA. The case was settled with PG&E's payment of $333 million for damages in 1996.

Too Much Water

Just as resource managers sometimes deal with situations in which they have too little water, there are times and places when and where the problem has been one of protecting lives and property from an overabundance of water. Five types of situations can be identified. One involves low-lying coastal areas that have been reclaimed from the sea and are protected through careful maintenance of dikes that keep the ocean out. A second situation concerns coastal areas where hurricanes bring flooding conditions that destroy property and lives. A third situation involves the age old problem of melting snow and ice causing rivers to rise above their banks and bring excessive flows of runoff to downstream floodplain areas. Torrential rains, usually of a local nature, provide a fourth example as they provide far more water than rivers can quickly carry away; and a fifth situation arises when upstream dams break and allow devastating walls of water to flow down narrow valleys.

The Netherlands and Belgium provide notable examples of areas in which dikes were built to reclaim land from the North Sea and where after an appropriate period of leaching, the protected lands were drained and converted into productive farms. The rich polders in these areas can be maintained only through vigilant action to hold back the sea during good weather and bad and by a continuing process of pumping excess water from inside the dikes into the sea. The United States has two comparable areas, the cities of Galveston in Texas and New Orleans in Louisiana. Both cities have considerable areas that lie only slightly above if not below sea level. Keeping areas within these cities dry enough for continued habitation is a matter of environmental importance, because of their historical significance, the rich memories associated with their thriving existence, and the fact that they provide the homes and work places for significant populations. The cost of protecting these values, however, has been demonstrated by the devastating loss of lives and property that accompanied the hurricane that hit Galveston in 1900 and Hurricane Katrina that struck New Orleans in August 2005.

The high water and tsunamic conditions caused by hurricanes and by earthquakes have long provided a feared phenomenon of nature. An example of the devastating effect they can have on coastal communities was provided by a tsunami that took 365,000 lives and destroyed property worth billions of dollars when it struck the southeastern coast of Asia stretching from Sumatra and Thailand to India in December 2004. The most that people who choose to live in these areas can do to adjust to this potential threat calls for developing better systems of warning of their occurrence and facilitating possible means of escape to higher ground.

Flood Control

Floods caused by excessive rain and by excessive runoff from upstream areas have been a common occurrence throughout the world's history. Floods are expected every year along many rivers and are sometimes welcomed as was the case along the Nile where annual flooding brought water-borne sediment to the land that added to the fertility of its soil.

Notable measures have been taken in many flood prone areas in the United States to protect them from the damage of major flooding. River channels have been deepened and straightened, upstream dams have been constructed to hold back potential flood waters, and extensive levees have been built to provide protection from floods. These measures have been expensive and sometimes have been counterproductive in that they have often given local residents a false sense of security that has been destroyed when levees have broken or been overtopped by flood waters. The holding back of floods in some areas has meant that more water has flown downstream to other places where it might do flood damage. Meanwhile, the covering of roads and parking areas with impervious coating has added to the flow of possible flood waters.

Congress has addressed the flood control issue on numerous occasions, one of the more notable being the Flood Control Act of 1936, which provided that the potential benefits associated with projects must exceed their costs. Among the more recent laws are the Coastal Zone Management Act of 1972, the Flood Disaster Protection Act of 1973, the Federal Emergency Management Act (FEMA) of 1979, and the National Flood Insurance Reform Act of 1994.

The FEMA has identified those areas that can expect damage from the highest floods expected in 100 years as flood hazard areas. These areas account for 94 million acres, about seven percent of the nation's area. The concept of the 100-year flood is an arbitrary yardstick that can be used for policy direction purposes. It does not, however, offer guarantees that areas are safe from flooding. Some areas along the Mississippi river, for example, experienced their fourth 100-year flood in an eight-year period in 2001 (Grunwald, 2001).

Developments that could suffer from flooding are discouraged in flood hazard areas. Cities often recognize this factor with flood plain zoning provisions that keep residential developments out of these areas. It must be recognized, however, that flood hazard areas offer some of the nation's most attractive sites for development, that the risk of flooding may be no more than that of a once in a 20- or 30-year flood and that they involve large contiguous areas that cannot reasonably be held out of economic use. People who choose to continue operations in these flood-prone areas operate without protection from levees and similar protective programs and assume risks they should try to cushion by seeking flood insurance.

Populations that live downstream from massive dams that store reservoirs of water for power production, irrigation, flood control or other purposes usually feel safe and secure from flooding. They should be aware though that considerable loss of life and property can result should these dams give way as happened with the Johnstown, PA, flood of 1889. Protection for downstream residents in these cases calls for periodic inspection of the dams and warning systems that will alert them to the need to flee to higher ground in the event of possible flooding.

Watershed Management

Over time the myriad of water resource issues that have called for management have been dealt with mostly on an individual, neighborhood or community basis. Water resource problems have usually been treated as separate problems by separate legal entities with management authority. Experience has shown, however, that these problems are interrelated and can be treated most comprehensively when they are viewed on a complete watershed basis. While political jurisdiction districts have provided the boundaries for water resource planning efforts, it is the geographic limits of watersheds that have provided the natural limits for their extension.

Most basically, a watershed is an area of land that drains to a common point. As water moves over and through this area it doesn't recognize political boundaries, and management at the level of the watershed recognizes that cooperation is needed among a variety of political entities that have jurisdiction over various parts of the watershed, as well as people living closest to this resource. This is especially true when considering that extraction or pollution upstream directly impacts water quality and availability downstream.

The importance of watershed limits has been recognized on various occasions. The Tennessee Valley Authority was established in 1933 for coordinated resource development. The bringing together of eight states and Mexico in the Colorado Compact of 1922 harnesses their joint concerns over sharing rights to the river's water. The Great Lakes Authority, established in 1904, made it possible for governments of the seven Great Lakes states and Canada to work together in handling joint interests. Alabama, Florida, and Pennsylvania have made statewide provisions for dealing with watershed management issues. State approval for organizing watershed management programs on a more local basis has led to their establishment in several areas. Particular attention to watershed management issues is also being addressed in numerous local areas, often with soil conservation programs designed to control undue soil erosion, but also with wider concerns, including recreational uses and consideration of the healthy watershed as an environmental amenity.

Watershed management programs deal directly with the needs of plants, animals, and people to have access to water, the quality of the water they have access to, and the health of surrounding ecosystems. Separate or combined emphasis can be given to such issues as provision of water supplies, their necessary amounts and quality, to their uses, to their run-off or drainage, and to their possible pollution. It calls for recognition of the interrelatedness of issues and provides a valuable tool for resolving differences between the varied interests of upstream and downstream users.

Florida's Watershed Management Program provides an excellent example of its use. The program was established in 1999 to create a holistic ecosystem-based approach to integration of its water protection and water quality programs. Fifty-two large watershed basins were identified, after which 29 smaller groups were designated for ease of environmental protection and needed restoration. Periodic watershed evaluations are conducted within each district, impaired waters are identified for needed improvement, and action programs are collaboratively developed for implementation.

Michigan has offered grants for watershed management through the Department of Environmental Quality since 1988 via an innovative Nonpoint Source Program. It recognizes watershed planning and implementation as an iterative process that requires flexibility in planning and implementation. Education and outreach are recognized as critical to the management process and plans continually evolve as watershed stakeholders develop capacity to work together. By 2012, there were over 150 approved watershed management plans in Michigan, implemented and operating with various degrees of success, yet all seeking collaborative management by a variety of stakeholders to protect and manage this resource that flows across political boundaries.

Implications with Global Warming

It is generally conceded that the world is now experiencing the beginning phase of an era of global warming. Uncertainties associated with this phenomenon make it impossible for one to predict the precise effects it will have on our physical and biological resource base and the uses we can make of it. The workings of the hydrological cycle are such, however, that we can identify the principal effects it is likely to have on water resources.

With global warming, higher air temperatures will bring quicker melting of ice and snow and increased evaporation of water both from bodies of water and surface land areas. More evaporation will lead to higher rainfall levels that can cause flooding and more episodes of violent weather. Typhoons, hurricanes, cyclones, and cataclysmic storms can be expected to strike on more frequent occasions.

The melting of glaciers, especially in Antarctica, will bring higher ocean levels. How much higher is still a matter of speculation; but it is known that a rise of only a few feet will inundate large areas now used for agricultural, residential, and various commercial uses. Some nations, such as Bangladesh, may find most of their area under water. The rapid melting of mountain snowpacks can cause downstream flooding and lead to soil erosion and leave large areas short of the water needed during summer months for crop irrigation. Seasonal flooding and the flooding that follows torrential storms can make large areas no longer suitable for continuance of their present uses.

Just as global warming can be expected to cause extensive flooding and excessive rainfall problems in some areas; it can also be expected to aggravate desertification problems in others. Severe drought conditions, attributed by many to global warming, were experienced in Africa, Australia, and many parts of America's western and southeastern regions in 2007. With dropping ground water levels, once flowing streams becoming dribbles, and reservoirs showing sunbaked bottoms, communities in these areas face a prospect of running out of water (Gertner, 2007). The excessively dry conditions in Texas in the summer of 2011 caused so many wildfires that it became impossible to contain or even fight all of them simultaneously.

It will take some years of experience with global warming before we will know if drought conditions, such as those experienced in 2007, are a passing phenomenon or the foreboding of an arid future for some currently well-established communities. With an increase of only five degrees Fahrenheit in average temperatures, however, we can anticipate water shortages that will have devastating impacts on many local economies. Some communities may find answers to this problem by desalinating sea water. Some may benefit from the building of long canals to other watersheds. Others may simply be abandoned as their survivors move to places where more adequate supplies of potable water are available.

Chapter 19: Air and the Atmosphere

"The American people have a right to air that they and their children breathe without fear."

~ Lyndon B. Johnson

In a physical sense, air is our most important natural resource. Without air to breathe, no one could live for more than a few minutes. But air is ubiquitous. It is an open access resource. It is free; no one owns it; there is usually plenty of it; and historically there were no restrictions on rights to its use. For ages, people were aware of its need for life and of its presence in wind. Early philosophers saw it along with land, water, and fire as one of the four basic elements of nature; but no one really knew what it was until the 18th century when scientists discovered its chemical composition.

Rights to use the air resources that cling to the earth's surface as parts of its atmosphere have been accepted without question throughout most of the world's history. It has only been during the last century that governments have nationalized the rights people have in the columns of space occupied by air that rises above their properties to permit air navigation. Prescription of these rights has also made it possible for governments to license and control uses made of the electromagnetic spectrum (radio spectrum). Until recently, we have used wind to blow away smoke and foul odors and to move ships and drive windmills, but it has only been during the last two centuries that we have used it to generate electric power.

Our new uses of air have redounded greatly to our benefit. But industrial progress has also brought problems with the use of air that have potentials for becoming serious impediments to our future welfare. Four of these problems are considered in this chapter. They involve the control of air pollution, the spread of air borne wastes, the need to protect the ozone shield, and the threat of global warming.

Control of Air Pollution

Air pollution is an old problem. The crowded tenements of ancient Rome were noted for their foul odors. Edward III of England issued a royal edict in the 1300s to limit the smoke from household fires that were filling the streets of London. Colonial villages had laws that restricted slaughterhouses to sites downwind from residential areas.

Some of our most notable cases of air pollution have come from natural sources, such as the brush and forest fires of the West that burn over thousands of acres every year and the dust storms of the 1930s that carried wind-borne dust from the Great Plains of mid-America to the East Coast. Volcanic eruptions have been a major source of air pollution as they have propelled ash into the atmosphere that has sometimes darkened skies for weeks and months before falling back to earth. One such eruption in Indonesia affected climate half a world away in northern North America in 1816, the year of "no summer," when smoke filled skies screened out sunlight, lowered temperatures, and cut the growing season in northern regions too short for crops to mature.

Pollution from man-made sources became a critical issue in several American communities during the 1800s when operators of industrial plants used the atmosphere as a sink to discharge their air borne wastes. Industrial plants frequently belched forth toxic wastes that killed plant life for miles around, blistered the paint on buildings, and did untold damage to the health of local populations. When people complained, operators saw dilution as the solution for their problem and raised the height of their smokestacks to disperse their wastes over larger areas. People accepted these abuses of the environment partly because they lacked knowledge about the full extent of the damage done. Placid acceptance was also common, because pollution was part of the expected price people expected to pay for enjoyment of the benefits of industrial production.

Controls of sorts were adopted in some areas; but the isolated instances of serious air pollution were largely ignored as problems of public concern until the mid-1900s when smog was recognized as a public health problem in Southern California. Need for positive action received front page notice when smog accompanied with atmospheric inversions brought both death and illness to dozens of people in Donora, PA, in 1948 and to London, UK, in 1952.

Air Pollution Control Programs

With air resources being treated as an open-access-for-use resource and no penalties being levied for its misuse, operators have often found that it makes economic sense to use it as a convenient sink for disposal of their wastes. Pollution control in these cases calls for requirements that operators internalize the costs they might otherwise extend to others. Practical observations and experience show that this end can be attained only through the provision and acceptance of public regulations that limit the right of operators to pollute.

Programs to control air pollution are complicated, because of the complexity of the issues involved. Among the more important of these are the need for specific information, choices of attainable pollution levels, the reluctance of polluters to accept regulations, problems of deciding what to do with old factories, and facilitation of new technological developments. Since it is not realistic to assume that pollution can be reduced to a zero level, problems also exist, because industries tend to locate in close proximity to others, a situation that calls for higher levels of pollution control in these areas than would be necessary if they located at more isolated sites. Of course one of the most complex issues arises from the transboundary nature of air and the fact that all nations share this same moving resource.

Congress showed its first interest in controlling air pollution by enacting the Air Pollution Control Act of 1954. This law funded research but recognized the Constitution's reservation of the power to control to the states. California and Florida proceeded to develop air pollution control measures while most other states took no action. A second federal law, the Clean Air Act of 1963, provided grants to the states to control cross-boundary pollution. The Motor Vehicle Air Pollution Act of 1965 asserted the federal government's power to control motor vehicle emissions; and the Air Quality Act of 1967 provided more funding for state action and required that they designate air quality regions.

The first significant air pollution control action by the federal government came in 1970 with the creation of the EPA and the enactment of the Clean Air Act Amendments of that year. This act required the Environmental Protection Agency to establish primary and secondary standards for the emission of air pollutants. The EPA prescribed the standards and turned the task of enforcing them over to the states. It also designated three classes of areas to which its emission standards would apply. The Class I areas, which included national parks and wilderness areas, were designated as areas within which no deviation from the standards would be permitted. Some pollution was permitted in the Class II areas, while somewhat lower standards were permitted with the Class III areas.

