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Environmental Quality Analysis

Theory & Method in the Social Sciences

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Volume 4

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Each paper presented at the conference was followed by one or two formal discussions. All of the discussants raised significant points and some of them were outstandingly penetrating. The main purpose of the formal discussions was to help the authors improve their papers, and in almost all cases the papers were substantially revised in light of them. Accordingly, the editors have decided not to publish the discussions themselves.

ENVIRONMENTAL QUALITY ANALYSIS

Theory and Method in the Social Sciences

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BACKGROUND

By now it is certainly not necessary to point out that environmental quality is a matter of deep interest and concern to the citizenry, government, and the professions. But for the social sciences it is a new area of concern. With the exception of some theoretical inquiries in economics and some early work in social psychology, applied social science work on environmental questions is less than ten years old.

Resources for the Future ventured into the environmental field as a result of natural evolution in its research mission with respect to natural resources. When RFF came into existence about fifteen years ago, the United States was at the crest of a wave of concern about the scarcity of natural resources. This followed a period of rapid depletion of resource stocks and little new exploration or development during World War II. A period of quantitative study at RFF indicated that resources scarcity as such was unlikely to put a brake on economic development in the United States until at least the end of this century.

But it also became clear that consideration of resources problems could not stop with this comforting conclusion. It was already apparent in the late fifties and early sixties that the quality of some of our important, if neglected, resources—particularly air and water—was deteriorating. Moreover, projections of resources inputs implied that vastly larger quantities of fuels, foods, minerals, and forest products would be used in the future. Conservation of mass tells us that these materials do not disappear into the void after they are burned and processed, but that a residual mass about equal to that initially extracted from nature must eventually be ac-

commodated. Unless economical and carefully designed control of residuals generation and recycling processes is undertaken, the common "dumps" of air and water must suffer spectacular quality degradation with grave effects on ecology and in due course on man. Furthermore, as time passes it will be necessary to utilize lower grades of ore deposits that require more processing so that progressively more energy and residual "tailings" will be associated with each unit of resource recovered. Accordingly, residuals will tend to rise at an increasing ratio with the use of resources. Also there will be a tendency to reach further into remote places to obtain resource commodities and energy, thus destroying or threatening to damage rare ecological or geomorphological features.

For the last decade RFF has been developing a program of studies on environmental quality. The focus in this program remains on *natural* resources so at this stage it does not incorporate much work on some of the more strictly urban concerns that are often included under the broad, and usually ill-defined, term "environment." These concerns include such matters as the aesthetic aspects of buildings and urban patterns, bad housing, traffic congestion and accidents, and crime. Thus the large-scale problems of managing the quality of such natural resources as air, water, and ecological systems is a subset, but a very important subset, of what are often called environmental problems.

The papers brought together in this volume are an extensive, but by no means complete, sampling from the work of the RFF program on the quality of the environment, which falls naturally into three broad areas: (1) The Environment and Economic Growth. This includes both theoretical and empirical projects on the impact of growth on the natural environment. (2) Management Programs. This includes both formal mathematical modeling to aid in understanding the complex interrelationship between human activities and environmental systems and analysis of salient public policy alternatives. (3) Political and Legal Institutions. The environment presents society with the problem of making special kinds of collective choices; i.e., about how particular commonly owned natural resources are to be used. They are special because with respect to traditional resources like land and minerals we usually rely mostly on the market to make these choices. Questions of leadership and institution building are also deeply involved here.

Understandably, in view of its short history, social science research on most of these issues is still largely at an exploration or methodological stage. But work is now advancing rapidly as we hope the papers in this volume will show. Before turning explicitly to them, however, we will develop the conceptual basis for RFF work in this field a little further and make some comments on the background of social sciences research in it.

A USEFUL CONCEPT FROM ECONOMICS

To address a research problem effectively it is important to have a reasonably clear concept of its central character and preferably one to which the pertinent disciplines can relate their work. We cannot hope to find such a concept that would please everyone, even in the social sciences. But we do know that for it to be operationally useful for social science research it must pertain to society's decision making systems and institutions, and yet, to be useful in connection with natural resources problems it must also intersect in meaningful ways with the phenomena of the natural world.

It seems to us that the most nearly suitable concept is that of "common property resources." The common property terminology arose out of the contemplation by economists of a rather limited range of natural resources problems—although in a more general sense it grew out of the term "commons" applied to commonly held lands of medieval England. Problems such as those associated with the exploitation of petroleum pools, groundwater aquifers, and ocean fisheries came in economics to be called "common pool" or "common property" problems. This is because the physical circumstances of their occurrence made it difficult, if not impossible, to assign private property rights to clearly identifiable portions of them under prevailing social institutions. Mapping out holdings on the surface of the earth or water did not suffice because the valued resource was "migratory" or could be captured in disproportionate amounts by intensive exploitation at particular places. So long as the prices or values of these resources could not be established by private exchange, the market system failed in a most fundamental way to allocate them to their most productive uses or provide for a pattern of development or exploitation which would serve both present and future uses in an efficient manner.

While economic theory has long recognized the existence of such situations and worked out an elaborate explanation of the types of overuse and misuse of resources that must result, these cases were treated as rare and exceptional occurrences in the overall workings of the economy. In general the economic theory of resources use and allocation has developed on the presumption that virtually everything of value is suitable for private ownership with little or no "spillover" to other persons, households, and firms when the private property is put to use by its owner. If this were true, the competitive market could then be visualized as a mechanism through which all mutual gains from trade could be exhausted until no one could be made better off by further exchanges given his preferences, the resources available to society, and his ability to call on those resources (the distribution of income). These statements may be regarded as a loose

description of the fundamental theorem of modern welfare economics. Of course, it was realized that sometimes adjustments had to be made for "market failure," but these were implicitly, if not explicitly, regarded as minor with respect to the overall allocation.

