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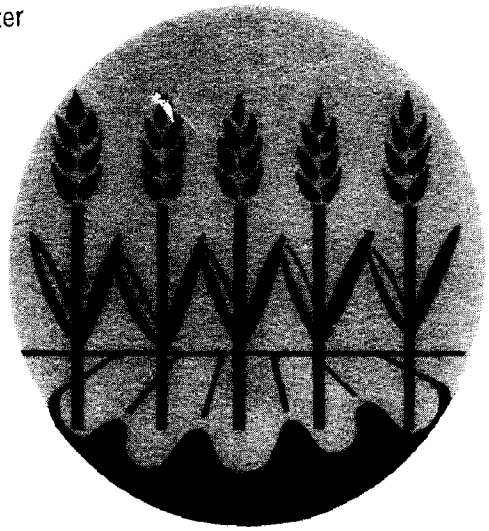

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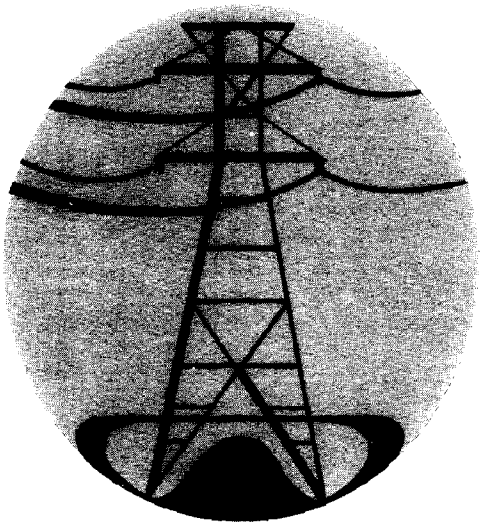
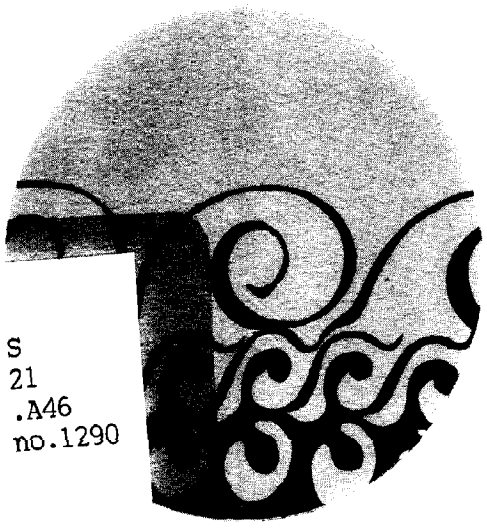


OUR LAND AND WATER RESOURCES

CURRENT AND PROSPECTIVE SUPPLIES AND USES



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ABSTRACT

U.S. land and water resources are analyzed as a basis for projecting national agricultural cropland and other land needs to the year 2000. Impact of changes in technology and resource development as well as environmental and institutional factors affecting the availability of these natural resources are discussed. Emphasis is placed on the continuing responsibility of Federal, State, and local governments to assess the adequacy of our natural resources to meet future needs and to improve the quality of the environment.

Keywords: Land, Water, Cropland, Land utilization, Landownership, Natural resources, Conservation, Government programs, Projections.

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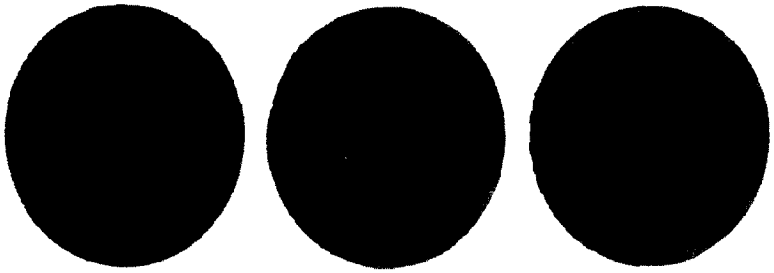

OUR LAND AND WATER RESOURCES

CURRENT AND PROSPECTIVE SUPPLIES AND USES

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Economic Research Service
May 1974

FOREWORD

Americans today have a greater appreciation than ever before of the importance of natural resources to our overall well-being, and of the need to use these resources wisely if we are to meet both present and future requirements. The quality of our environment is also an important consideration in the development and use of these resources.