Emission standards were prescribed for nitrogen oxide, sulfur oxides, carbon monoxide, lead, ozone, and particulates. Nitrogen oxide comes mainly from the exhaust fumes of motor vehicles and from factory smokestacks. It is a principal cause of smog and can combine with water vapor to form acid rain. Sulfur oxides come from the burning of coal and gasoline. They have a toxic effect that kills plants, harms lungs, erodes stone, metal, and rubber, and are a cause of acid rain. Carbon monoxide is a poisonous gas created by internal combustion machines that has a potential for killing people. Lead is a metal that, when air borne, can cause serious health problems. Its principal source was leaded gasoline which has since been mostly phased out of use. Ozone is a poisonous form of oxygen, which plays an essential role in the high atmosphere, but which can cause smog, have injurious effects on health, and have a corrosive effect on fabrics and other materials. Particulates involve the tiny bits of soot, dust, and sometimes dangerous chemicals, such as asbestos and mercury, which come from the emissions of fireplaces, smokestacks, and motor vehicles. They have adverse effects on visibility and have at times constituted a leading threat to public health.

In addition to establishing standards of allowable pollution, the EPA was empowered to halt the construction of new or modified pollution sources. It also was empowered to apply sanctions by withholding federal funds that would ordinarily go to the states as aids for waste treatment plants or highway construction if states failed to enforce the air pollution control regulations. The 1970 law also authorized the granting or licensing of pollution rights to industries and other operators with the provision that they attain the lowest achievable emission rates (LAER) and make use of the best available control technology (BACT) in their operations. Penalties, mostly in fines, were prescribed for non-compliance.

Emphasis was given at first to a command and control approach that had the EPA issuing the commands while the states were charged with their enforcement. This arrangement soon gave rise to questions about the effectiveness and efficiencies imposed by rigid enforcement. Standards for particular pollutants that seemed to be acceptable for protecting the health of the general public could be too low for some people. Standards that were quite satisfactory in rural areas were inadequate in congested urban communities. And standards, which were acceptable out-of-doors, where they were measured, could be inadequate indoors where most people lived and worked.

Another set of problems of economic consequence involved the problems industries faced in complying with the emission standards. Operators often had plants, some of which could not meet the required standards, and others that could provide surpluses of credits above the stated standards. Must they close down part of their operations? If so, did they have an incentive to pollute less with their newer plants than the EPA standards required? Could they continue to keep some of their least efficient facilities in operation as long as they could provide sufficient excesses of credits by using new facilities to meet overall compliance with the regulations?

Consideration of possible improvements in the operation of its pollution control program brought adjustments that allowed acceptance of new arrangements. The Clean Air Act Amendments of 1990 gave new responsibilities to the EPA. It was charged with setting emission standards for 189 hazardous pollutants. Earlier legislation had accepted *x* tolerable risk' as the standard. Emphasis was now shifted to standards based on “best available technology.” A successful program was launched to get companies to voluntarily reduce emissions of benzene, cadmium, mercury and 14 other toxic items. Polluters were required to acquire and pay for pollution permits and submit reports on the monitoring of their waste disposal programs to the EPA.

Emission reduction credits (ERC) representing a firm's right to emit one ton of a stated pollutant per year within its ERC's validation quota could be earned. These credits, usually earned when a firm installed new equipment or closed down earlier operations, were made available for transfer either within a multiplant firm or through external trading with other firms. Offset arrangements were expanded to allow older firms to continue emitting some pollutants in excess of standards if they could balance them with transfers of emission credits from other firms or plants. Encouragement also was provided for trading ERC units internally within multiplant firms and for external trading with others.

Another arrangement called netting allows plants to use savings from reduced emissions from different sources within their plants to offset pollution caused by other in-plant operations. An arrangement known as bubble was authorized in 1979. It allows firms to total all of their operations and treat them as a unit in meeting their emissions requirements. Still another adjustment allows firms to bank their ERCs for future use.

Considerable progress in curtailing air pollution during the 1970 to 2002 period was reported by the EPA (EPA, 2003). Aggregate emissions for the six major pollutants were down 48 percent for the 32-year period. Emissions of sulfur oxides were down 44 percent thanks to the expanded use of smokestack scrubbers and a shift to burning lower sulfur-content coal. Carbon monoxides were down 48 percent; lead was down 98 percent mostly because of the phasing out of leaded gasoline; volatile organic compounds (the source of ozone) were down 51 percent; and particulates down 34 percent. Emission of nitrogen oxides, however, dropped only 17 percent due mostly to increased automobile ownership and the need for generating more electrical energy. The EPA estimated in 1999 that its emission control programs would provide $4 in benefits for every dollar in costs by 2010. (EPA, 1999)

The heavy dependence of the American public on the use of gasoline and diesel fuel to power automobiles, trucks, buses, and other equipment poses a major problem in air pollution control. California has taken the lead among the states in seeking tighter regulations and to shifting use to less polluting alternatives. The federal government has been slower to act, but since 1970, it has required the installation of catalytic converters in cars to secure more efficient burning of fuels, sought cleaner fuels and set minimum efficiency standards for new cars. A Corporate Average Fuel Economy program was started to set fuel economy standards for entire fleets of cars and trucks. Political pressures have been exerted to keep these standards at lower levels than many advocates of higher fuel efficiency standards accept as being justified. A fleet average of only 27.5 miles per gallon of fuel was required in 2005 for cars while a lower average of 20.7 miles per gallon applied for the light trucks and SUVs that accounted for the majority of vehicles sold.

Smog problems in the Los Angeles area caused California to take the lead in enacting air quality standards. As part of its control program, it initiated a regulatory scheme known as the Regional Clean Air Improvements market (RECLAIM) for its South Coast Area in 1993. Action was taken to set a cap on the total acceptable amount of nitrogen and sulfur oxides that could be released into the air each year. The size of this cap was reduced from five to eight percent each successive year for the next decade. Pollution allowances were allocated to polluters together with considerable flexibility for buying and selling pollution rights. Pollution allowances are posted on the Internet to permit bidding and counterbidding in a marketing of allowance rights.

The Chicago Climate Exchange (CCX), which started operations in 2003, operates as a private voluntary legally binding entity to promote reductions in greenhouse emissions and to provide a market for the sale and trading of emission credits for controlling the emission of sulfur and nitrogen oxides. Its members include corporations, universities, and state and local governments. It has sponsored projects to improve the use of methane, promote reforestation and better farming practices, and substitute the use of renewable for non-renewable resources.

Sister agencies, such as the European Climate Exchange, have since been established in other countries. One of their principal functions has involved the provision of markets for the trading of greenhouse gas emission credits to meet the compliance standards of various nations with Kyoto Protocol requirements.

Taxation of CO2 emissions offers a possible means for controlling air pollution (Joseph J. Seneca and Michael L. Taussig, Environmental Economics, p.235, 1979). Successful use of this approach, which involves the Pigovian or carbon taxes discussed in Chapter 17, would call for the levying of far higher tax rates on products, such as gasoline and diesel fuel than have been applied thus far. Use of the higher rates for purposes other than highway maintenance would certainly be opposed by many. The approach also can be criticized in that some payers of the tax might argue that payment carries with it a right to pollute.

Overall, It must be recognized that there are two sides to the air pollution control problem. Economists tend to accept tradable permits and possible taxation arrangements as viable means for securing reductions in pollution. For them, these techniques provide measures for internalizing negative externalities that can bring benefits in economic growth that outweigh their costs. Some others in our society see the generation of pollution as ethically and morally wrong. They are reluctant to grant property rights to pollute, because they feel pollution should be regarded more as a crime than as a legitimate cost of doing business. As Mark Sagoff ("Ethics and Tradable Permits: Pollution Trading and the Global Atmosphere," p. 244, 2000) has noted, governments "should not be in the business of selling indulgences, which is to say, permitting people to commit crimes or create serious risks if they just pay a fee to the treasury."

Enforcement Problems

Air pollution control does not come without need for enforcement and enforcement entails problems and costs. Current enforcement procedures call for periodic inspections that can easily fail to notice infractions. Enforcement problems also arise, because of the tendency of plants to often locate in close proximity to each other, a circumstance that compounds local air pollution problems even when all the EPA regulations are met.

Enforcement calls for the imposition of penalties when firms or their officials violate the regulations. The Clean Air Act of 1990 authorized fines of up to $200,000 for violations. Citations of up to $5,000 a day can be levied when field inspectors find non-functioning equipment. Emergency orders with fines of from $5,000 to $25,000 a day can be assessed for actions that constitute threats to the environment, as well as to human life, and criminal penalties involving commitment to prison can be imposed for willful violation of the Clean Air Act provisions.

Differences of opinion exist concerning choices of the appropriate ambient levels of pollution that should be permitted and the extent to which these levels should be enforced. President Reagan's first director of the EPA chose to take the burden of compliance with some EPA regulations off of business by not enforcing them. In a later case during the second Bush administration, environmentalists were widely critical of an EPA decision to lower its emissions requirements affecting the release of arsenic into the air.

With air resources, as well as water resources, problems exist concerning the levels of pollution that should be allowed. Environmentalists and public health authorities would like to reduce the emission of some substances to the zero level. Attainment of this goal may be physically impossible. Within the realm of what can be done, it must be recognized that attainments of different levels of emission control have different costs levels. From an economic cost standpoint, the cost of reducing the emission levels of any given pollutant usually escalates as tighter standards are applied. Half or two-thirds of the pollution may be eliminated at nominal cost while complete elimination may be nearly impossible.

Licensing of the right to pollute provides a workable means of dealing with a difficult problem. However, it should be recognized that granting rights to discharge wastes creates and privatizes a property right where no recognized rights existed before. Wise policy in these cases calls for public retention of the power to supervise the exercise of this right. Governments should retain the privilege of revoking licenses and requiring acceptance of tighter future standards of control when and if new technology so permits.

Control of Air Borne Wastes

The ability of wind to carry toxic wastes and disburse them at locations distant from the points of their emission has long had its beneficial effect for polluters. It has meant that smoke is blown away, that its capacity to do harm has been diluted, and that the damage it causes is less evident as it is spread over larger areas beyond the site of emissions. The far reaching effect that smoke from erupting volcanoes can have has long been accepted as an act of nature that mankind must accept. But when smoke comes from forest fires, we see need for controlling the fires; when misuse of the land leads to dust storms, we adopt soil conservation measures. When it becomes obvious that air borne emissions have toxic effects on flora and fauna, we have valid reasons for controlling emissions at their source.

Acid rain is a problem of this nature (EPA, 2007). The problem occurs as a byproduct of burning fossil fuels. Sulfur dioxide (SO2) and nitrogen oxide emissions are released into the atmosphere where they react with water vapor, oxygen, and various oxidants in the presence of sunlight to form solutions of sulfuric and nitric acid. Mild solutions of these acids then fall to earth as dry matter or as rainfall, snow or fog. Accumulations can continue for years without showing visible signs of damage. But areas located downwind even hundreds of miles from the smokestacks of industry can be adversely affected once accumulations of the deposits from acid rain raise the acid content of soils and lakes to high pH levels. The increased acidity can make soils unfit for normal agricultural use and make lake waters uninhabitable for native fish and aquatic life.

Acid rain has its most damaging effects at high altitudes and at sites located downwind from industries that burn great quantities of fossil fuels. It contributes to the slow growth, injury and killing of forests. It reduces the productivity of soils by adding to their acidity. It has injurious effects on fish and aquatic life in lakes. It damages buildings, painted surfaces, and statuary. It also has caused increased human suffering from respiratory diseases.

Title IV of the Clean Air Act of 1990 set a goal of reducing SO2 levels by 10 million tons below 1980 levels. Emphasis was given in the first phase of the acid reduction program to operation improvements in 445 coal burning electric power generation plants located in 21 Eastern and Midwestern states. The adoption of scrubbing and improved burner technologies by these plants together with a shift to burning low sulfur coal brought significant reductions of SO2 emissions by 1995. A second phase of the program, scheduled to start in 2000 called for extending the control program to smaller plants and further tightened the standards applied to the large and dirtier plants. The 1990 law also called for extension of emission standards to 1,000 additional plants by 2010.

The trading system devised by the EPA allocates pollution allowances to utility plants based on their historical fuel consumption and emission rates. Each allowance allows plants to emit one ton of SO2 per year. Once an allowance is used, it is retired and can no longer be used. Plants are allowed to buy, sell, or bank their allowances. Operators are free to use their allowances as they wish as long as their operations do not exceed the emission levels established by law. Participation in the trading system is open to anyone and in 1996 some 85 percent of the allowances offered for auction by the EPA were acquired by brokers. This feature has also opened a possibility for environmental groups to buy allowances that can be retired without use thus contributing to less creation of SO2 emissions.

Protecting the Ozone Shield

A recently recognized air pollution problem involves protection of the ozone shield that safeguards the earth from excessive solar radiation (EPA, 2006). Ozone is a toxic colorless gas made up of three molecules of oxygen rather than the usual two. It is used commercially for bleaching purposes and can be used to sterilize both air and water. It is normally found in nature much more at high elevations, such as mountain tops than at sea level. Its particular value to mankind is that it occurs in higher concentrations in the earth's upper atmosphere where it provides a protective shield that screens out much of the ultraviolet radiation the earth receives from the sun.

Problems with the ozone shield started with the development during the 1930s of chlorofluorocarbons (CFCs). A newly developed product at the time, CFCs involve a chemical combination of chlorine, fluorine, iodine, and bromine to form freon, a new gas that had promising industrial uses. Its two most important uses were as an air propellant and as a refrigerant.

Freon came into popular use during the post-World War II years when it was widely accepted as an aerosol agent for use with soft drinks and some household products and also as a cooling compound in refrigerators and air conditioning. The product was used without question until 1974 when Mario Molina and F. S. Rowland published an article, which indicated that once released, freon rises into the upper atmosphere. Once there, its exposure to ultraviolet radiation causes the gas to decompose and release chlorine. Molecules of the chlorine then consume large quantities of ozone, another gas, which shields the earth from much of the ultraviolet radiation from the sun that would otherwise strike the earth (Molina and Rowland, 1974). Received in moderation, ultraviolet radiation has its positive benefits, but overexposure can cause skin cancer and have other possible ill effects on animals and plants.

The initial alarm caused by Molina and Rowland's report led the U.S. National Academy of Sciences to call for ending all but the most essential uses of CFCs in 1976. Two years later the United States joined Canada, Denmark, Norway, and Sweden in enacting measures to ban the use of CFCs for aerosol propellants. The Reagan administration opposed taking further action. Some low level international negotiations were undertaken, but the only international recognition of the ozone depletion problem came when a Vienna Convention called half-heartedly for international control of CFC production.

Worldwide concerns over the problem moved front and center with the release in 1985 of a study that showed that CFCs had already destroyed portions of the ozone layer found above the earth's polar zones. Public response brought demands for action. DuPont, the principal American producer of CFCs indicated willingness to shift to production of a substitute product. International negotiations were started to place rigid controls on CFC production. This concern culminated with the Montreal Protocol on Substances That Deplete the Ozone Layer, which was sponsored by the United Nations and signed by representatives of 24 countries in 1987.

The Montreal Protocol called for a 50 percent reduction in CFCs. Two weeks after its signing, evidence presented by the National Aeronautics and Space Administration and the World Meteorological Organization indicated that far more ozone depletion had taken place over the mid- and high northern latitudes during the winter than had been anticipated. DuPont promptly announced its intention to eliminate CFC production entirely. The European Community pushed for action to phase out its production by 2000. A new agreement called the London Revisions to the Montreal Protocol was signed in 1990. The new agreement called for ending CFC production and consumption in the developing nations by 2000.

