AMERICA'S NATURAL RESOURCES

Edited for the Natural Resources Council of America

by

CHARLES H. CALLISON
NATIONAL AUDUBON SOCIETY

Revised Printing

THE RONALD PRESS COMPANY • NEW YORK
1967

CONTENTS

1 CONSERVATION: AN ECOLOGICAL APPROACH . . 3
Shirley W. Allen

2 RENEWABLE RESOURCES AND HUMAN POUULATIONS 10
Fairfield Osborn

3 SOIL 24
Firman E. Bear and Selden Lee Tinsley

4 WATER 43
H. G. Wilm

5 GRASSLANDS 62
David F. Costello

6 FORESTS 86
Henry Clepper and Lowell Besley

7 WILDLIFE 111
Joseph J. Shomon

8 FISH 136
Albert S. Hazzard and William Voigt, Jr.

9 PARKS AND WILDERNESS 152
Howard Zahniser and Michael Nadel

10 LAND-USE PRINCIPLES AND NEEDS 170
Edward H. Graham

11 NEEDED: A NATURAL RESOURCES POLICY . . . 187
Ira N. Gabrielson

APPENDIX A: A POLICY FOR RENEWABLE NATURAL RESOURCES 199

APPENDIX B: THE CONTRIBUTORS 203

INDEX 209

CHAPTER TEN

LAND-USE PRINCIPLES AND NEEDS

Edward H. Graham

The dictionary definition of land is "The solid part of the surface of the earth." One of the first facts of geography is that the surface of the earth is three-fourths water. Essentially terrestrial creatures, we feel the vastness of the oceans and the great water areas of the earth as somehow unreal and forbidding. Even the land, as we come to know more about it, seems less friendly than it might, for half of it is desert, mountain, or polar area—much too dry, cold, or otherwise severe for permanent human habitation. Although much of the other half is adapted to the growth of grass, shrubs, and trees, and man can live there in relative comfort, it is a somber fact that not more than one-tenth of the earth's land surface has the combination of climate, topography, and soil necessary for the production of food.

In considering the natural resources that the land provides, we obviously require more than the usual dictionary definition of land. Land is more than the solid part of the earth's surface. It is more than a geographic area. It is

more than real estate. Land, as it has come to have meaning to us today, is a natural resource possessing many tangible and intangible values.

The value of land may be expressed in various terms. The use of land for human habitation may be considered its most practical value. Next to habitation, the production of the essential elements of living is most valuable—food, clothing, and shelter. Other uses of land follow as man and his works become more and more diverse. Land for transport, industry, and recreation now has great value. It is now possible to state principles that express the character and value of land from an ecological point of view.

Principles

LAND EXPRESSES NATURAL FACTORS. *It is a principle of land use that an area of land is an expression of all the various natural factors existing in the area.*

Even in this day and age, land represents the fundamental resource to which other natural resources are related and of which they are a part. We have yet to think of resources as being closely related to each other, but only in that way can we properly evaluate them. The animals of an area do not exist apart from the vegetation. The plants depend upon water and the soil. The soil is related to the vegetation as well as to the topography and geologic history of an area. The climate, in one way or another, influences both soils and living things, interdependently. All these natural factors are interrelated and they interact.

Land varies greatly from place to place, depending

upon conditions. The arctic tundra is sparsely inhabited but supports no agriculture. Deserts with low rainfall and poorly leached mineral soils are traditionally nomadic grazing lands, although they are often profitably cultivated when they can be irrigated. Much of the tropics is best adapted to tree growth. The alluvial lands of the world, replenished regularly by flooding, have supported great civilizations from the beginning of history. The temperate zone woodland areas support much of the world's subsistence farming, while the natural grasslands have become our great granaries. Thus we find that there are broad correlations between portions of the earth and the things that man has been able to do with them. We have taken such broad generalizations for granted, but the relation of man to the place in which he lives is basic, and only in degree does it vary for smaller areas and specific sites.

Some of the earliest civilizations were developed in semiarid areas where, along the flood plains of the great rivers, intensive agriculture was possible. The delta lands of the Nile, Tigris-Euphrates, and Indus Rivers saw the growth and development of great social orders. There man selected the soils that were well watered and richly nourished for raising the crops he required.