For many years the Department of Agriculture has actively promoted the wise use of our land and water resources. It has done this through research and education programs, and through technical and financial assistance services available in every county and State. Because of the renewed interest in how to best use these resources in producing needed goods and services while protecting environmental values, I have directed agencies of the Department to give emphasis in their programs to measures for maintaining and improving the Nation's natural resources. Secretary's Memorandum No. 1827, *Statement on Land Use Policies,* issued in October 1973 (see the appendix), expresses the Department's goals and policies for achieving better use of our natural resources.

It is my hope that this report will be useful not only in describing the present and projected use of our land and water resources, but also in presenting some of the problems that confront us and our expectations for the future.

Earl L. Butz

Secretary of Agriculture

PREFACE

This report was prepared to provide background information for land use policy discussions. It includes a current summary of national rural land and water uses, estimates of future land and water requirements to meet projected national agricultural production needs, and a discussion of environmental and institutional factors that affect the availability of land for agricultural and other uses. Major land use problems resulting from competing uses and those causing environmental conflicts are examined.

Water supplies, trends in water use, and projected water requirements are discussed. Present and future water needs are analyzed in more detail in *The Nation's Water Resources: First National Assessment,* published by the U.S. Water Resources Council in 1968.

This report was prepared from Economic Research Service staff papers and economic studies of rural land and water problems. The primary data for these studies were obtained in large measure from resource inventories compiled by the Economic Research Service, Soil Conservation Service, and the Forest Service, U.S. Department of Agriculture. The principal sources of published data and analyses are cited in the report. These data were supplemented with information from programs carried out by the Department in cooperation with private landowners and with State and local governments.

ACKNOWLEDGMENTS

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Overall direction of the report was under Howard Hill, Orville Krause, and Robert Boxley, ERS.

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SUMMARY

Although thousands of acres of farmland are converted annually to other uses–urbanization, roads, wildlife, and recreation–and population has risen a third in 20 years, we are in no danger of running out of farmland. Increasingly efficient production methods, a declining rate of population growth, and an abundance of water resources and land with agricultural potential should ensure our domestic food and fiber needs to the year 2000 and leave enough land left over for other purposes.

Distribution of the Nation's land among major uses has not changed markedly in recent decades. Agriculture continues to use more of our land than any other segment of the economy. In the 50 States, about a fifth of all land is used for growing crops and well over a third, including both grassland and woodland grazed, is used for livestock grazing. Forest land occupies a third of the total land area. About one-eighth of the land consists of marshes and swamp, desert, tundra, and barren land. Land in urban uses has about doubled since 1950 and now makes up almost 2 percent of the total land area. One percent of the land area is used for roads, airports, and other rural transportation facilities.

How land is used, and its potential for development or conversion to other uses, is interrelated with availability and quality of water. Water supplies and demands vary widely among regions. Nationwide, 5 percent of annual runoff supply is consumed; that is, it does not return to surface or ground sources. Agriculture accounts for at least half and in many cases for nearly all water consumed in 13 of the 18 water resource regions. The Water Resources Council projects that water withdrawals for steam-electric power will exceed all other major uses by 2000 (fig. 1). Irrigation will continue to be the principal consumptive use of water, although it will decline slightly as a share of total use.

More than a million acres of rural land are converted annually to urban and transportation uses and to water storage and flood control reservoirs. Probably less than half of this land was in crops before it was converted to other uses. Total conversion of cropland to other uses currently averages over 2½ million acres a year. This acreage is partially offset by development of 1¼ million acres of new cropland each year.