The new agreement limited CFC production in the major producing nations but gave the less developed nations a 10-year grace period during which they were to phase out CFC production. China and India refused to sign the 1990 agreement until the more developed nations agreed to provide a $2 billion fund to assist developing nations subsidize the cost of installing and using substitutes for CFCs. Provision of the grace period allowed some developing countries to increase their production of freon, considerable quantities of which were sold in an international black market. A reported 6,367 tons of freon were smuggled into the United States between 1994 and 1997 (Baker, 2000). Large quantities of smuggled freon were still being used for repair of air conditioning equipment in later years.

With the phasing out of CFC production, the ozone shield problem was thought to be solved as it was assumed that a sufficient quantity of the CFCs in the atmosphere would soon be broken down to make their presence no longer dangerous. Atmospheric studies have indicated, however, that while less ozone is being emitted into the atmosphere, the size of the ozone hole over the South Pole did not reach its peak of 11 million square miles until 2003 and that it is taking longer than was first expected for the CFCs to break down. (Chang, 2005)

Global Warming

Scientific studies indicate that the world's climate has alternated between long periods of warm and cold temperature over time. Evidence indicates that tropical conditions that supported luxurious plant growth and dinosaurs have existed at times as far north as Greenland and that ice ages also have occurred during which ice sheets have covered areas far south into the earth's present temperate zones. Our ancestors did not keep temperature records for our benefit. We know, however, that the last millennium has had its warm and cool periods (Kininmonth, 2004). A cycle of warmer than average weather during the 10^{th} century, for example, made it possible for the Vikings to establish settlements in Greenland that were later abandoned, because of colder conditions. We know that favorable climatic conditions have contributed to the rise of our industrial order since the 1700s and that the world's climate has been gradually warming since the mid-1900s.

Comprehensive data on world climatic change has been assembled by the United Nations Intergovernmental Panel on Climate Change, by the United Kingdom's Hadley Centre for Climate Prediction and Research, and by the United States Global Research Program (Long, 2003). As Figure 19–1 shows, their findings indicate that mean average global temperatures have been edging upward since 1850, the time when reliable measurement began, and that they are increasing at an increasing rate. Comparisons of their data with findings from glacial ice cores and tree rings show that the 1995–2005 decade had the highest mean average temperatures of the last thousand years. Data reported by IPCC in 2007 indicated that world's mean average temperatures were at the highest level they have been in the last 2,000 years.

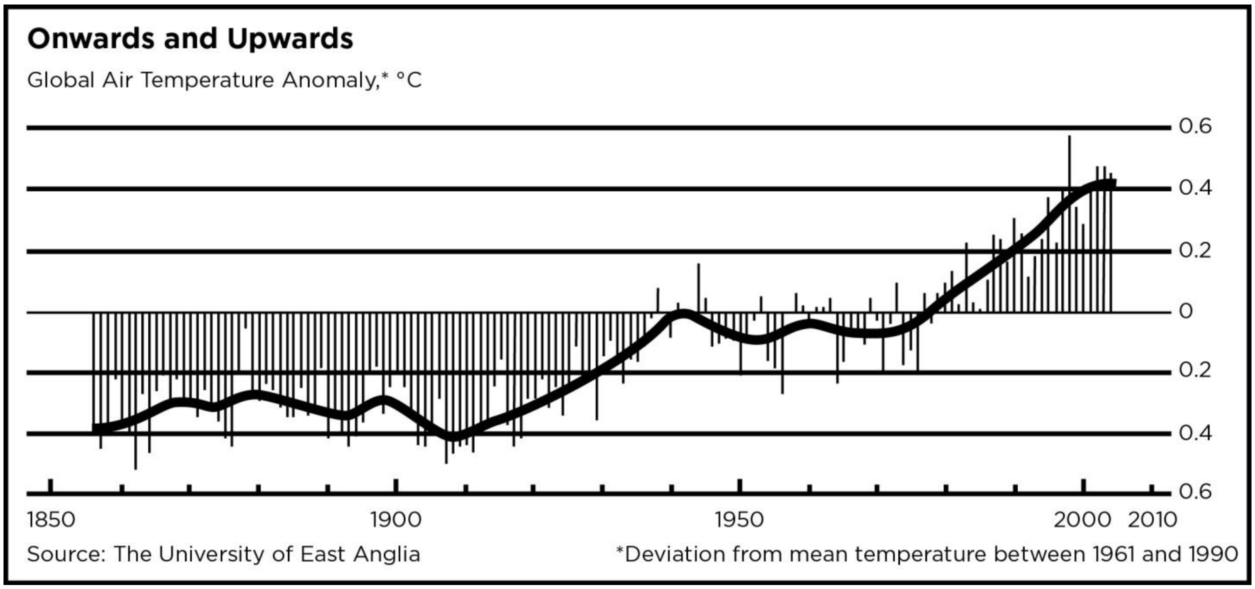


Figure 19–1. Mean Global Temperatures from 1850

The overall increase in average temperatures has been gradual and somewhat erratic. El Niño conditions associated with the warming of Pacific Ocean waters have occurred in some years but not others. Some winters have been colder and some summers warmer than a straight line projection would show, but the upward mean average trend is convincing. A World Climate Conference in 2007 attributed most of the responsibility for this upward trend to human activities, primarily to the adverse effects creation and release of great quantities of carbon dioxide (CO2) into the atmosphere have had on world temperatures. Critics of this view, often spokesmen for power generation and oil and coal production interests, are inclined to dismiss this assumption and argue that such global warming as has taken place is a product of natural trends accelerated by factors, such as volcanic eruptions and possible increased radiation from the sun.

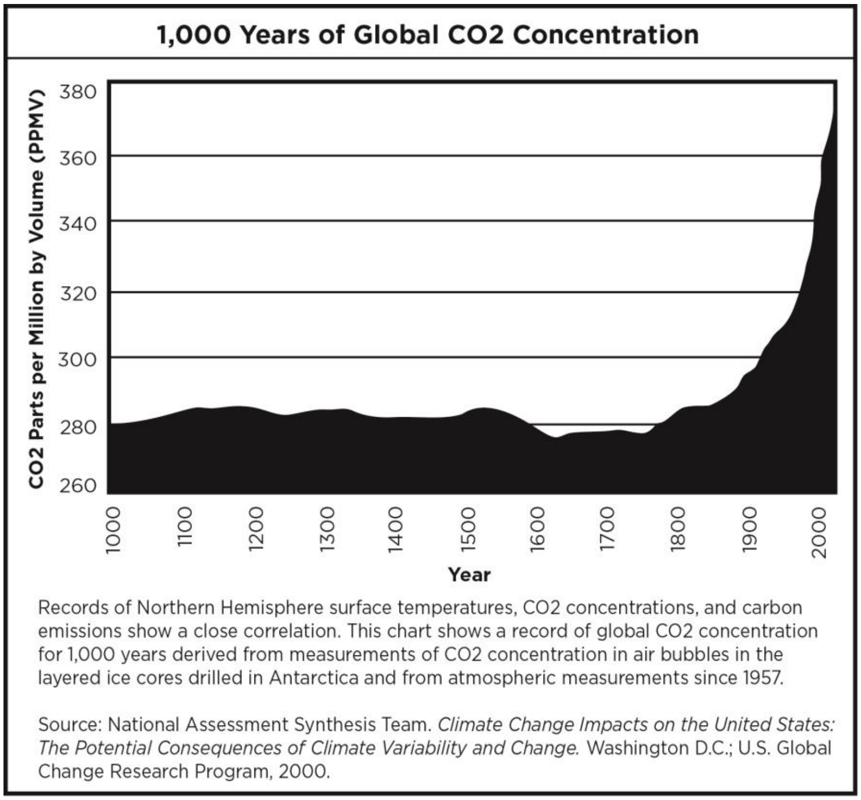
Table 19–1. Greenhouse Gas Emissions, United States, 1990, 2000, and 2006 (C02 Equivalents Measured in Millions of Tons of Their Weight)

	1990	2000	2006
Total Emissions	6,146.7	6,978.4	7,075.6
Carbon Dioxide	5,017.5	5,890.5	5,934.4
Methane	708.4	608	605.1
Nitrous Oxide	333.7	341.9	378.6
HFCs, PFCs, SF	87.1	138	157.6

Source: U.S. Energy Information Administration, Emission of Greenhouse Gases in the U.S., DOE/EIA Series 0573 (2006).

Carbon dioxide, the gas most blamed for global warming, plays an essential role in our lives. It provides a necessary ingredient for the photosynthesis process that permits plant growth. Explanation of the role it plays with global warming calls for recognition of the fact that our natural world operates with carbon and nitrogen cycles, as well as with its hydrological cycle. With the carbon cycle, billions of tons of carbon dioxide are released into the atmosphere each year. Most of it comes when elements of carbon are combined with oxygen through respiration, the decay of organic materials, and the burning of fuels to form carbon dioxide. At the same time, plants use the process of photosynthesis in the presence of sunlight to convert carbon dioxide from the atmosphere into carbohydrates and release oxygen in to the atmosphere.

For long ages, a general balance was maintained between the two phases of the carbon cycle that kept the level of CO2 in the atmosphere at a low level. Two increasingly prevalent practices of mankind have brought an upsetting of the balance between the two phases. Our cutting of forests and clearing of plants from land has greatly reduced the amount of carbon sequestration that once took place and our increased burning of fossil fuels for powering automobiles, for heating space, and for generating electric power have greatly increased the emission of carbon dioxide gases. Figure 19–2 shows the global concentrations of CO2 in the atmosphere for the past 1,000 years. The sharp increase after 1900 shows a dramatic departure from the previous 900 years.



Records of Northern Hemisphere surface temperatures, CO2 concentrations, and carbon emissions show a close correlation. This chart shows a record of global CO2 concentration for 1,000 years derived from measurements of CO2 concentration in air bubbles in the layered ice cores drilled in Antarctica and from atmospheric measurements since 1957.

Source: National Assessment Synthesis Team. *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change.* Washington D.C.; U.S. Global Change Research Program, 2000.

Figure 19–2. One Thousand Years of Global CO2 Concentration

Some CO2 has always risen to the higher atmosphere where it plays a beneficial role by providing the earth with a blanket that allows solar energy to pass but limits radiation of heat from the earth to outer space (Keller, 2009). Without this blanketing effect, average temperatures on the earth's surface would drop to levels that would cause freezing of ocean waters. With the tremendous increase in CO2 emissions, often called greenhouse gases, and the tremendous increase in global CO2 emissions of the last century, much of the increase has risen in the atmosphere where it, along with chlorofluorocarbons, methane, and nitrous oxide, have thickened the blanket that limits radiation of heat from the earth. Figure 19–3 from the U.S. Global Change Research Program aindicates, it is this thickening that has come from the generation of more greenhouses gases that causes global warming.

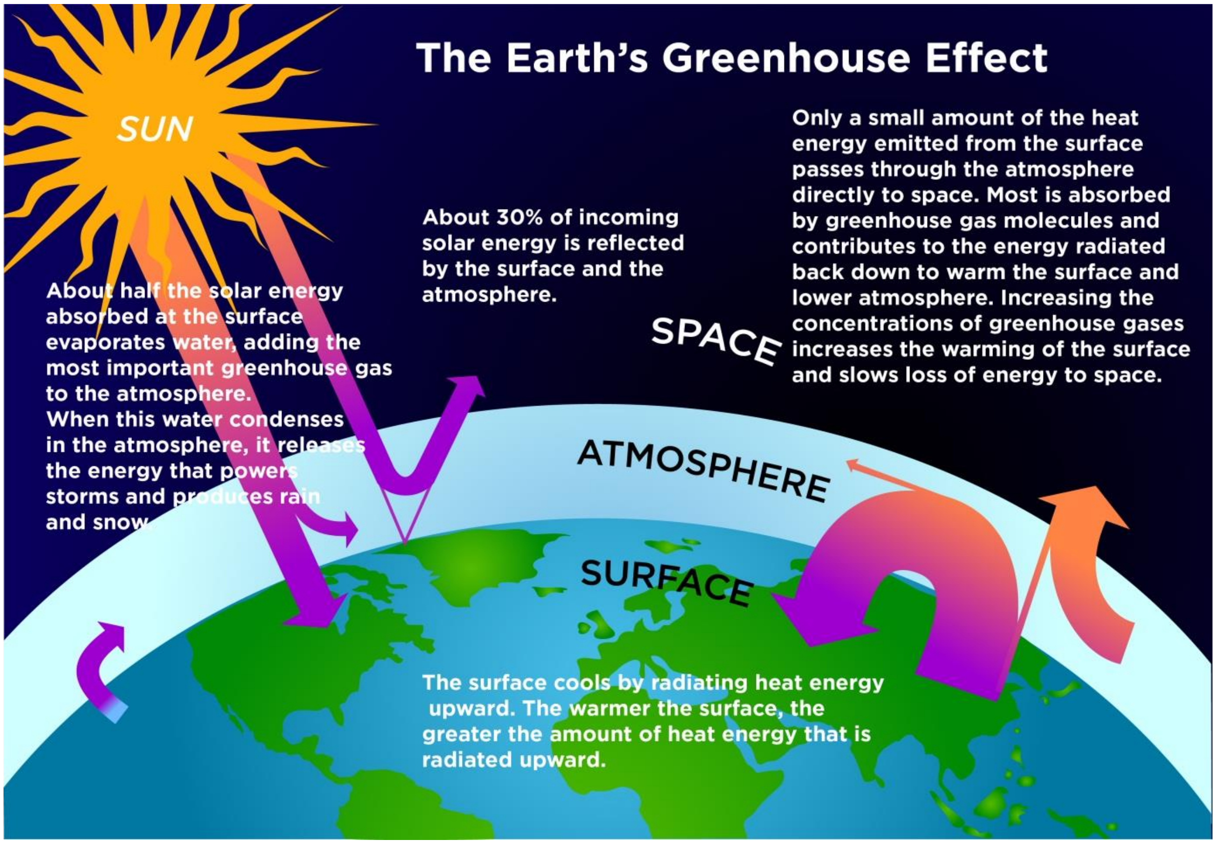


Figure 19–3. The Earth's Greenhouse Effect

With global temperatures rising, questions may be asked as to whether this trend is desirable. Warmer temperatures can have both desirable and undesirable results. Many people welcome the idea of warmer winters even though this may be associated with hotter summer weather. Warmer weather can also have important impacts on how we use our land resources. An increase of only two degrees Celsius (3.6 degrees Fahrenheit), an increase some observers believe will take place within the next 50 years, can lengthen growing seasons enough to make large areas in Alaska, Canada, Russia, and southern Argentina available for cereal and other crop production.

Warmer weather could make it practicable to raise bananas in Arkansas, oranges in Michigan, and cotton in Saskatchewan. With the melting of glaciers, areas in Greenland and northern Canada could be opened for agricultural settlement and farming and oceans cruises could be taken to the North Pole. Just as the adoption of air conditioning has favored the shifting of considerable economic activity from northern to southern regions in the United States, global warming has a potential for reversing that trend.