Early man was not confined to river deltas, however. The history of England shows us that Neolithic man used forested lands to support him. The contemporaries of the fierce auroch and the great Irish elk, these people with their polished stone implements reached the British Isles about 5000 B.C. Their practice of agriculture, together with their flocks and herds, had such an impact upon the native forest that it never recovered.

During recent centuries, the agricultural demands for

land throughout the world have resulted in use much more intensive than any practiced by earlier peoples. Such recent demands, due largely to a greatly expanded human and domestic animal population, have caused destruction of native vegetation, soil erosion, and disturbance of natural conditions on a scale so unprecedented as to constitute conservation and land-use problems quite new in human history.

LAND POSSESSES PRODUCTION POTENTIAL. *It is a second principle of land use that an area of land possesses a characteristic energy system or production potential.*

Throughout the history of modern man the *amount* of land available has not diminished, at least to any appreciable extent. On the other hand, the *condition* of the land has been greatly modified. Today there is no land that is not used, in the sense of its having some value to man. Even the Antarctic has always had a challenge value, and now provides the setting for an unusual example of international scientific cooperation, where twelve nations are collaborating in physical and biological research. The high mountains possess esthetic value and the great deserts a wilderness worth that cannot be duplicated. Elsewhere the lands of the earth have been cleared, cultivated, lumbered, grazed, or inhabited, some of them for as long as human societies have existed.

It is characteristic of man's history that his societies have become steadily more and more complex, and within recent time this complexity has increased at a geometric rate. While this complexity has given rise to infinite problems in the economic and social phases of community, national, and world organization, its effect upon the land has also been appreciable.

A country like the United States with varied land resources and a relatively sparse population may support a high standard of living without precise attention to land-use principles. A small country like Holland, with a high population per unit of land, can enjoy a high standard of living only as a result of meticulous attention to land management. It is doubtful if some of the desert countries of the Middle East can ever aspire to such heights, although the possession of a coveted resource such as oil may for a time support an economy independent of land resources. Some countries, such as Switzerland, exchange for land products the products of their own invention and industry. It must also be recognized that some peoples live largely on the products of the sea. In fact, the land cannot in its fullest meaning be separated from water and the resources that water makes available. But, in a general sense, it remains axiomatic that people depend upon land, and that there is a relationship between the land and its capacity to support a human population at a particular standard of comfort and leisure.

Each site, therefore, is possessed of inherent characteristics that determine its value to man, in terms of the energy he may convert to his purposes. Although man may increase the productivity of a site, such increase bears a direct relationship to the natural characteristics of the site. Only at great expense can a site of low potential be made to produce abundantly. On the other hand, the energy system of a land area is not static, but may vary from time to time in accordance with cultural practices or as natural influences vary—seasonally, as with variations in temperature; over a period of years, as with rainfall; or geologically, as with climate.

CULTURE IS RELATED TO ENVIRONMENT. *A third principle of land use is that the culture pattern and behavior of a people are related to the natural environment that supports them.*

From the time man first used the land, he must have felt the need to make it produce more abundantly. Improvement of wild plants by selection is so old that the world's major crops have no living progenitors in the wild. Irrigation is ancient, and much primitive agriculture was not possible without drainage. In the interior of New Guinea there is a people still practicing stone-age agriculture who turn under vegetation for green manure and use contour terraces for erosion control. In both the New and Old Worlds, mountain lands were made habitable and capable of supporting large numbers of people by well-developed terrace agriculture, including systems of water manipulation. The Greeks used leguminous crops for "reinvigorating" the soil, and the Romans employed systematic crop rotations. In seventeenth-century England, Jethro Tull's "horse-hoeing husbandry" introduced the age of mechanized farming by his machine drill and system of cultivating throughout the growth of the crop. A century later the Frenchman, Boussingault, introduced the era of agricultural chemistry by his pioneer experiments in plant physiology.

Wherever man has used the land, he has shown an uncanny capacity, undoubtedly the result of repeated trial and error over a long period of time, to learn to use the most productive lands for most intensive use. Such empirical method has been followed to the present day. If we once more look to England, a country where land has been intensively used for a long time and whose land-use

history is well known, we find that technologic developments over the centuries have steadily improved land yields and helped to support more and more people.