But it has become more clear over the past few decades that the pure private property concept applies satisfactorily to a progressively narrowing range of natural resources and economic activities. As time has passed, common property natural resources have become rapidly more significant in our production and consumption activities and in the quality of life more generally. This has resulted both from their increasing scarcity and their declining quality as well as from the fact that they tend to be "superior goods," the demand for which rises more than in proportion to increases in income. The air mantle, watercourses and oceans, landscapes, the electromagnetic spectrum, complex ecosystems, climate, and rare geomorphological features of the earth are becoming relatively more valuable than the goods and commodities whose production impinges upon these "superior goods." Private property and market exchange have but little applicability to their allocation, development, and conservation. Collective choice mechanisms and institutions are needed if they are to be used and conserved effectively and efficiently. Man is not only overusing and misusing these resources in quite understandable ways, given our current institutional milieu, but actually is starting to affect the basic supply of some of them—for example, through inadvertent weather, climate, and biota modification. We are at but a primitive stage in our understanding of these resources, and of the problems of management, analytical methods, policy, and institution building with which they present us—although it can be claimed that the papers in this book reflect progress in all these respects. In one way or another they all relate to the problem of managing that set of natural resources that are held in common by the society.

PREVIOUS WORK IN THE OTHER SOCIAL SCIENCES

If economics has been slow to adapt itself to the increasingly pervasive importance of common property natural resources, attention from other disciplines, with the exception of law, has been close to nonexistent. There was a phase in the development of sociology, social psychology, and social anthropology, extending into the twentieth century, when the influence of the natural environment on human behavior was regarded as important if not dominant. There were reasoned, if not necessarily correct, links from climate to physiology to personality and finally to war and politics. There were even some primitive efforts at the application of scientific

method to the propositions. For example, early in this century, Edwin Dexter correlated weather and behavior, including such things as deportment in New York public schools and murders and arrests for drunkenness in Denver. Theories like his fell into disrepute later in the twentieth century with the result that sociologists, social psychologists, and social anthropologists turned their attention almost entirely away from the natural world. Moreover, as American society became more urban, these fields came more and more to be populated by persons of urban origin and orientation. The result is that there is very little in the recent literature of these disciplines helpful in understanding basic attitudes toward, and preferences with respect to, common property natural resources or in devising collective management policies, strategies, and institutions with respect to them. A few good beginnings have been made but have not been followed up by the force of concentrated professional research. For example, Walter Firey in his *Land Use in Central Boston* (Harvard University Press, 1947) showed that the value of land in Boston was not so much a function of its location with respect to natural features or relative to the remainder of the city but was associated primarily with symbolic meanings. Interestingly, the most pertinent and successful work with a social psychological cast was done not by social scientists as such but by geographers—especially those associated with Gilbert White at the University of Chicago. In recent years there have been a few studies by sociologists and political scientists of the institutional aspects of watershed organizations and of decision making with respect to specific issues relating to water supply or water pollution at the local governmental level. Only a few sociological studies have been made of societal power structures with respect to environmental problems; perhaps the most ambitious of these is reported in this volume.

Political science research is equally undeveloped with respect to what is so centrally a problem of politics and government—the management of common property natural resources. Our political institutions face a number of hard challenges arising from the rapidly growing importance of common property resources. For example, the "problem sheds" in which these problems occur do not conform in areal extent to existing units of government. They are regional and international—rarely local, state, or national. Thus we face the difficult problem of designing government institutions to comport better with the spatial character of these problems and defining the relation of these institutions to governments of general jurisdiction. Furthermore, since the market does not assign values to common property natural resources, we must learn to understand what kind of political structures can accurately reflect the preferences of affected people. While political scientists and public administrators have con-

cerned themselves with natural resources—especially water resources—they have usually not addressed the problem of institutional design, and the existing literature as yet contains little of real help on this pressing problem. A small group of political theorists, economists, and legal scholars is now beginning to provide a structure for the analysis of these problems and to make some progress on them. A substantial part of this work is reflected in the final section of this book.

PLAN OF THE BOOK

This book, like the RFF program, is organized around the three main themes—understanding environment and economic growth, developing management programs, and designing political and legal institutions. For the most part the papers are theoretical and methodological in character as is fitting at this stage of social sciences work. But if this were the end of the matter little would have been gained, for empirical work based on carefully developed theory is badly needed. Several of the papers already report significant empirical results, and some of the others are at the take-off point for applied work. We feel that there can be found in this book at least modest encouragement that the social sciences will meet the challenge to help improve the management of our common property resources.

The first paper in the section on environment and economic growth is by Ralph d'Arge. He applies the concepts of modern economic growth theory to a situation where finite limits exist, both with respect to non-renewable natural resources that serve as inputs to production-consumption processes and to the ability of the common property environmental resources to accommodate the unrecycled residuals from these activities. This involves the application of a "materials balance" approach adopted from basic physics. Put simply, this means that the mass of residuals generated is equal to that embodied in the natural resources inputs used in production and consumption, except for that part that accumulates in the economic system. The residuals generated can be disposed of ultimately in only two ways: recycled back into production and consumption activities or discharged into the environment—air, land, water. A portion, and often all, of the residuals generated is discharged to common property resources. Such discharge is therefore unpriced in the ordinary course of market exchange, even though the waste disposal services rendered by the environment conflict with other valuable uses of the common property natural resources. The second paper in this section (by Robert Ayres) uses a similar approach, but at a much more detailed and therefore less