On the undesirable side, the melting of polar ice caps will bring higher ocean water levels that will lead to the inundation of many coastal communities and the flooding of large coastal areas now used for crop production purposes. It will mean that many weeds, pests, allergies and tropical diseases will spread farther north and south. Summer temperatures will rise and cities, such as Chicago, will have many more days when temperatures exceed 100 degrees Fahrenheit. It will bring major increases in the demand for air conditioning facilities and will adversely affect the levels of productivity that can be expected from workers who labor without air conditioning.

Also among its negative effects are the unknown impacts that global warming can have on rainfall patterns, ocean currents, possible desertification, and other meteorological phenomenon. As experience with el Niño occurrences in the Pacific has shown, warmer ocean waters can have far reaching impacts on rainfall patterns in North America. Warm waters in the south Atlantic and south Pacific are credited with a possible rising number and intensity of tropical storms and hurricanes.

Global warming will bring more evaporation of moisture from bodies of water and from land and that will bring heavier rainfall in some areas, but it can also cause large areas, such as the American Southwest, to experience desertification. Its negative effect in increasing CO2 emissions from soils can have adverse effects on large areas of farmland in semitropical regions that are now used for crop production. Reductions in winter snowfall and quicker snow melt will cause rivers and irrigation canals to run dry during summer months. At this point, no one can honestly predict the full extent to which global warming will affect our lives and welfare.

Using current data, the Intergovernmental Panel on Climate Change (Fourth Assessment, 2007) predicts from its models that average world temperatures can rise by as much as 11.5 degrees Fahrenheit by 2100 and that the water level of the oceans can rise by as much as 34 inches, the precise amount depending upon future emissions of greenhouse gases and climate sensitivity. Some observers feel that these projections are overly modest. Al Gore's presentation in the 2006 film documentary An Inconvenient Truth, for example, suggests higher possible increases in temperatures together with a rise in surface land levels at the two poles once their ice caps are melted that can result in a 20 foot rise in ocean levels.

There is little doubt that society can adjust to moderate increases in global temperatures. Major problems could arise though if the cumulative effect of generating additional greenhouse gases year after year accelerates the rate of global warming. The CO2 that has already risen in the atmosphere will continue to have its blanketing effect for decades. Adding more year after year might well cause more warming than is currently contemplated (Cox, 2005). Should such be the case, a marked increase in the peak temperatures various areas experience could bring the demise of much of the biological world as we know it. Spending a few moments in a wet or dry sauna can provide a pleasant experience while forced exposure to the same temperatures for several hours or days would have fatal consequences for many plant and animals species.

Meeting the Global Warming Problem

As we face the prospect of global warming, it should first be noted that any bad effects our past activities have had are probably irreversible in our lifetimes. The volume of excess CO2 already created will need decades to dissipate. Furthermore, there is little we can do to limit the global warming attributable to natural causes. To the extent that we identify our practices as causes of the problem, however, sound policies can be directed toward trying to keep the situation no worse than it is. Voluntary action to reduce greenhouse gas emissions can have beneficial though probably somewhat limited effects. International action involving all of the world's people is needed if the emissions problem is to be brought under control and carbon sequestration programs can play an important preventative role.

International programs. There is little individuals, firms or governments, acting by themselves, can do to stop global warming. Worldwide action to integrate measures for climate control was recommended by the World Commission on Economic Development (the so-called Bruntland Commission) as part of its strategy for securing sustainable development. The Earth Summit conference (The United Nations Rio de Janiero Conference on Environment and Development, 1992) followed by producing a Convention on Climate Change that called on the signatory nations to limit emissions of greenhouse gases to the 1990 level by 2000. The United States joined several other nations in making the agreement. Subsequent reports indicate that little progress was realized in meeting the Convention goal.

New rounds of meetings were held at Berlin in 1995 and Geneva in 1996. At the later meeting, representatives from the United States advocated substitution of a binding pact to reduce greenhouse gas emissions to the already agreed upon compliance level. More discussion followed and resulted in the Kyoto Protocol of 1997 (Yamin, 2005).

This agreement would require the United States to cut its greenhouse gas emissions by 600 million tons a year by 2012, a level seven percent below its 1990 emissions. President Clinton's representative signed the Kyoto agreement, making the United States one of the 163 nations that agreed to its terms, but the Republican controlled Senate failed to act on its approval and the incoming Bush administration reversed the nation's position by withdrawing its support. Possible Congressional action to accept the Kyoto standards was still opposed by the administration in later years.

Russia's decision in 2006 to accept the Kyoto agreement brought worldwide acceptance among nations to the 55 percent level required to make it effective; but questions about its overall relevance exist as long as China and the United States do not feel bound by its provisions. Acting on its own, California took action in 2006 to bring its greenhouse gas emissions down to the Kyoto protocol level. Popular demands that the United States follow suit can bring its compliance at some future date. Should this happen, the real question then will be “Are the Kyoto goals sufficient to slow global warming and do the various nations have the will to effectively reduce CO2 emissions to an appropriate impact level if compliance adversely effects their economic objectives?”

Carbon sequestration. Carbon sequestration, the use of measures to keep carbon from finding its way as CO2 to the upper atmosphere, provides a supplementary means for limiting the gas emissions that cause global warming. Carbon is sequestered under natural conditions from the air by growing plants through the photosynthesis process and by soils at moderate temperatures (mostly below 60 degrees Fahrenheit). Carbon is returned to the atmosphere with the oxidation that accompanies the decay of plant materials and the breakdown of soil humus that comes with the plowing and harrowing of farm fields. Increased oxidation of soil humus also occurs with hot weather, a factor which helps explain the thin soils found at many tropical locations.

For long centuries, the forests, grass and other plants that covered much of the earth's land surface played a significant role in sequestering enough carbon to balance the natural emissions of CO2 into the atmosphere. This situation changed as forests were cut, natural plant cover was destroyed to make room for crop culture, and the organic material in soils was exposed to oxidation through plowing and other farming practices. A reversal of these trends can bring increased carbon sequestration. Making large areas green again does not provide a complete answer to the greenhouse emission problem, but it does offer opportunities for lessening the problem.

Carbon can also be sequestered by culturing the plankton found in ocean waters, by measures to capture carbon in manufacturing processes through exposure of CO2 gases to amine-based solvents, and by the geologic storage that comes with pumping CO2 gasses into abandoned mines and oil wells or the ocean.

Some of the most promising prospects for carbon sequestration involve 1) the culture of young growing forests and plant cover (mature forests lose about as much carbon through decay as they sequester), 2) increased use of no-till farming practices that reduce oxidation of carbon from soils, 3) increased use of cover crops to keep growing plant cover on larger areas of surface land and for longer periods during the year, and 4) adding iron particles to sea water to stimulate plankton growth.

The Kyoto protocol authorizes countries to use credits for carbon sequestration to offset their commitments for reducing CO2 emissions. A European Union Greenhouse Gas Emissions Trading Scheme has operated since in 2005 for this purpose. The World Bank has reported (State and Trends of the Carbon Market, 2006) that 374 million metric tons of credits for offsetting CO2 emissions were traded in 2005. Some of these credits, however, did not involve carbon sequestration.

The challenge ahead. The United States generates more CO2 than any other nation. The EPA has projected a 42.7 percent increase in greenhouse gas emissions in the United States between 2000 and 2020 during which an 80 percent increase in economic growth is expected (U.S. Climate Action Report, 2002). Acceptance of cleaner and more efficient technologies will bring reductions in the rate of CO2 emission increases; but concerns about the effects curtailing emissions might have on economic activity and auto travel has caused the nation to drag its feet in complying with the Kyoto Protocol goal.

Comparable resistance to controls on greenhouse gas emissions can be expected in other nations and most particularly in the less developed nations. International Energy Agency projections (Table 19–2) indicate that their volume of CO2 emissions will almost double between 2004 and 2030 while their share of the world total rises from 39 to 52 percent. China and the other nations in this group see increased industrialization as the means they must use as they promote economic growth. Unless means are devised that will allow them to secure the added energy they need from alternative sources, their businessmen, like those in the developed nations, can hardly be expected to show enthusiasm for limiting greenhouse gas emissions.

Table 19–2. Total Consumption of Energy Resources and Total CO2 Emissions for World and Major User Groups, 1990, 2004, and Two Projections to 2030

Consumption of Energy Resources (Millions of Tons)				
	1990	2004	2030	Alternate 2030*
World	6,154	7,639	11,664	10,542
More Developed Nations	3,135	3,826	4,892	4,528
Transitional Economies	1,014	704	947	851
Less Developed Economies	2,005	3,109	5,825	5,163
China	689	1,050	2,181	
OECD Europe	1,146	1,333	1,496	
United States	1,304	1,599	2,059	1,894
Carbon Dioxide Emissions (Millions of Tons)				
World	20,463	26,079	40,420	34,080
More Developed Nations	11,051	12,827	15,495	13,184
Transitional Economies	3,731	2,560	3,193	2,786
Less Developed Nations	5,317	10,171	21,111	17,530
China	2,289	4,769	10,425	
OECD Europe	3,934	4,078	4,651	
United States	4,832	5,769	7,138	6,266

Source: International Energy Agency, World Energy Outlook, 2006.
Tables from pages 492–534.
*Alternate scenario assumes adoption of some
policies that were being considered in 2005.

Avoiding the clash between increasing demands for energy and need to control CO2 emissions poses a challenge of worldwide moment. Whatever the outcome may be, the overall context of the global warming problem provides a classic example of Hardin's Tragedy of the Commons. The earth's capacity to provide a sink for the emission of greenhouse gases has long been regarded as an inexhaustible commons resource. It has only been during recent decades that our overtaxing of its capacity to control global warming has been noted. And now, the emerging prospect of global warming looms like an approaching hurricane of still undetermined ferocity, which has a potential for wreaking havoc with our well-being; but the full consequences of which will not be known until it hits.

Logic tells us that we should be taking action to avert the undesired effects of global warming. But insofar as remedial action calls for limiting CO2 emissions, it also impinges on the luxurious life styles we have come to cherish. We reap advantages from the burning of fossil fuels. We enjoy the manufactured goods, mobility and other privileges it provides. As consumers we value our present well-being and would like to retain our privilege for emitting greenhouse gases. But we also realize that controls may be needed to limit our emissions to levels that will not threaten the well-being of the world about us.

Rational solutions for the problem of global warming call for a mutual sharing of possible sacrifices by everyone while concerted collective action is taken to define and enforce rules of the game that will limit future CO2 emissions to the earth's limited capacity for dealing with them. With compromising measures, we may muddle through. With the choice of doing nothing, we face the prospect of uninviting consequences that can change the nature of the world.

Chapter 20: Management of Fund Resources

"The meek shall inherit the earth,

but not the mineral rights."

~ J. Paul Getty

A major difference between the living conditions enjoyed by modern mankind and those of our primitive ancestors centers on the extent and the efficiency with which we rely on the use of fund resources. Aside from the fact that they lived on dry land, early mankind made little use of the earth's fund resources. The food that they ate, the clothing they wore, the houses they lived in, and the heat from the fires they built came from plants and animals, all products of the earth's flow resources.

Man's first use of a fund resource probably came when he found that he could use a rock as a tool or weapon. Deposits of copper, lead and tin permitted the fashioning of tools. A major advance came when it was found that iron could be made into better tools and weapons. Gold and silver were valued, because they could be fashioned into articles of adornment. Two other important early uses of fund resources came with the making of clay into bricks and the use of stone and marble for building purposes.

It has only been during recent times that we have discovered the opportunities associated with harnessing the energy that can come from the burning of fossil fuels. This new source has freed us from much of our earlier dependence on human and animal muscle power, waterwheels, and the wind that drove windmills and ships. Energy has become the driving force of modern industry and has contributed greatly to the levels of living we enjoy. Our vision of the future calls for the use of more, not less, energy. But considering the fact that most of our current supply of energy comes from the burning of mineral fuels and that this burning is a major contributor to global warming, where does this leave us?

Answers to the problem of how and where the world will secure the supplies of energy it needs go somewhat beyond the scope of this chapter. Important aspects of the problem will be touched upon, however, as attention is focused on the general managerial considerations that apply to our use of fund resources and on the use problems that are associated with the three major classes of fund resources.

General Management Issues

As is the general case with resource management, operators who deal with the mining and processing of fund resources find it to their advantage to use their operations to the point at which they optimize their economic returns. They must seek an excess of economic returns above their costs if they are to remain in business. Beyond this breakeven point they should push their production to the point at which they have the maximum spread between their average revenues and average costs and if possible beyond that to the point at which their *MFC* = *MVP*.

The goal of having their *MFCs* = their *MVPs* provides an economic bulls-eye for their operations. Hitting these points is complicated by the imperfect knowledge operators have concerning of where they will find their resources, how rich their deposits may be, the costs that will be associated with their capture and shipment to market, the prices their products might command once they are available for sale, and the extent to which they should discount the value of future returns.

Fund resources are not an ubiquitous resource. Usable deposits of sand, gravel, and building stone are found at many locations but can be scarce in places where they are much needed. Merchantable quantities of mineral ores are usually found at scattered sites, often at only a few locations, and then frequently at distant places that require high transportation costs in getting them to market. Moreover, mineral deposits are usually hidden from casual view. Their existence may be discovered by accident. They can be discovered by prospectors who stake all they have on the chance that they might discover something of value; or with modern technology, their discovery can involve applications of technical skills and techniques.

An illustration of some of these problems is provided by the example of gold mining in the American West. Several of the first adventurers who arrived in Virginia came with dreams of riches inspired by accounts they had heard of the piles of gold and silver Spanish conquistadors had found in Central America. Their hopes vanished as they found no gold. Years later when gold was discovered in the streambed of the American river in California, a gold rush followed. Individual miners gambled their hopes and all the resources they could call upon on the chance that they could strike it rich by finding their bonanza. This gambling fever led prospectors to roam all over the West in later years always looking for prospective deposits of gold or silver that sometimes were found in lucrative quantities but more often remained undiscovered. Only in more recent times has the search for gold and other metals become a solid business proposition conducted by mining engineers who know what to look for and understand the most practical and profitable means for mining it.

The fact that many of the most sought after deposits are hidden and must be discovered before they can be made available for economic use and that once discovered, mine shafts must be sunk or drilling operations started, inserts an uncertainty element in development decisions. If operators find their hoped for resources, all may go exceedingly well. If their operations are only partially successful, there may be a disappointing return on investment. If no merchantable ore or oil is found, the entire investment may be lost. The uncertainty of a positive return means that the promise of possible gain from prospecting and "wildcatting" operations must be enough higher than that available from investments in more dependable ventures to entice investors to chance their operation. Unlike the "safe" business ventures favored by conservative investors, investments in mining and oil drilling operations are not for the faint of heart.

Concerns have been expressed about possible exhaustion of our supply of minerals. Fossil fuels lose their value as they are used and metallic minerals are often processed into products that have little recycling value. This situation brings subtractions from the total physical supplies of these resources. But it does not mean that supplies are no longer available. Faced with the prospect that their current supplies of top grade ores or fuels will run out, operators do not throw up their arms and abandon hope. They know that the earth's surface is composed of minerals. They look for new sources of supply. Improved technologies affecting their operations and the prospect of higher prices make it profitable for them to turn to the use of lower grade ores. They also look for substitutes that may serve as well or better than their original products.