This sizable reduction in cropland has been possible because of a 50-percent increase in output per crop acre during the last 20 years. Contributing to the gain in output are more efficient farm organization, increased irrigation and use of agricultural chemicals, improvements in other farming inputs, development of more productive cropland, and retirement of less productive acreage.

Under a specific set of assumptions with respect to population, exports, and related variables, acreage of crops harvested in the year 2000 is projected to decline slightly from 1969 acreage, as shown in table 1. A population growth of 30 percent and a moderate increase in exports are basic to these estimates. With a lower population growth rate and no other changes, projected requirements for harvested cropland are 291 million acres in 1980 and 261 million acres in 2000. Projected cropland requirements would increase to 304 million acres of harvested cropland in 1980 and 309 million acres in 2000, if exports of farm products are higher than assumed in the base projection. This is an increase of about 6 to 7 million acres of cropland for each $1 billion increase in farm exports. Export levels assumed for the high projection are up 25 percent in 1980 from the baseline projection, and up 75 percent in 2000.

Total acreage potentially available for crop production exceeds these projections. By 1980, the total acreage of cropland harvested could range from 340 to 350 million acres, assuming no limitation on crop acreage and favorable cost-price relations for agricultural production. This increase in crop acreage could be met by more complete use of land now in farms with a cropping history and continuation of cropland development at about the current rate. In the longer term, considerable additional land could be developed for crop production, although costs could be quite high because of the extensive improvements–clearing, drainage, irrigation, etc.–needed to make it suitable for regular cultivation.

Acreage required for urban needs is projected to grow by as much as 21 million acres between 1969 and 2000. Some increase in the area used for recreation and wildlife habitat is expected. Where recreation and wildlife uses are introduced as a multiple use of