Today we have the advantage of a great wealth of information from the biological and physical sciences that may be applied to more intelligent use of the land. The practical results of such knowledge are in some instances remarkable. The application of minute quantities of molybdenum to the soil, for example, may be sufficient to triple the yield of alfalfa. The United States is a notable example of a country that has increased its agricultural production. Farm production per man-hour has increased more than 75 per cent in the last decade. Today one hour of farm labor produces more than five times as much food and other crops as it did 40 years ago. In 1940, one farm worker supported ten others; today he provides food and fiber for 33 others. Although our per-acre yields in a few crops are still below those of some countries where intensive hand labor gets more from the land than we do, our yields have increased more than 60 per cent over those of pre-World War II days.

In the face of modern technologic "miracles," the natural limitations of the earth are sometimes questioned, and the claim is made that the powers of modern science will make possible food and human necessities without end. But the nature of the earth and the history of peoples show that the natural environment is always a powerful force in determining what man gets from the land. Both science and environment are tools at our disposal. On one hand, the population of the earth is increasing so rapidly as to simulate an "explosion," as the demographers —scientists who study population statistics—have so graphically disclosed. On the other hand, our knowledge in-

creases at an "explosive" rate also. If it could be charted, it is not at all unlikely that the sum of our knowledge would show a steep upward curve approximating that of population and the demands that we make upon our resources.

It has been rightly said that we live in a cultural environment in which economic, social, and technologic factors are paramount. In human affairs this cannot be denied. The point of this chapter, however, is that such cultural environment is inseparable from, and is based upon, a natural environment. The natural and the cultural are interrelated, and should not be thought of as either antagonistic or separate.

LAND HAS NONCOMMODITY VALUE. *A fourth principle of land use is that an area of land possesses human values in addition to its production potential.*

There are many values of land that do not derive from the capacity of a natural situation to produce commodities. Some of them are utilitarian, others are intangible; all of them are real. Among the utilitarian values of land apart from commodity production is site value. All of the works of man—his dwellings, factories, monuments, water impoundments, roads, airports—are located according to his needs and preferences. There must be land on which to place these works, and various kinds of land possess special values for particular purposes. The site value of land has always been important, but as man has increased in numbers the value of site has correspondingly increased.

It is one of the verities of our time that the needs of man have become greater out of proportion to his sheer increase in numbers. No longer is it sufficient for the land

to produce food, clothing, and shelter. It must in addition provide many other things. It must provide cellulose for plastic products unknown only a few years ago. It must yield more space for roads, for we travel more and reach farther for food and other products of the land. Even air transport demands land—a modern airport requires 5,000 acres or more. By 1960 more than 50 million acres, including much good agricultural land, had been absorbed by towns, cities, and industrial developments. This shift in land use is accelerating at a rate that is now approaching two million acres per year.

In some of the countries of Europe the demand for land has reached the point where it can no longer be met. The most difficult land-use problems in such countries as Holland and England often center around the most desirable choice to be made from many alternatives, many times involving conflicts between urban and rural demands. In the United States we now recognize the encroachment of urban developments upon agricultural land as a problem of serious national dimensions. Locally, it has meant the disappearance of valuable farm lands suited to the production of specialized crops, as illustrated by the suburban invasion of orange groves and walnut orchards in California and the usurping of truck-crop soils by a turnpike in New Jersey.

The intangible values of land are of extreme importance. "Man does not live by bread alone." As people have come to work shorter hours and gain longer vacations, the demand for enjoyment of the outdoors has increased. There is today a pressing need for more parks and recreational areas. These may vary from easily reached municipal playgrounds and county parks to state, national, and international areas of unique character.

Wilderness areas are being championed by those who wish to camp, hike, or canoe in wild country far from the distractions of the city or urbanized outdoor recreation. Natural areas are often preserved for purposes other than their recreational value. Wildlife refuges may perpetuate homes for rare or vanishing kinds of wild animals and plants. Some areas are protected for their unusual scientific or scenic interest.

This brings us to consideration of land for its aesthetic value alone. The scenic grandeur of landscape has been one of the important reasons for the establishment of public parks, especially those of national and international character. Another reason has been the preservation of the native vegetation and wild fauna that inhabit the areas. In its potentialities for fulfilling an appreciation of the aesthetic, we find the most delicate and sensitive value that can be ascribed to land.