Figure 20–1 provides a practical view of the overall economic supply situation with most fund resources. The current known supply of the resource that is available for economic uses can be depicted by the shaded area in the lower left corner of the diagram. This total can be expanded in either or both of two directions. Expansions of supply can come from new discoveries or the application of improved technologies in finding and capturing the resource. Additions to the economic supply may also come with higher prices or reductions in processing costs.

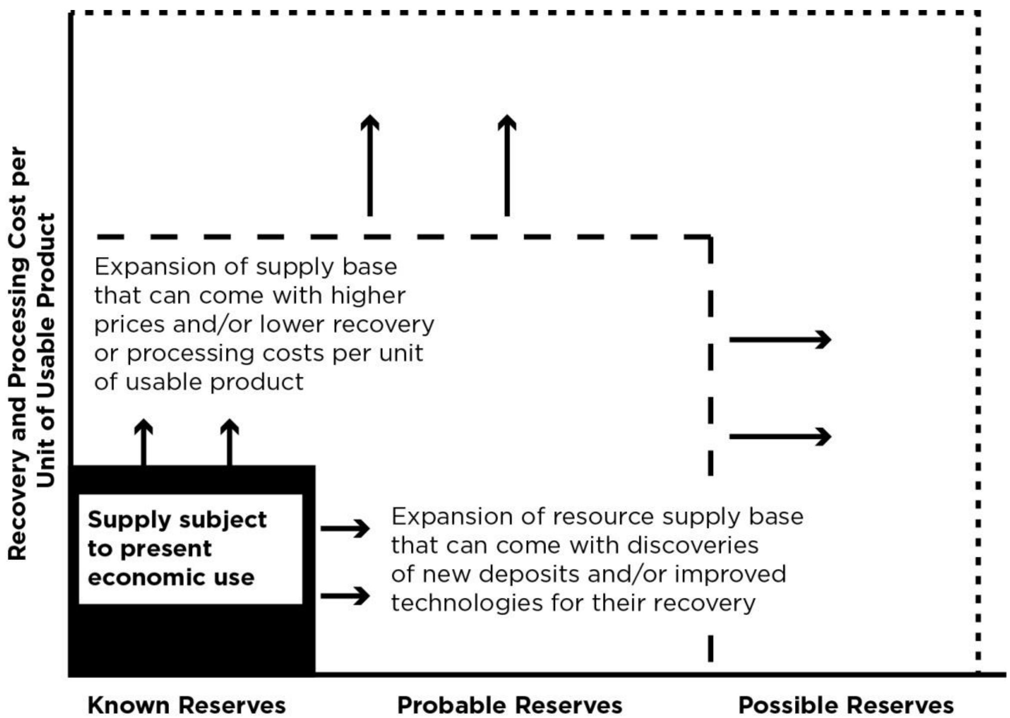


Figure 20–1. Potential Economic Supply of Fund Resources

A good example of a shift in mining operations to use of ores of lower grade is provided by the experience of copper mining in the Butte, MT, mines during the early 1900s. Ores with a content of five percent copper were mined at first and profitable operations continued until ores with less than 0.5 percent copper were being taken at the time the mines closed. Mining operations were then suspended, not because copper ore could no longer be mined and smelted, but, because richer deposits of copper were available elsewhere.

A second example of considerable significance has occurred with the mining of iron ore. The first major mining operations of iron ores in the United States centered in areas, such as Pennsylvania, Alabama, and the northern Lake States, where ores with high iron content were found. The mining-out of some of the higher grade deposits in the Mesabi Range in Minnesota was lamented in the early post-World War II period as a national tragedy. This concern dissipated, however, when operators found that they could use a pelitization process to concentrate iron from lower grade ores at plants near their source into a higher quality resource for shipment at less transportation cost to steel mills (Kakela, 1978).

Advancing technology has played a tremendous role in expanding human knowledge about possible uses of mineral resources. Little value was placed on iron until warriors found that swords made from iron were harder, less likely to break, and thus more deadly than weapons made of wood or copper. At a later date, the use of coal to produce steam opened the way for putting steam engines on wheels and revolutionizing transportation. The operators who found that oil could be used to provide heat and power started a development process that led to production of kerosene to light the lamps of half the world and then of gasoline that made the internal combustion engine a reality and thus triggered the possibilities of automotive and air navigation.

A basic problem operators face in using fund resources concerns the optimum timing of their mining. When there is limited demand for their use, operators are usually content to produce only the amounts for which market demand exists. Production of too much would glut their markets. Producers of sand and gravel for local building operations may stockpile some of their product to care for periods of above normal demand but normally gear their operations to the expected current demand for their product.

There are situations in which operators may wish they had the option of putting all of their coal or oil on the market at one time. They can, of course, sell their mines or oil wells with the resources still in the ground. But it would be foolhardy for them to try to market all of the coal that can be mined or all of the oil that can be pumped at one time. Capturing the resource for release within a short time would drive up output unit costs, because several mines shafts would have to be opened or oil wells drilled with crews hired; and inefficiencies in production would probably result in losses of considerable product that could be claimed with more leisurely operations. Offering all of their product for sale within a short time span would also disorient their markets and force operators to accept lower output unit prices for their product.

Two of the most important decisions owners of fund resources make with the timing of their operations concern questions of when should they start their mining operations and the duration of the periods over which they should plan to operate. Both decisions are complicated, because of imperfect knowledge. Owners may follow do nothing policies simply, because they are unaware of the presence or value of their resource. And even when they are aware of their opportunities, they may do nothing, because they lack the financing needed to start mining operations, or because they prefer not being bothered with the problems that come with mining operations. Operations can be delayed if an owner chooses to hold a resource in reserve for later exploitation after a current operation is concluded. They might also be postponed if an operator, such as the holder of the drilling rights to oil a deposit, thinks that they will be worth considerably more in the future than at present. Depending on the operator, the calculation of the present value of the anticipated future return may or may not be discounted.

Decisions about the duration of operation planning periods also are complicated by imperfect knowledge because, with their resource hidden from view, owners usually lack definite information concerning the quantity and quality of their hidden resources. With this uncertainty, owners typically plan to continue their mining of a vein of coal or mineral ore until it is mined out or with oil until the last barrel of oil pumped barely pays for its pumping.

In those instances in which operators do have reliable information about the extent of their mineral or oil deposits, managers typically face a problem of deciding on the optimum timing of their operations. Should they spread their operations over extended time periods or might they find it more profitable to mine their resources at a more rapid rate? Their decisions involve both their scale of operations and the time horizons within which they expect to operate. The choices they make also are affected to a considerable degree by the extent to which they use compound and discount interest rates in their calculations.

As was explained in Chapter 7 and in Figure 7–2, reliance on high interest rates shortens the time periods of optimum operations. Society generally has good reasons for encouraging the spreading out of mining operations over long periods of time. Marketplace decision-making, however, emphasizes the importance of valuing future returns in terms of their current values, a factor that has a non-conservational effect in encouraging rapid exploitation of fund resources. While the factors favoring use of high discount rates must be recognized, it should be noted that other factors are often at work that favor the acceptance of a more conservational approach. Chief among these are the spread out nature of demand for fund resources over time and expectations that the resources will be of considerably higher market value in the future. Also important are considerations, such as an operator's desire to remain in business for a long period, a feeling of responsibility in servicing community needs, and a feeling of duty to provide continued employment for one's work force.

Environmental Considerations

Mining operations have more potential than most other uses for disturbing the natural environment. Surface and open pit mines have left gaping holes in the landscape that the Surface Mine Reclamation Act of 1977 now requires be restored to their original contour. Underground mines have their piles of slag. Oil wells are surrounded with compacted earth and leave oil spills. Oil refineries have burning flares that light up the night sky and cause air pollution. Abandoned gravel pits and quarries can fill with water and become attractive nuisances that take the lives of adventurous swimmers.

Mining operations frequently call for the use of heavy machinery, create local traffic problems, and can be a cause of fires and unwanted dust and smoke. Their operations can generate unwanted noise and can call for considerable use of water. Mine waters and the dumping of mine tailings can pollute local streams with acids and hazardous wastes that kill plants and aquatic life and make water unfit for human use. Deep mines can disrupt local water tables and be a cause of surface land subsidence.

The negative side effects of mining operations are such that cities and residential communities may prefer to keep them at a distance. Zoning regulations can be used to require setback regulations or to specify minimum size of areas that can be used for various mining purposes.

In addition to the impacts they have on land and water, mining operations also have significant effects on public health and safety. Most mining operations involve working with heavy machinery, sometimes with explosives, and in the case of underground mining, working in dark confined areas where possible cave-ins and pockets of poisonous gas make mining a hazardous occupation. Rigid observance of work safety and health protection standards is needed with all mining operations.

Another welfare issue is associated with the fact that mining operations come and go. While minerals are being mined and oil is being pumped, communities can enjoy boom times. Once the supplies of these resources are diminished to a point at which further capture is no longer economically profitable, mining operations close down, workers have to move to other areas for employment, local businesses fail and communities go into periods of decline if substitute economic activities are not found to sustain the local economies.

While mining activities have created environmental problems, it must be remembered that the supplying of fund resources for our use has had tremendous beneficial effects in easing the conditions under which we live. Fund resources provide many of the necessary materials for the building, heating, cooling and lighting of the places where we live and work. They provide most of the tools and toys we work with, the vehicles that carry us about, and many of the medications that keep us alive and in good health. Fortunately for mankind, most of the adverse impacts uses of fund resources have on the environment involve issues and challenges that management can meet.

Controversy is associated with the taxation policies applied to takings of fund resources. Mining removes resources from their natural home. The royalty policy first adopted by the federal government accepted the view that a portion of whatever was secured should be shared with the state. Several states accept this view with severance taxes on the mining of coal and some mineral ores. The federal government, however, abrogated its earlier policy in its Mining Act of 1867 and permits prospectors to establish claims on much of the public domain, easily acquire title to their claims, and enjoy the fruits of their labor. Many prospectors received nothing; but some have struck it rich and acquired fortunes that were free from taxation until the adoption of the income tax.

A different approach applies with oil and gas explorations. Parts of the public domain are reserved from exploration. The Bureau of Land Management issues licenses for oil and gas explorations and development in the non-reserved portions of the public domain and in coastal waters. These rights have often been leased at what some critics consider as give-away prices. Two other important incentives were provided in the 1917–1970 period to encourage oil and gas explorations. One of them allowed an expensing policy in calculations of taxable incomes that allowed producers to write off all costs of drilling both producing and dry wells during the first year of production rather than follow the usual accounting rule of spreading them over the period of expected use. A second incentive allowed deductions of 27.5 percent of revenues as depletion allowances associated with the expected exhaustion of their resource base. As Tom Tietenberg has indicated, this approach has stimulated the extraction of oil and natural gas and provided a means for avoiding taxing, as profits, the returns that really represent a liquidation of assets (Tietenberg and Lewis, 2008)

Some of these benefits were reduced by the Energy Act of 1978, which also provided credits for investments in energy secured from solar and wind sources. Minor adjustments in taxing policy came during the 1980s; and a windfall profits tax was passed in 1980 and repealed in 1988. The Reagan administration pushed for further tax cuts and acceptance of a free market for oil and natural gas. Later developments brought some adding and then reduction of excise taxes. Taxes were further reduced under the Energy Policy Act of 2005, which also contains features favoring the development of alternative fuels. Critics of the 2005 law argue that it still provides subsidies worth billions of dollars to an oil and gas industry that is realizing massive profits at a time when major emphasis in policy should be placed on conservation measures and shifts to alternative sources of energy. Defenders of the policy in turn insist that their jealously guarded benefits must be maintained to encourage domestic production of needed oil and gas supplies.

Mineral Fuel Resources

Two classes of mineral fuels are in current use throughout the world. Fossil fuels in the form of coal, natural gas and petroleum provide major sources of energy while nuclear materials are also used for this purpose. In accordance with the Law of Entropy, both classes break down in use leaving only heat, ashes and gases in the case of the fossil fuels and only heat, radiation and spent uranium in the case of nuclear materials. Unlike uranium, the fossil fuels were originally formed as byproducts of the decomposition of organic wastes geologic ages ago. Despite their biological origins, after being stored under pressure within the earth's crust for thousands of years, they have the characteristics of minerals in that their supply cannot be replenished within our time horizon.

Use of fossil fuels has provided a tremendous boon to mankind during the last three centuries. The economic and industrial progress that has been realized could not have been achieved without their use. Their use for facilitating our mobility and for heating and cooling our homes and places of work has also contributed greatly to our levels of living. Continued economic growth and continued support for the amenities of good living that we have come to cherish calls for continued emphasis and dependence on the burning of fossil fuels. At the same time, worldwide concern about the perils of global warming tells us that action is needed to reduce the adverse effects burning fossil fuels has in generating emissions of greenhouse gasses. The conflict between these objectives poses a major challenge that can best be met through search for and development of alternative environmentally friendly sources of energy.

An Organization for European Cooperation and Development report, World Energy Outlook, (Table 20–1) indicates that the demand for world energy rose from 7.3 billion tons of energy equivalent in 1980 to 11.2 billion tons in 2004 and is projected to rise to 17.1 billion tons in 2030. Overall world demand is expected to rise 52.6 percent between 2004 and 2030 with 65.3 percent of the increase coming from fossil fuels. Demand for coal is expected to rise by 41 percent, oil by 57 percent, natural gas by 89 percent. A smaller increase of only nine percent is anticipated to come from nuclear sources.

Table 20–1. World and United States Primary Demand for Energy Resources, 1980, 2004, and a Projection to 2030 (Millions of Tons Metric Tons of Energy)

	World Totals			United States	
	1980	2004	2030	2004	2030
Coal	1,785	2,773	4,441	545	695
Oil	3,107	3,940	5,575	946	1,150
Natural Gas	1,237	2,302	3,869	515	599
Nuclear	186	714	861	212	243
Hydro	148	242	408	23	26
Biomass	765	1,176	1,645	71	155
Other	33	57	296	11	60
Total	7,261	11,204	17,095	2,324	2,929

Source: International Energy Agency, World Energy Outlook, 2006, pp. 66 and 498.

A parallel calculation of world energy CO2 emissions suggests that total world emissions of CO2 will rise from 26.1 billion tons in 2004 to 40.4 billion tons in 2030. Of these totals, the OECD, or more developed, nations will account for an increase from 12.9 billion tons in 2004 to 15.5 billion tons in 2030 while emissions will increase from 10.2 billion tons to 21.1 billion tons in the less developed nations. Among the less developed nations, total emissions were projected to increase from 4.8 to 10.4 billion tons in China as compared with an increase from 5.8 to 7.1 billons tons in the United States.