Water Uses: 1965 vs. the year 2000

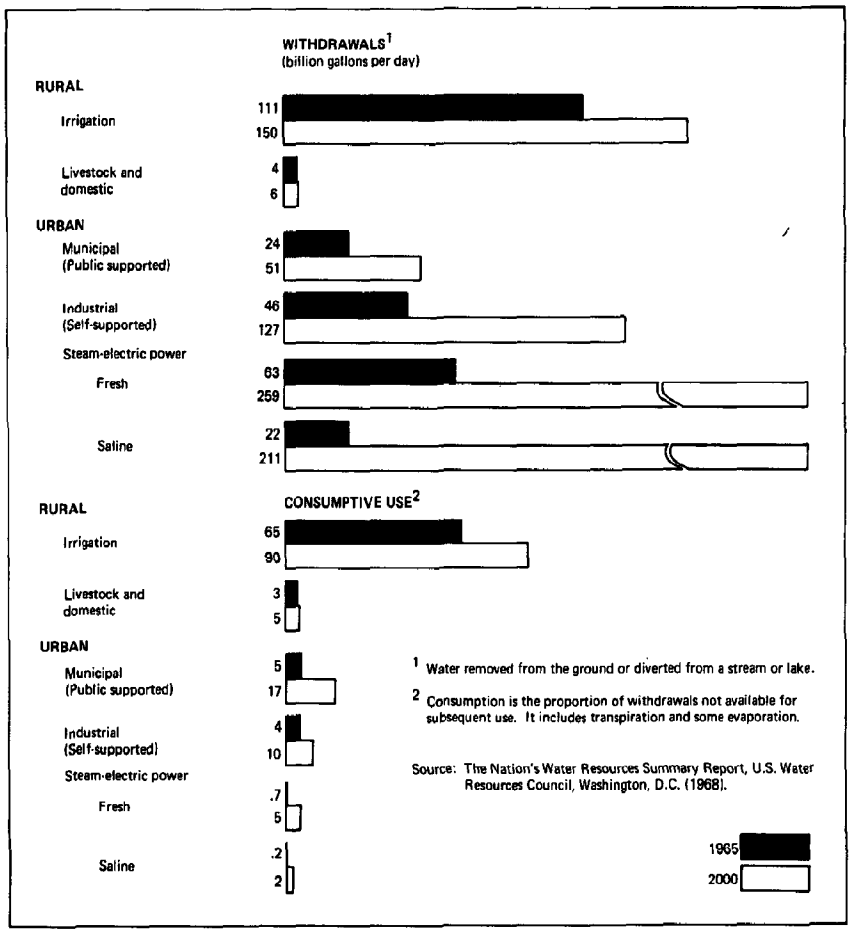


Figure 1

Table 1–Major uses of land in the 48 States: Historic and projected, 1949-2000

Land use	Historic		Projected[1]	
	1949	1969	1980	2000
	Million acres			
Cropland used for crops[2]	387	333	320	298
Cropland harvested	(352)	(286)	(292)	(272)
Forest and woodland[3]	601	603	591	578
Pasture, range, and other agricultural land[4]	768	767	771	782
Urban and related[5]	42	60	66	81
Other special uses and miscellaneous uses[6]	106	134	149	158
Total land area[7]	1,904	1,897	1,897	1,897

[1] Land use projections are derived from projections prepared for the Water Resources Council by the Economic Research Service, and the Bureau of Economic Analysis, Department of Commerce. Exclusion of data for Alaska and Hawaii significantly affects acreage of noncommercial forest, wasteland, and total land area, but has little effect on agricultural and commercial forest acreages.

[2] Cropland harvested, crop failure, and cultivated summer fallow.

[3] Excludes reserved forest land in parks, and other special uses of land. The total acreage of forest land in the 48 contiguous States was approximately 627 million acres in 1949 and 632 million acres in 1969.

[4] Permanent grassland pasture and range in farms and not in farms, land in crop rotation but used only for pasture or idle, and miscellaneous other land in farms.

[5] Area in urban places, highway and road rights-of-way, railroad rights-of-way, and nonmilitary airports.

[6] Includes National and State parks and wildlife areas, national forest wilderness and primitive areas, national defense lands, State institutional sites, miscellaneous other special uses, and unclassified areas such as marshes, open swamps, bare rocks, sand dunes, and deserts.

[7] Change in total land area is attributable to changes in methods used in occasional remeasurements by the Bureau of the Census, and increases in the area of manmade reservoirs.

land, however, land will not necessarily be converted from other uses such as agriculture or forestry. The area required for national defense installations, water storage and flood control reservoirs, and surface mining is expected to total 5 million acres by 2000. None of these projected changes would substantially alter the present distribution of major land uses.

The sum of the many private and public land use decisions has importance both for the near and the long term. This concern for the future is evident in several areas of current national interest in which land use has a central role: meeting present and future needs for agricultural and forest products, allocating land among competing uses, improving envrionmental quality, meeting present and future energy needs, and devising institutions to reconcile private and public interests in resources and achieve local, State, and national goals for resource management and use.

Government and citizen participation in setting objectives for land use, and designing measures to achieve these objectives, are essential elements of land use policy. The demonstrated broad interest in environmental improvement, which directly touches on many land use decisions, is evidence of growing public concern about the adequacy of our land and water resources to meet increasing needs. Decisions made now about the way land and water resources are developed and used will affect our own well-being and that of future generations.

INTRODUCTION

The Nation's land and water resources, while abundant, are limited in the amount of products and services they can supply. Changes in technology and resource development affect the amount and productivity of our natural resources, while factors such as population growth and migration, industrial development, and changes in goods and services the people desire affect demands for the products of land and water.

The adequacy of our land and water resources to provide products and services essential to the well-being of all the people, now and in the future, is a continuing concern. Actions to improve environmental quality or to meet energy needs will affect future land and water use. Environmental and economic objectives, including estimates of the demand for national food and fiber production, need to be jointly considered in assessing long-term consequences of alternative resource programs and resource development decisions.