Needs

From the foregoing consideration of principles, we find that certain needs must be met if we are to make the most reasonable utilization of the land resources available to us. Such needs relate to a thorough and appropriate knowledge of the land, an integrated system of instruction in our schools of higher learning, and the practice of good land use by those who work with and manage the land.

LAND INVENTORY. *There is need for a comprehensive knowledge of our land.* The existing systems of land classification are important and pioneer steps in making the most of the capacity of our land to support us. Based on

various environmental factors, systems of land classification have been developed as guides for using land without lowering its productive capacity. Such systems are being improved and made more readily applicable to specific purposes. They serve largely to distinguish kinds of land useful for cultivated crops, pasture, range, woodland, and wildlife. Within each of these major kinds of agricultural use, more detailed separations are needed and have to some extent been developed. For crop lands there are capability units; for range lands, range site and condition classes; for woodlands, tree site indexes. There is a growing need for greater refinement of land classification and other guides to use of land for agricultural crops, whether cultivated, livestock, woodland, or wildlife.

Many countries, including the United States, have within recent decades found it necessary to adopt national legislation that provides for various means of production adjustment when the supply of certain agricultural crops considerably exceeds or falls short of the demand. A proper land classification may well serve as a sound, ecologic evaluation upon which such necessary economic adjustments in agriculture may be made. A land capability inventory adequate for such broad agricultural purposes exists in the United States for approximately 400 million acres. The classification of 100 million acres more could be made adequate with some revision. We need almost half the land in the United States classified according to capability, if we are to have a sound basis for a dynamic, nationwide program of production adjustment, acreage allotments, and major shifts in use for our agricultural lands.

The need for a comprehensive land classification extends beyond our agricultural demands, however. We

need to know the suitability of all of our land for all potential uses. If we are to approach the urban-rural conflicts in use, we need land-use guides as points of departure. There is little wisdom in the construction of extensive suburban developments on high-quality agricultural soil, particularly if alternative sites are available. Once covered with brick and concrete, productive land is for all practical purposes never again available for agricultural production. Granting that there are many problems that will not be settled by even the most intimate knowledge of land, any group of town and country people who conscientiously wish to develop their community in reasonable fashion will find an inventory and classification of land to be helpful in the solution of their problems. Industrial plants, airports, military establishments, and highways are often located without regard to the inherent character of the land they occupy, and land with recreation, scenic, or esthetic value is often recklessly disturbed. The time has come when we must give careful attention to the values of all available land areas in relation to what we can best do with them.

INTEGRATED INSTRUCTION. *There is need for an integrated system of resource instruction.* It is often remarked that in conservation a scientist or technician may know his own field very well but seems woefully ignorant of any other. On the other hand, a man who knows a bit about a great many things but not much about anything may be so little wanted that he cannot find satisfactory employment. Yet in the conservation field, the only man more valuable than the specialist is the specialist who also is acquainted with fields related to his own. This man is steadily becoming more valuable. The need for him may

well be growing out of our increasing awareness of the ecological nature of the world in which we live. It emerges also from the growing tendency to tackle problems as a team. One kind of knowledge may not be enough to solve a problem. For example, we know by experience that soil erosion problems can be solved only by the coordinated efforts of soil scientists, engineers, agronomists, foresters, biologists, range conservationists, economists, and others. The same is true in other fields of land use. The need for coordinated effort is being recognized by administrators in the conservation field who either employ or consult men trained in spheres of activity other than those for which the administrators have primary responsibility.

One of the ways in which to meet the need for coordination in land-use programs is to train men in coordination. Although this can be done by private and public employers, it can be accomplished far more effectively and economically in a college or university. Frequently, the greatest difficulty in coordination is lack of appreciation of the value and importance of the work of others. This attitude could well be changed in a man's formative years. Progress is, in fact, being made in this regard. Some schools are breaking the departmental barrier, so that an engineer, for instance, can get credit for a course in liberal arts. Land-use seminars are employed where students from several departments relate their efforts to answer a single question. A few attempts have been made to give an advanced degree for a thesis that forms part of a larger work in which each part is an integrated portion of a solution to a common problem. This sort of training and experience is invaluable in preparing a student for the work he is likely to be called upon to do in

the conservation world. It should be stimulated and fostered to a degree far beyond what has so far been reached in most institutions of higher learning. This is not to deny the necessity for a thorough basic training in a scientific or specialized discipline, for a man is far more effective in coordinated effort if he speaks with real authority in his chosen field.