Use of Oil

The World Energy Outlook report for 2006 indicates that oil provided 3.9 billion metric tons of the world's total of 11.2 billion tons of energy equivalent from all sources used in 2004. This total is projected to rise to an expected demand for 5.6 billion of a world total of 17.1 billion tons in 2030. Meanwhile, world demand for oil is expected to rise from 82.5 million barrels per day in 2004 to 117.1 million in 2030 (World Energy Outlook, 2006). Of this total demand, 47.5 million barrels per day came from the developed nations in 2004 and 55.1 million are expected in 2030, while demand in the less developed countries is expected to rise from 31.5 to 57.0 million barrels per day. The report assumed that the world has adequate reserves to meet the 2030 projection and cited an Oil and Gas Journal estimate (volume 103, Dec. 19, 2005) that the world has 1,292.5 billion barrels of oil reserves, 55 percent of which are located in southwestern Asia while only 21.4 billion barrels are in the United States.

Energy consumption tripled in the United States between 1950 and 2000; and as Table 20–1 indicates, its consumption accounted for 20.7 percent of the world total in 2004. Calculated in Btu terms in Table 20–2, oil accounted for 40.13 of the total of 99.7 quadrillion British thermal units of energy it consumed in 2004, while it accounted for only 11.53 of the total of 70.4 quadrillion units it produced. Oil and to a much lesser extent natural gas were the only two resource needs that required imports from other nations. Overall, the nation, which was a leading producer and exporter of oil 50 years ago, now produced only 26.2 percent of the oil it consumed. Data for 2004 indicate that the nation produced 1,988 million barrels of oil per day, of which 9.8 million were exported, while it imported 3,674 million barrels of crude oil plus 1,047 million barrels of refined petroleum products per day (Statistical Abstract of the United States 2007, Table 880). Imports came from several nations, the leading sources being Canada, Mexico, Saudi Arabia, Venezuela, and Nigeria. Greater needs are anticipated in the decades to come and tremendous competition for their use from developing countries, such as China and India is expected.

Table 20–2. Production and Consumption of Energy Resources, United States, 2004 (Quadrillion of Btu)

	Produced	Consumed	Production as a Share of Consumption
Oil	11.53	40.13	28.7%
Natural Gas	19.34	22.99	84.1%
Coal	26.69	22.39	100%
Nuclear	8.23	8.23	100%
Renewable Resources	6.12	6.12	100%
Total	70.37	99.74	77.2%

Source: Statistical Abstract of the United States, 2007, Table 895.

Our increasing demand for these resources is easily explained. We love our cars and the ability they give us to be a mobile people, to travel, and to commute considerable distances to work. We have come to expect the comfort these resources provide for our houses and work places. Our industries and incomes are dependent on the power we get from burning oil, gas and coal. Global warming is a problem for the future that has not yet impinged much on our daily lives.

Few people are willing to forego the benefits oil consumption provides for living easier lives. Yet continuation of this privilege of use poses important managerial issues for the future, not the least of which is where the oil will come from. Producers of oil can be expected to continue operations much as in the past with their emphasis on finding marketable deposits, managing rates of production, and coping with hazards, such as leaking pipes, area contamination, fires, and hurricanes. Theirs is an enterprise that involves more than the average amount of risk to investors but that also offers high profits to those who succeed.

Projections of future demands, such as that of an 80 percent increase in world demand for oil between 2004 and 2030 reported in Table 20–1, are based largely on projections of current use rates with assumptions about increasing population numbers and increasing per capita consumption levels. How much demand will increase, however, will be affected by world economic conditions, the availability of oil for use, the prices at which it will sell, and the progress nations make in finding substitutes for their current reliance on oil.

Our perception of oil as a market commodity has changed. When it was tapped for use in the late 1800s, it was seen as a cheap source of energy. The United States led the world in oil production and usage. Its reserves have since been drawn down while new supplies have been found elsewhere so that it now has less than two percent of the world's known oil reserves. Meanwhile, the demand here and throughout the world for oil is increasing. Oil prices are rising to unexpected new levels, and there is a concerted demand for the nation to reduce its dependence on foreign oil. This situation has brought a double need for finding new domestic sources of oil and also for seeking substitute approaches that can be used to fill our energy needs.

While the problem of meeting our oil consumption needs has been growing, the world has also become increasingly aware of a global warming problem and of a need to curtail the emissions of greenhouse gases that are generated with the burning of oil and other fossil fuels. The possibilities associated with the reclaiming of oil from oil sands provide a partial answer to our needed quest for additional supplies of oil. Increased use of nuclear power, which will be discussed later, provides an important means for helping the world meet its energy needs. Other important alternatives include use of biofuels, and possible increased uses of water power, geothermal, wind, tidal, solar, and hydrogen as sources of energy.

Oil sands. Oil sands, also called tar sands, involve combinations of sand, clay, water and bitumen. Bitumen is a semisolid form of oil that does not flow but that can be refined to provide petroleum products. Large deposits are found in northern Alberta and Saskatchewan in Canada. Other deposits are being mined in Venezuela and Utah. Though not assigned this much importance in official estimates, these deposits are said to contain as much as two-thirds of the world's oil reserves.

Several problems have been associated with their processing. The Canadian deposits are located in a cold, often frigid region. They have been extracted like coal in surface mining operations in which case their product was too heavy to be transported through oil pipelines. The deposits have often been distant from the refineries that handle their processing. Large quantities of water and natural gas have been required to provide the steam needed in their processing.

Their processing has had adverse environmental impacts in that it has destroyed boreal forests and landscapes, polluted local waters, and released tremendous quantities of greenhouse gases. Their emissions of CO2 largely explains Canada's 24 percent increase in emissions since

1990 during a period when the nation was committed by its acceptance of the Kyoto protocol to reduce its overall emission by six percent by 2012.

Introduction of new technologies, such as the injection of steam or vapor into the oil sand deposits to force the release of liquid oil has brought improvements in production. However, serious environmental problems associated with the generation of greenhouse gases still exist.

Shift to biofuels. Considerable attention has been given in recent years to the possible substitution of biofuels for gasoline in the operation of internal combustion engines. While oil could be purchased for $20 or less per barrel, it was not economical to produce biofuels in large amounts. This balance has shifted with the increase in world oil prices; and with promising technological advances that are bringing reductions in processing costs, biofuels may well become the economic products of choice in their competition with oil for many uses.

Biofuels involve several fuels, such as ethanol, butane, biodiesel, and methanol, which can be derived from biomass through the processing of recently harvested living organisms. Source materials range from crops, such as corn, soybeans, switch grass, and sugar cane, to manure, garbage, straw, wood chips, and a current promising crop, algae.

Ethanol, which is a form of alcohol, was considered the logical fuel for use in internal combustion engines until gasoline became available as a less expensive alternative. It is now used as an additive to gasoline and with some modifications in motors can be used as a complete substitute for gasoline. This has been the case in Brazil where the government chose to emphasize its domestic production as a substitute for oil imports. Butane is a gas, similar to ethanol in its chemical composition, which is frequently used for heating purposes and also as a fuel in military vehicles. Biodiesel, which is derived from the processing of vegetable oils and animal fats, can be used as a substitute for diesel oil by cars and trucks. Methanol, or wood alcohol, was once used as an additive to gasoline and has high potential value, both as a fuel and for use in the production of liquid hydrogen.

Increased use of biofuels offers several advantages to nations, such as the United States. They provide alternative fuels that cause less air pollution than the use of oil products. Unlike petroleum processing, which often takes place hundreds of miles from where oil is found and then shipped in tankers or by pipelines, the bulky nature of the raw materials for making biofuels calls for material-oriented processing plants that provide opportunities for the development of new domestic industries. By substituting markets for domestically produced flow resources for foreign oil imports, their use can further the conservation of natural resources while creating domestic employment opportunities and having a positive impact on a nation's balance of trade.

On the negative side, it may be noted that the benefits promised from increased use of biofuels may come as a mixed blessing. Critics of the program for expanding use of ethanol in the United States, for example, charge that it offers a thrice more costly substitute for the continued use of gasoline: more costly, because billions of dollars in public subsidies are associated with its promotion; more costly, because its until-now cost of production together with its lower energy equivalent per gallon than gasoline makes it a more expensive product; and because its dependence for production on food crops, such as corn, has led to higher food prices for consumers. Its expanded use can also be questioned on efficiency and environmental grounds.

Considerable expenditure of energy resources, much of it coming from the burning of fossil fuels, is involved with ethanol production. Research reported by David Pimentel and Tad Patzek (2005) found that its production from corn entailed the net consumption of 29 percent more fossil energy than it produced (45 percent more with switch grass and 57 percent more with wood biomass). Moreover, while its use promises a reduction in the generation of greenhouse gases, it releases undesired levels of volatile organic compounds and nitrogen oxides into the atmosphere.

Overall, it is doubtful that increased production of ethanol can make more than a dent in the nation's demand for oil. Use of the nation's entire corn crop in 2006 for this purpose would have produced only enough ethanol to offset six percent of the nation's demand for oil. Boosting this energy equivalent to the 10 percent level could require choices between using land to produce crops for food or for ethanol and call for bringing environmentally sensitive areas into use for biomass production. (Borders and Burnett, 2007).

Alternative renewable sources of energy. Approximately 94 percent of the 99.74 quadrillion of Btus consumed in the United States in 2004 were provided by the burning of mineral fuels and the generation of nuclear power. This means that only six percent came from reliance on the use of renewable flow resources. If progress is to be realized in meeting the challenge of global warming, serious consideration must be given to our prospects for securing more energy from the clean alternative renewable sources described in Table 20–3.

Table 20–3. Renewable Sources of Energy Used to Produce Electric Power, United States, 2006

	Production Plants in Operation	Capacity in MWe (Megawatts)	Share of Total Capacity
Hydro	4,138	96,988	9.02%
Geothermal	215	3,170	0.29%
Wind	341	11,603	1.08%
Solar	31	411	0.04%
Tidal	0		-
Biomass	270	8,256	0.58%
Nuclear	103	105,584	9.82%
Mineral Fuels			79.17%

Source: Data assembled from reports issues by the
Energy Information Administration, U.S. Department of Energy.

Hydro power has been used for centuries as an on-site source of energy for the operation of grist mills and local industries. Today it is used almost entirely for generation of electric power. As the data reported in Tables 20–1, 20–2, and 20–3 indicates, it ranks highest among the renewable resources of energy used to supply power in the United States. With increasing demand for clean sources of energy, some increase in its volume can be expected in the years ahead; but its share of the nation's total will probably not increase for the simple reason that the era of big dam construction has passed.

A huge potential exists for increasing the supply of energy that can come from the expanded use of geothermal power. This source calls for using steam and boiling water produced by tapping heat from beneath the earth's surface. With Enhanced Geothermal Systems (EGS), water is injected into hot dry rock as much as 10 kilometers below the earth's surface to create a flow of steam that can be used to generate electric power. While it still accounts for only a tiny portion of the world's energy, geothermal plants are in operation in 70 countries, including 215 plants in the United States. On a worldwide basis geothermal sources are credited with the production of 9.3 GWe (gigawatts of electric power) in 2005. An additional 28 GWe were used for space heating; and this total rises to a possible 100 GWe when the energy used by ground source heat pumps is counted. Geothermal power has its greatest use in Iceland where 26 percent of the nation's use of energy comes from this source.

A report produced by a MIT-led panel (The Future of Geothermal Energy – Impact of Geothermal Systems, 2007) suggests that by pumping water down 10 kilometers, GTE has a potential for providing a clean source of energy for much of the world for the next 300,000 years. The panel also asserts that, with an investment of $14.1 billion in GTE, the United States can be producing 100,000 megawatts of electric power (approximately one percent of its need for power) from geothermal sources by 2050.

Wind has a long history of use for filling the sails of ships and for powering windmills. It has been only during recent years that it has been used on more than a minor basis; but since the year 2000 groves of wind turbines have been appearing on the landscape at an increasing rate. The United States had clusters of wind turbines feeding energy into electric power grids at 341 sites in 2006. Denmark leads the world with its dependence on wind power for 20 percent of its energy consumption. Wind power provides a clean and easy to maintain source of power. Its principal disadvantage springs from the intermittency of its supply.

Ocean tides offer a tremendous predicable source of energy that can be realized if we can find workable ways to harness their potential. Tidal mills have been used for centuries in some parts of Europe to provide power for minor industrial operations. Underwater turbines have been installed at several sites since 2000 to capture the energy generated as water flows into and out of ocean estuaries. Estimates indicate that up to 10 percent of the United Kingdom's need for electricity can be supplied by tidal power. The United States has no tidal plants in operation but opportunities exist for their use. Some of the biggest opportunities for generating power together with major engineering challenges concerning the designing and the construction of workable facilities are found with estuaries, such as Canada's Bay of Fundy where a tidal head difference of 50 feet occurs between high and low tides.

We can look to the sun as an ultimate source for clean, renewable and reliable energy. Solar energy provides light and heat for life on earth. Through photosynthesis, it permits the growth of the plants needed to sustain the earth's animal and human populations. Until recent years, we have been content to limit our reliance on solar power to these uses. Technological progress, however, has shown that solar power can be used to power automobiles, ships and satellites in space. Solar panels are being used increasingly to trap solar energy for use in heating and cooling buildings.

Solar panels have been coming into increasing use to heat and cool living space and in some cases to generate electric power. Photovoltaic cells and elaborate systems involving sets of mirrors are being used to convert solar energy into electric power. Solar power was used at various sites around the world to produce 3.1 GWe of grid-connected photovoltaic electric power in 2004 together with an additional 2.3 GWe of off-grid power. This production provides a small sample of the possibilities that lie ahead as we look to solar power as a feasible means of meeting our energy needs.

Hydrogen power, which can be secured by combining atoms of hydrogen with atoms of oxygen from the atmosphere, offers an attractive potential for creating needed supplies of clean emission-free energy. Hydrogen fuel cells have been successfully developed for this purpose and their practicality has been demonstrated both for generating electricity and for providing mobile power for vehicle operation. Its use as yet, however, has been limited primarily to industrial applications.

Advocates of its use see it as a logical alternative to our current heavy reliance on the use of gasoline to power automobiles. They cite the fact that the supply of hydrogen is abundant, that fuel cells provide a cleaner and more efficient source of energy, that the cells can be compact in size, that they can permit travel over long distances and be easily replaced, and that they offer a safe source of energy. Cost considerations, however, have discouraged its market acceptance. Technological advances and rising oil prices may bring changes in this situation. At this point, reductions in the cost of producing and using hydrogen fuel cells and the cost of supplying the hydrogen needed for their operation is needed to make hydrogen power competitive.

The fact that hydrogen is lighter than air means that it is found on the earth's surface only in the form of compounds, such as water and methane. The practicability of its use is accordingly dependent on the ease of its capture. A small portion of its present supply comes from the use of an electrolysis process that splits it out from the H2O of water. This process provides a clean source of hydrogen but is costly as it requires the use of considerable quantities of energy. Most of our supply of hydrogen (95 percent percent in the United States in 2003) came from a steam reforming process that separates hydrogen atoms from the carbon atoms in methane. This process also is costly, requires considerable use of energy, and has the disadvantage of generating greenhouse gases, as well as hydrogen. Consideration of this detail suggests that, while use of hydrogen power can lead to less dependence on oil, it may not lead to less air pollution.