Each level of government–Federal, State, and local–has powers to influence the way people use land. The Federal Government directly manages a large area of land and, through its spending and taxing powers, also influences land use decisions. Federal cropland retirement and cropland adjustment programs are examples of programs that have had major influence on land use. Other Federal programs, such as those for water resource development, transportation, power, and regional development, have land use effects that frequently extend beyond State boundaries.

The States have broad authority to regulate land use and some have enacted legislation directed toward environmental and land use problems. A number of States have enacted legislation permitting special tax treatment of farmland. Local governments also have the power to regulate land use. Every State has enacted legislation that permits some zoning of rural land. Most cities, and many counties within Standard Metropolitan Statistical Areas (SMSA's), do detailed land use planning.[1]

No single approach or prescription can be offered for resolving land problems. Broadly speaking, the problems arise from changing objectives and needs for the products and services of land. Possibly the most challenging problem in achieving better land use is in devising workable and acceptable institutional arrangements for guiding or coordinating land use decisions.

LAND RESOURCES

Major Land Uses

Demands on our land resources have increased greatly over the last two decades. Population has grown by a third, while the total output of goods and services has risen even more because of an improved standard of living. In spite of these demands for food and fiber and space for living in the rural environment, the total land use pattern has remained virtually unchanged (fig. 2, table 2). As in 1950, cropland still comprises about a fifth of our total land area, grassland pasture and range about a fourth, forest land about a third, and wasteland an eighth.

Land for urban uses has about doubled since 1950 but still takes only 1½ percent of our 50-State land area. Land for transportation purposes (about 1 percent of the total) is up only slightly because many new roads have been built on existing rights-of-way and some roads have been abandoned. In response to greatly increased demand, land designated as recreation and wildlife areas has tripled and now accounts for about 4 percent of the land resource (table 3). The increase in this category is largely due to a reclassification of some public forest or wilderness while the land cover itself remained unchanged. Total land available for recreation, including land available in the other primary use categories on a shared basis, comprises a high share of the country's total area. This recreation land is discussed later.

Land use varies greatly among regions of the 48 contiguous States. More than half of the land in the

[1] A Standard Metropolitan Statistical Area (SMSA) is defined by the Census Bureau as a county or group of contiguous counties (except in New England) which contains at least one central city or twin cities with at least 50,000 population.