GOOD LAND USE. *There is a need for the practice of good land use.* In addition to the need for an understanding of land and its capabilities and for properly trained technical personnel, there remains a need for the actual practice of good land use. Experience and accomplishments in conservation in the United States during the past several decades have served to emphasize the fact that conservation depends primarily upon those who own land and those who work with it and manage it. This is true whether the land is a national park, a large western ranch, a 100-acre cornbelt farm, or a city lot. The values of the park can be perpetuated only if the administering public agency is dedicated to perpetuating them. The rancher is solely responsible for the management of the range and its vegetation upon which his livestock and the success of his ranch enterprise depend. The midwestern farmer will determine, through his normal farm operations, whether the soil and its productivity will be preserved or eroded and depleted. The suburban dweller controls the condition not only of his house, but also of his yard and garden, and upon him alone falls the responsibility of whether his place is maintained in good condition.

All of our laws, inventories, and technical skills, as well as all our normal efforts at research and education, are of little avail in achieving good land use unless they can be

brought to bear upon the land itself, and unless they become a part of the knowledge and conviction of those who manage the land. As individuals and as a nation we will achieve conservation only as we come to think and act habitually, almost instinctively, in terms of good land use. When the farmer farms on the contour because it no longer occurs to him that there is any other way to do it, as many of our young farmers now do, then conservation has become a reality. It has then become the right and ethical thing to do; it is part of the mores of our society.

In order to practice good land use, individuals and groups must have the support that derives from legal authority and other assistance available from government. Local, state, and federal governments now provide assistance of various kinds in the management of our land resources—technical, educational, and legislative. Noteworthy steps have been taken toward achieving coordinated land use within recent years. The establishment of conservation districts has permitted landowners and operators to organize themselves into legally constituted groups to receive assistance in undertaking good land use. Through watershed legislation, both federal and state, assistance is now provided beyond that available to individuals, especially in the water-management phases of the total conservation job. Such progress points toward the possibility of ultimately achieving a fully coordinated program of good land use on every parcel of land in the United States, through the initiative and participation of individuals and community groups, with proper assistance from local, state, and national governments.

Conclusion

An area of land expresses all the various natural factors existing in the area, and it possesses a characteristic energy system or production potential. The culture of a people, while admittedly a function of their society, technology, and economic order, is nevertheless intimately related to the natural environment that supports them. Land also has value beyond that for the production of commodities.

There is need for broad kinds of land inventory as approaches to natural resource problems and for coordination on the part of those who design national, state, and local programs of resource management. We need to train those who will work with the land in such a way that each will be able to correlate his efforts productively with those of others with whom he must work. And, finally, good land use becomes a reality through the practice of those who own and manage the land.

For Further Reading

CLAWSON, MARION. 1963. *Land for Americans.* Rand McNally & Co., Chicago. 141 pp.

GRAHAM, EDWARD H. 1944. *Natural Principles of Land Use.* Oxford University Press, New York. 274 pp.

LEOPOLD, ALDO. 1949. *A Sand County Almanac.* Oxford University Press, New York. 226 pp.

MACKAYE, BENTON. 1962. *The New Exploration: A Philosophy of Regional Planning.* University of Illinois Press, Urbana. 243 pp.

MUNZER, MARTHA E. 1964. *Planning Our Town.* Alfred A. Knopf, Inc., New York. 180 pp.

SEARS, PAUL B. 1939. *Life and Environment: The Interrelations of Living Things.* Teachers College, Columbia University, New York. 175 pp.

STAMP, L. DUDLEY. 1955. *Man and the Land.* William Collins Sons & Co., Ltd., London. 272 pp.

U.S. Department of Agriculture Yearbooks: 1955, *Water,* 751 pp.; 1958, *Land,* 605 pp.; 1963, *A Place To Live,* 584 pp. U.S. Government Printing Office, Washington, D.C.

WOOTEN, HUGH H., *et al.* 1962. *Major Uses of Land and Water in the United States, with special reference to agriculture.* U.S. Government Printing Office, Washington, D.C. 54 pp.