Possible technological developments. World energy policy is currently faced with two major challenges. Low cost alternatives to the burning of fossil fuels are needed to supply the world's energy needs and wide scale reductions in greenhouse gas emissions are needed to slow down global warming. Progress toward attainment of these goals is being made with techniques for securing more energy from flow resources, such as solar and wind power.

Notable possibilities for the further attainment of these goals can come from technological advances that have yet to become realities. While it is not realistic to count these benefits before they occur, the possibility of their development provides a major challenge for modern science. Development of a low cost, low greenhouse gas emission technique for producing hydrogen fuels, is one possibility. Another could come with measures to reduce the toxicity of the wastes now associated with the production of nuclear power. Similarly, the development of a financially profitable technique for sequestering carbon from greenhouse gasses could do much to limit the serious nature of the contribution they make to global warming.

Use of Natural Gas

Use of natural gas poses problems very similar to those that apply with oil. As Table 20–1 indicates, world demand for its use is expected to increase 68.1 percent between 2004 and 2030 while the demand for oil will increase by 41.5 percent. Less concern is expressed about the possible limits on its supply partly because it is not used to provide power for automobiles, and partly because our major reliance on domestic supplies means that usage does not affect the nation's balance of trade payments. High national demand within the United States, however, is drawing down the nation's reserves and is causing rising prices, a factor that affects many families as they pay the cost of heating their houses.

Natural gas can be liquidified for shipment to distant markets and is supplied in this form in many countries. To date, most of the supply in the United States has come from domestic sources, frequently through pipelines that stretch half way across the continent. As yet, little concern has been expressed about what communities would do if supplies are exhausted.

Substitute sources of supply would be sought, because once people have become accustomed to the convenience of its use, they are not apt to abandon it. Electric power could be substituted as a heating agent. Some communities would likely return to the use of coal gas, which many of them used before natural gas became available.

Hydraulic fracturing, commonly called fracking, is a technique that was developed in the late 1940's to release gas and oil deposits by fracturing rock and creating cracks that allow the trapped gas or oil to escape. While this technology was used to a limited degree for half a century, it became a major driver of natural gas production around 2006. Natural gas extracted from such sources accounted for 10 percent of U.S. production in 2007, and rose to 30 percent of production by 2010. The impacts of this enormous shift have been lower natural gas prices and heated public debate over externalities associated with the process. Opponents of fracking claim that the process can and has contaminated groundwater by allowing gas to infiltrate aquifers that sustain human life. Another argument against fracking is contamination of water that is used as a hydraulic fluid, often mixed with a variety of chemicals, to provide the pressure needed to crack the rock. The economic windfall and vastly increased production associated with fracking has led most governmental units to concentrate on legislating best practices to mitigate negative externalities rather than ban fracking completely. Wide use might also be made of methane gas that can be used as a fuel, but which has usually been emitted into the atmosphere in the past. Methane is a major component of natural gas. Considerable deposits are found in the earth's crust. It is also produced aerobically by the fermentation of organic matter in manure, wastewater sludge, municipal solid wastes and other biodegradable feedstocks. Progress has been accomplished in capturing it for commercial use as fuel. A Methane for Market Partnership was launched by the EPA in 2004 to promote international efforts to reduce emissions of methane into the atmosphere and promote its recovery for commercial use.

Coal

Next to oil and natural gas, coal is our most important source of energy. Worldwide demand is expected to rise from the 4.8 billion tons used in 2002 to 7.0 billion tons in 2030. Of this total, the 22 developed OECD nations used 2.2 billion tons (46.7 percent of the world total) in 2004 and are expected to use 2.5 billion tons (45.73 percent of the world total) in 2030. (World Energy Outlook, 2004)

A separate set of calculations for the United States (Statistical Abstract of the United States 2007, Tables 890 and 891) indicates that 1,112.1 million tons of coal were produced in 2004, that being 18.3 percent of the 6,079 million tons produced worldwide. This production came 33.1 percent from underground mines and 66.9 percent from surface mines. Of the 1,104 billion tons of coal consumed, 91.9 percent was used by electric utility plants. The nation was estimated to have 494,450 million tons of coal reserves, 67.8 percent of which would call for underground mining.

Unlike the situation with oil and natural gas, the world faces no impending shortage of coal. Nations, such as the United States and China, are thought to have a 500-year supply of known coal reserves. The leading environmental issues associated with its mining and use involve concerns about its effects on the health and safety of its workers, its contribution to air pollution and global warming, and its environmental impact on scenery and nearby land and water use.

While people were conscious of the presence of coal deposits, little use was made of them until around 1200. Four hundred years passed after that before coal was first used for smelting purposes in England. Commercial production started 300 years ago in the early 1700s. The first mines started with people finding surface outcroppings of coal and then following them into the earth with mining operations. Today's mines are of two major types: operations below ground that follow veins of coal, usually found between layers of rock, into their underground locations, and beds of coal that lie near the surface that can be captured in open pit mining operations once the overburden of soil and other surface materials is removed.

Coal mining operations are found at many different locations in the United States. The first mines were primarily underground operations. The fact that underground mining takes place without natural light in poorly ventilated caverns where accumulations of poisonous gases are often present and that it often involves use of explosives together with a constant danger of loose falling rocks has made it one of our most hazardous work operations. Its past association with injurious health problems, such as “black lung” disease, has also made coal mining a problem of public health concern.

The state legislature in Pennsylvania took notice of the mine safety problem by passing a law in 1869 that required state inspection of mines. Similar legislation followed in several other states. A Bureau of Mines was established at the federal level in 1910 with the twin objective of providing research on mining problems and promotion of mine safety. More legislative and governmental action followed with the passage of the Occupational Safety Act and Health Acts of 1970, and the Surface Mining Control and Reclamation Act of 1977. Compliance with the regulations established by these laws has helped make mining a less hazardous occupation than it was century ago. Mine disasters still occur, however, as problem situations arise.

A major new problem of considerable consequence arose after World War II with the widespread adoption of open pit mining operations. Operators found that large bodies of coal were located a few feet below the earth's surface and could be mined in open air operations if the overburden were first removed. Removal of the overburden created regrettable environmental problems in mountainous areas, such as West Virginia, where the dumping of overburden at surface locations brought despoiling of the landscape, interference with the natural flow of streams, and frequent bringing of deposits of chemicals to the surface, the leaching of which poisoned local streams for other uses. Surface mining area reclamation programs that call for the smoothing of deposits of overburden, returning layers of topsoil to the surface and replanting reclaimed areas to grass and other crops have been instituted since the late 1900s to care for these problems.

The most serious environmental problem associated with the use of coal concerns its emission of tremendous quantities of CO2 and other greenhouse gases. It is a major contributor to air pollution and global warming. Government programs have been instituted in an attempt to deal with this problem. Progress has been realized in getting users to shift to the burning of low sulfur-content coals and power plants throughout the nation are using technological improvements, such as scrubbing operations, to meet environmental standards. A serious problem that goes beyond uses of coal still remains as the world seeks pollution-free answers to its continuing need for sources of energy.

Barring possible technological improvements that can bring low cost supplies of energy from flow resource sources, the United States and the world will probably continue to rely on coal as its primary source of energy for generating electric power. Environmental management of this resource calls for continued efforts to prevent undue pollution and the destruction of environmental values. Improvements in use practices must be sought, because this route affords the only means by which society can benefit from the use of this resource without having to bear unwanted results. With China and other developing countries turning to widespread use of coal, efforts also are needed to get these nations to accept use practices that will minimize the ill effects they might otherwise have on the environment.

Nuclear Resources

Development of the atomic bomb during World War II opened the way for using nuclear resources as a source of power. At an early point, this prospect was heralded as a tremendous opportunity for providing power at a low cost that would replace the need for dependence on other power sources. Experience soon demonstrated the fallacy of this early enthusiasm. Use of nuclear power involves several serious problems. It calls for use of above average levels of technical expertise. Extreme care must be taken to avoid melt-downs that can lead to the release of radiation into the atmosphere that can have devastating effects on plants, animals, and human life for miles around the nuclear power plants. The safeguards needed to meet these problems have come at a price that has raised the cost of producing the nuclear power.

Equally important with the protection from radiation issue is the problem of finding an appropriate disposal method and place for disposing of the uranium tailings and spent fuel. These residues contain radioactive substances that have half-lives ranging from a 1,000 years to more than 200,000 years, during which time they retain lethal power to effect damage. Spent fuel rods currently are being held in steel drums at temporary storage sites. The threat of possible leakages calls for their transfer to permanent safe storage sites. Choice of these sites involves a gigantic LULU problem as no community wants to be near them. After years of consideration, a decision was made in 2002 to store them in a mountain cavern in Nevada, Yucca Mountain, where the "screw Nevada" solution was loudly denounced by local residents. Even after congressional approval, opposition to the site remained strong and became an issue in the 2008 presidential campaign when then candidate Barack Obama promised to abandon the project if elected. President Obama cut funding for the project early in his presidency but faced congressional and legal challenges from those who claimed he did not have the authority to stop the project. None-the-less, it appears that the Yucca Mountain Nuclear Waste Repository will not become operational and explorations continue to find another site. Once a suitable storage site is found, additional problems will arise as no city wants to have drums of nuclear wastes carried through it and the railroads and trucks that will be used to transport the wastes all follow routes through major cities.

Congress passed the Atomic Energy Act in 1946 to nationalize the handling of nuclear resources and establish what is now the United States Nuclear Regulation Commission. Several large nuclear power plants were built during the mid-1900s and 442 licensed reactors, 103 in the United States, were in operation in 31 countries in 2006 where they supplied 17 percent of the world's electric power and 9.8 percent of that of the United States.

The near calamity associated with the malfunction of the Three Mile facility in Pennsylvania in 1979 brought a sudden end to the zeal for nuclear power development in the United States. Comparable caution on the worldwide scene was caused by the melt-down disaster at the Chernobyl plant in Russia in 1986. Concerns about rising oil prices and a global need for additional sources of power, however, have prompted continued interest, both in the United States and several other nations, in prospects for increased generation of nuclear power.

This issue was addressed by a study group at the Massachusetts Institute of Technology (<u>The Future of Nuclear Power</u>, 2003). Their report contains several recommendations for making the nuclear energy option viable. But while recognizing the attractive features of this option, it notes that five factors discourage expanded use of nuclear power. These factors include its high relative costs, concerns about safety, anticipated environmental and health effects, potential security risks stemming from proliferation, and unresolved challenges in long-term management associated with nuclear power developments.

Metallic Minerals

Metals play a necessary role in modern life. We use them in building construction, the manufacture of machinery and other goods, for the holding and storage of products, as a conduit for moving rail traffic, electric power, and oil and natural gas, and for dozens of other purposes. A listing of our more important metals includes aluminum, antimony, arsenic, bismuth, cadmium, chromium, copper, gold, iron, lead, manganese, mercury, molybdenum, nickel, platinum, silver, tin, titanium, tungsten, uranium, vanadium, and zinc. Aside from the values placed on gold and silver, copper, iron, lead and tin were the most used metals in earlier times. The values of most of the others has come with the findings of modern metallurgy. Aluminum is the most abundant metal found in nature. Yet it was not until 1886 that the process was developed that made it available for the uses now made of it.

As Table 20–4 indicates, the United States is heavily dependent on other nations for major portions of many of the metallic minerals it uses. It can look to domestic production for most of the iron, lead, and zinc it uses while it must look to other nations for all of the alumina (bauxite), arsenic and manganese it needs.

Table 20–4. United States Production and Consumption and World Production of Selected Non-fuel Minerals, 2005 (1,000 Metric Tons)

	U.S. Production	U.S. Consumption	World Production
Aluminum	2,500	6,800	31,200
Cadmium	0.55	0.19	19
Cement	99,850	129,810	
Clays	41,900	36,900	
Copper	1,140	2,400	14,900
Gypsum	18,000	37,900	110,000
Iron ore	55,000	54,000	1,520,000
Lead	427	1,510	3,300
Magnesium	300	660	
Potash	1,200	6,100	31,000
Salt	45,900	53,600	
Sulfur	9,460	12,300	64,000
Zinc	719	1,370	10,100

Source: U.S. Geological Survey, Mineral Commodity Summary, 2006, and Minerals Yearbook, 2006.

Mining for metallic ores is associated with much the same problems as mining for coal. Some mines are located underground while others involve open pit mining. Mines and mining conditions are subject to state inspections and regulations. Mine safety regulations apply and working conditions are subject to the government's occupational safety regulations. Open pit mines, such as iron mines in Minnesota and copper mines in Utah, have created environmental eye sores but measures are being taken to remedy this problem. A few of the metallic minerals such arsenic, bismuth, and cadmium are subject to the EPA use-limitation standards, because of their poisonous nature.

The environmental problem with metallic resources is not one of scarcity of supply. At various times in the last half century, data have been posted on the years of supply the nation had left of different metals. These calculations were based on announced known reserves and involved totals that were augmented as new reserves were discovered and developed. Metals with announced sufficient reserves to supply the nation for six or seven years in 1970 still have supply lives of comparable duration after 30 and 40 years of continued use. The data on known reserves is a moving total that un until now has increased about as fast as resources are used.

Some experts believe there is no reason to fear running out of any metallic mineral (Tiltin, 2003). Prices may rise, but in many cases there is sufficient supply left in the earth's crust to be found if we are willing to pay increased cost to find and extract it. When conservation and saving a resource is the issue, concern should be focused on the continued use and recycling of metals. Basic metals, such as aluminum, copper, and iron, can easily be recycled if users can be bothered to send their used equipment and products to points at which they can be handled. The problem of fragmentation poses a different concern with many minor metals that are combined in small amounts with steel to secure special effects. The cost of separating metals out in the recycling process may far exceed the cost of seeking new supplies.

In many respects, the principal environmental concern that arises with the use of metallic minerals comes with their processing for use rather than from the metals themselves. Their ores typically call for applications of considerable amounts of power and heat as they are processed for use. Much of the needed power or heat currently comes from the burning of fossil fuels, a situation that gives rise to the same environmental problems as other uses of the fossil fuels.

Other Non-Metallic Minerals

Easily overlooked in discussions of minerals, but still of major importance, is a large residual grouping the members of which are neither fossil fuels nor metals.

Among the more significant of these are asphalt, cement, clay, graphite, limestone phosphate, potash, sand, silica, slate, talc, stone, and sulfur. Among these resources, more tonnage of sand and gravel are used in our economy than of any other mineral. Cement, limestone, other building stone, bricks made from clay, and sand are needed for building construction. Large quantities of asphalt, cement, sand and gravel are required for paving purposes; sand and silica are needed for glass production; and gypsum, lime, phosphate, and potash find extensive use in commercial fertilizers. As Table 20–3 indicates, the nation used 121.2 million metric tons of cement in 2004, 53.9 million of salt, 43.5 million of clays, 39.3 million of gypsum, 12.4 million of sulfur, and 5.8 million of potash.

While each of these resources has it place in our environment, none of them are in critical short supply and there have been few occasions when public policies have been needed to regulate their use.

Chapter 21: Toward a Sustainable Future

"It is the task of our time and in our generation to hand down undiminished to those who come after us, as was handed down by those who went before, the natural wealth and beauty which is ours."

~ John F. Kennedy

What do *you* want out of life? What do *we* want? What does a society want? These are questions everyone and every community should ask. Most do; but in seeking answers, many choose to treat these as open ended questions, because they are very difficult to address. Some have more definitive answers than others. Generally, as individuals, we tend to plan for what we want and need for some days and weeks ahead while leaving the answers to the longer run question for the future to decide. As communities, our traditional planning processes provide some answers, but the focus tends to be on future allowable growth and not a whole vision of the future. But we all know that society can be better and smarter while individuals can make better quality choices. This becomes increasingly complex if we consider a global network of diverse societies with similar and conflicting goals.

On the individual side, when we do choose to consider the question of personal desires, many of us, especially in Western society, are first inclined to attach pride and power to possession of worldly goods. This is not an unnatural response. Some of us may be content with what we have, but people usually want more of a good thing, not less. And even if we have a fortune to give away, we want to enjoy the pleasure of giving it to a worthy cause, not the pain of losing it or the anguish of not having it to begin with.

But while we may be much inclined to seek the maximization of monetary goals, most of us are also motivated in our wants by a host of other considerations. We seek good health, the privilege of living productive and constructive lives, peace and security, freedom from fear and oppression, having fun by ourselves or with the companionship of others, the joys of family life, self-respect and the respect of others, opportunities to expand our talents, feelings of accomplishment, and peace of mind. It is no wonder that choices regarding community wants are more complex than individual choices. But, it is in our collective choices that we can address the most pressing issues regarding what we want for the future, especially for choices that involve the natural environment.

Clearly, our individual choices and quality-of-life impact the environment. The environment impacts not only our quality of life but also the options available for future generations. In other words, what most of us want out of life can be tied directly or indirectly to the uses made of the environment. Our foremost desires, as well as our very survival, depend upon it for sustenance. We want to have a rich natural environment showering us with earth's blessings tomorrow, throughout the rest of our lives, and for generations to come. However, the condition of the natural environment, and its ability to provide benefits, is tied to human behavior and the impacts of management or mismanagement. But some of us see the connections more vividly than others, just as some are more apt to take necessary actions that are respective of the environment.

As we face the issue of protecting and sustaining the environment, we must recognize that it is not a subject on which we are all of the same mind. There are optimists like Simon and Kahn (The Resourceful Earth, 1984) who foresee a more productive world in the future than we have enjoyed in the past and who anticipate the adoption of yet to be discovered technologies that will brush away our concerns about possible scarcities and wants. On the other side, we have pessimists who have doubtful concerns about the human prospect and who fear that our exploitive practices will leave us holding an empty or almost empty bag in the future. Lester Brown’s voice has been among the most notable in offering the world a cautionary note about carefully and respectfully limiting our wanton consumption and wastefulness (Brown, 2009). More recently, other notable figures have joined in, making respect for the environment and an interest in sustainability more acceptable causes today.

What course of action should managers of the environment take in dealing with the problems of sustenance? A first concern calls for concerted action to protect our physical and biological resource base. For example, insofar as we identify global warming or other hazardous trends as threats to our future well-being, collective action should be taken to do whatever mankind can do to keep our resource base healthy and productive. However, depending upon which society, and the degree of development, the ability to take action is often trumped by the immediate needs of basic human survival.

With our economic outlook, logic tells us that we should seek a middle path between the extreme views of the overly optimistic and the overly pessimistic. We must accept the fact that the economic dream of endless growth and expansion is not realistic, especially when we consider the ecological limits imposed on us by nature and the seemingly uncontainable desire for greater prosperity. As Stead and Stead have observed: to "bring the economic system into sync with the earth's natural entropic processes, humankind must find ways to slow down the high entropy energy, resource, and waste processes that result from the current level of business activities" (Stead and Stead, 1996). We must concede that there is still ample room in the bottle for continued growth; but over time we must also think in terms of rightsizing our economic growth aspirations to match what is feasible given our population numbers and our resource constraints. We must stabilize the demands we make of nature, and accept what Herman E. Daly envisages as the steady state economy (Daly, 1991).

Pursuit of a sustainable future calls for the acceptance of Gro Harlem Brundtland's pronouncement in Our Common Future, (United Nations Commission on Environment and Development, Stockholm, 1987) that: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Pursuance of this goal does not dictate an end to continued development of the earth's resources. But it does call for following rational development policies, for stretching our use of scarce resources, for shifting where possible from the use of fund to flow resources, and for placing heavy emphasis on elimination of wastes, pollution of our resource base, and practices that threaten the well-being of the residents of the planet. Again, since various parts of the world exhibit different levels of intensity in their dependence on earth’s resources, and in their environmental footprint, the degrees of urgency faced in dealing with these issues vary. So do the degrees of commitment to change.

Economic considerations will play important roles in guiding our choice of policies, but equal emphasis must be given to understanding and respecting the ecological constraints that govern the operation of our biosphere. In a world where increasing recognition is being given to the rights of other individuals and other species, more than passing attention must be given to the acceptance and observance of high ethical and moral standards. This means that new institutions must emerge that are founded on more advanced and contemporary knowledge of human ethics and moral standards. This is particularly so as Millennials, with their unique goals, interests, values, social networks and impacts get integrated into societal thinking about social responsibility. As more problems and issues arise that require global solutions, new and different global institutions will be required.

The choice of policies and techniques that can best be used will vary with circumstances. Refinements will often be needed. In every case they must meet the three-fold requirement of being physically and biologically possible, economically and technologically feasible, and institutionally acceptable. Development must be measured by the triple bottom line; people, the planet, and profits. By meeting that standard, managers of the environment should be able to devise and carry out programs that permit beneficial developments and use of the earth's resources while preserving their use values for future generations.

It must be recognized, however, that this objective cannot be attained simply by efforts to improve management of the environment. There are other worldwide problems, problems that many of us may choose to ignore, yet the solutions to which will have considerable bearing on our prospects for a sustainable future. Three of the most important of these are: 1) The need to eliminate the wasteful practice of war, 2) the need for more equitable distribution of benefits gathered from development and use of the earth's resources, and 3) the need for bringing world population numbers into a balance that will allow everyone to enjoy a credible level of living.

The great majority of the world's people desire peace and security in their ability to live productive and fruitful lives. Wars clearly bring needless destruction of lives and property. They leave a havoc of wasted lives and resources that can have devastating effects on local environments for years into the future. Most of the issues over which wars are fought could be handled by peaceful negotiation and compromise if the leaders of nations would simply choose to live by the golden rule: *"do unto others what you would have them do unto you."* Perhaps better still, most wars could be avoided if societies adhered to the philosophy of “*do unto others what they would have you do unto them*.” The world would probably be in greater harmony if people and nations believed that adequate avenues exist for having their true voices heard. There is growing need for a globally embraced philosophy that addresses the issue of what is best for the collective world.

A significant first step toward securing a sustainable future calls for the elimination of wars with their senseless killing and maiming of people, disruption of lives, and costly destruction of nature's resources. World peace calls for granting all people the right to exist, the ability to make their own laws without outside interference, and a world of mutual trust in which nations see each other as equals, none trying to dominate or dictate to others. Increasingly, the world is witnessing deeper expressions of discontent and greater willingness of people to push for solutions that they feel directly address their needs. The advent of information and communication technologies, as well as the subsequent greater global connectivity, has brought greater capacity for people to express their views, connect with others with the same perspective, and build a more global support base to mobilize action. The goal of maintaining peace is becoming increasingly difficult as more people gain the ability to express and communicate their discontent. This applies both to economic, as well as environmental discontent. A concern for the well-being of others, and a willingness to do something about it, is a necessary step to living on a planet free from war.

Closely associated with the goal of making peace with each other is a need for nations and their people to also keep peace with nature. It too deserves our respect. We must recognize that human beings are part of nature that we must abide by its rules if we are to make beneficial use of its resources, and that we have responsibilities for safeguarding its power to regenerate itself. Significant compromise of the environment today translates into future constraints to our ability to enjoy a great quality of life in the future. This is increasingly true in the New Economy, where the quality of natural resources attracts the innovators and knowledge workers who drive creation of place and prosperity in all its varied aspects. Given the link between quality of life, societal discontent, and societal stability, leaders must be much more careful about their roles in environmental management today.

The problem of attaining better allocation of incomes and resources within and between nations is one that most political leaders choose to ignore. Yet it is a major problem of our time. A United Nations study (United Nations Development Program, Human Development Report, 1992) indicated that the wealthiest 20 percent of the world's population enjoyed 83 percent of its income while the poorest 20 percent received only 1.4 percent of the total. It also reported that the world had 350 billionaires who together had a net worth equal to that of the poorest 45 percent of the world's population in 1992. According to *Forbes* magazine, by 2011 there were

1210 billionaires and the distribution of wealth was even less equal. By 2000, the richest one percent (defined as an adult with income of $510,000 U.S. or more pr. year) owned 40 percent of global assets, and the richest 10 percent of adults accounted for 85 percent of the world total (Davies et al., 2007). More and more billionaires come from emerging and developing nations where their wealth stands in sharp contrast to that of the masses of the people. Despite the growing wealth disparity, we are also witnessing policies in some countries that seek to protect the rich by reducing their tax burden.

Vastly unequal distributions of income exist in the more developed, as well as the less developed nations. In the United States, it is hard to justify tax reduction programs that favor the wealthy while shifting higher proportions of the tax burden to lower-income groups; and equally hard to justify granting million dollar bonuses to CEOs when members of their work forces live below the poverty line. From an environmental view, one must agree with Steven C. Hackett that: "Highly unequal distributions of income, and the mass poverty that goes with them, are difficult to reconcile with a sustainable society" (Hackett, 1998).

The problem of mal-distribution of incomes and wealth is closely related to a needed recognition both within and between nations that all people, regardless of their differences, have equal rights to live and enjoy normal lives as long as their activities do not have injurious effects on others. Toleration, accommodation, and acceptance of diversity among people are needed if the people of the world are to work constructively together.

Problems of mal-distribution of wealth and disregard for human rights have another dimension that must be taken seriously in a world subject to international terrorism. Major problems exist in both the developed and the less developed nations with people who feel that they are victims of evil conspiracies perpetrated by the "haves" in society against the "have-nots.” This situation can be acute in nations with large numbers of young people who are un- or underemployed, and who often lack educational training that could give them skills for getting ahead. Yet they live in a world where modern communication devices keep them mindful of the benefits that are available to others but denied to them. As Paul R. Ehrlich and Anne H. Ehrlich have noted:

> *“. . . large numbers of unemployed, disaffected young men who see the West as their enemy can provide public support and cannon fodder for terrorism”* (Ehrlich and

Ehrlich, 2004).

The wave of uprisings in many countries in the Middle East and North Africa Regions in 2011 was a graphic illustration of how social media has increased the likelihood that discontent can translate into policy change, government change, and national instability. Coincidentally, some of the countries exhibiting the widest disparity in wealth and income were the ones most impacted.

The issue of population control ranks high among the world's problems and is a matter of momentous significance so far as sustaining the environment is concerned. None-the-less, it is an issue that much of the world's population is unwilling to address for various reasons. The issue is important, because the places in the world that face the biggest problems in providing their people with the products and services most needed for good living conditions are also the places that face the prospect of burgeoning increases in population pressure against their limited resources. As was indicated in Chapter 3, these nations face an expected doubling of population numbers by 2050 if fertility rates remain at their 2004 levels. If these nations have problems now in providing their people with the goods and services, our idea of modern life demands, what chance do they have of doing so with a doubling of population pressure against their resources? Stabilizing population growth rates would seem to be a world responsibility that must be pursued if sustaining the worldwide environment and quality of life are worthy goals. The relationships among population growth, the needs and aspirations of people, social discontent, and prosperity have become more complex today than ever before.

As we face up to the population increase problem, we must recognize that our perspective on this issue has changed with passing time. High birth rates were needed for long centuries to balance the deaths caused by disease, wars, and famine. With the improved living conditions of the last three centuries we have needed more people to settle empty lands and provide a work force that has contributed greatly to the human prospect. Many observers feel, however, that our earlier view of population increase as a blessing is now outmoded. They submit that we have gone far enough in multiplying and replenishing the earth, and that further growth can be too much of a good thing. Further population increase for many areas means more congestion and the possible undesirable stretching of an often limited resource base to meet the needs of more people. Sustaining the environment calls for limiting population numbers, and the volume of average per capita demands they create, to the productivity limits dictated by the carrying capacity of our environmental resource base.

Adjustment to the problems of securing worldwide peace, securing better allocation of income and wealth among people, and reducing the threat of overpopulation all call for institutional changes. Education and modifications of attitudes on these issues are needed if we are to be better able to act in the interests of sustaining the environment and our society. There must be some recognition that in order to act in one's best interest it is necessary to act in the interest of all, humans, and the natural environment.

Our concept of property rights is another institutional factor that has considerable bearing on how environmental resources are treated in the future. Strong arguments have been advanced for privatizing rights once held in common property resources. There is nothing wrong with the concept of private property as long as owners exercise their rights in ways that contribute to the well-being of their communities, as well as of themselves. Sustaining the environment may very well call for reexamination of the rights we have in property with a reassignment of emphasis on the responsibilities owners have to use their properties in the interests of society. As Gareth Edwards-Jones et al. (2000) have indicated, property should be seen not so much as a commodity that can be bought and sold but rather as a body of entitlements that carry with them responsibilities for care, community stewardship, and intergenerational equity.

Despite considerable complexity, or perhaps because of it, effective land resource management has never been more needed. Land Resource managers must not only have the necessary wherewithal to understand the complexity of people's needs and wants, but also understand the greater potential for conflict and problems if resources are not well-managed. They must be adequately equipped to effectively balance current against future needs, and find ways to provide critical benefits from the environment while preserving regenerative capacity. They must be willing to see problems and solutions through multiple disciplinary lenses simultaneously and recognize connections and related impacts.

Today's quality of life is strongly linked to tomorrow's. Imbalances today increase the likelihood of current and future instability. The environment is no longer just a resource to be exploited with little consequence for the economy and for national security. Overexploitation can have economic and national security implications of significant proportions. The times call for knowledgeable people to help deal with very significant problems as society seeks to balance the needs of today and tomorrow. In addition to considerations of resource management over time, we are faced with the current reality of a global community where actions in one geographic place can dramatically impact the entire planet. Although the world has changed rapidly with technology, human perceptions, as well as formal and informal institutions, have often lagged behind.

One motivation for producing this book, and for the detailed treatment of the foundations of land resource management, is to provide a map that shows where we’ve come from, and how we got to the present. It provides a context to understand how humans have viewed the natural world in the past and looks at why these views were accepted institutionally over time. A second, and equally compelling reason to write this book, is to look ahead and see future possibilities that almost certainly reflect rapid and fundamental changes. It points the direction toward a sustainable and prosperous future and calls upon land resource managers to make the best possible decisions, not only for profits, but for people and the planet.

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