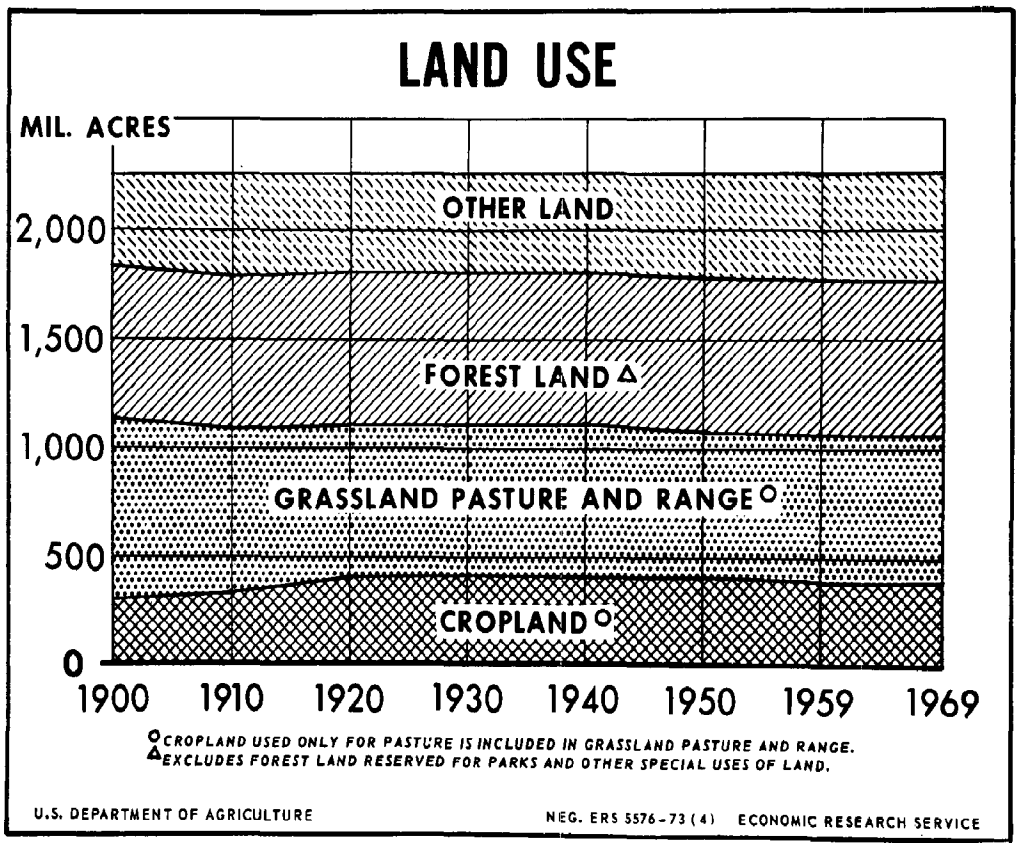


Figure 2

Corn Belt and the Northern Plains is in cropland. Pasture and rangeland predominate in the Southern Plains and Mountain States. Forest land is the major use in the Northeastern, Appalachian, Southeastern, and Delta States, and along the Pacific Coast above San Francisco.

Land use and management problems in Alaska differ from those normally experienced in other States. Alaska, with 363 million acres, accounts for 16 percent of our land area. About 60 percent is in the miscellaneous "other" category (swamp, tundra, bare rock, etc.,), and a third is in forest land; relatively little is in cropland. The climate is subarctic, population density is very low, and land is practically all in public ownership.

Cropland

The Nation's cropland resources total 472 million acres, or 21 percent of the land area. This total represents neither the acreage actually used in crop production each year nor the acreage that could be used for crops. Rather, it represents the acreage presently in the crop rotation. In any given year, part of the available cropland is used for crops, part is used only for pasture, and the rest is idle. Component acreages of the total cropland base for specified years 1949-69 are shown in table 4.

Because of crop failure and land preparation requirements, the acreage harvested does not fully identify the total acreage required in crop production. Cropland used for crops or the land input to crop production is more adequately measured by aggregating three component acreages—cropland harvested, crop failure, and cultivated summer fallow. In 1973, the acreage required for crop production totaled 354 million acres.

The idle component of the cropland acreage includes cropland completely idle and cropland used only to grow soil improvement crops. The sum of these categories (cropland used for crops, soil improvement crops not harvested or pastured, and completely idle cropland) is the most reliable indicator of total cropland acreage when showing trends (fig. 3). Cropland pasture is identified in table 3 but is not shown in figure 2 because the census definition has changed over time so that historical figures are not comparable.

Over the last two decades, total cropland, excluding cropland pasture, declined about 6 percent, or about a million acres a year. Although the total acreage of cropland has not varied greatly during this period,

Table 2–Trends in major uses of land, selected years, 1950-69

Land use	1950	1954	1959	1964	1969
	Million acres				
Cropland[1]	478	466	458	444	472
Grassland pasture and range[2]	632	634	633	640	604
Forest land[3]	721	727	728	727	723
(grazed)	(319)	(301)	(245)	(225)	(198)
Special areas[4]	138	143	151	168	178
Miscellaneous other land[5]	304	303	301	287	287
Total[6]	2,273	2,273	2,271	2,266	2,264

[1] Cropland harvested, crop failure, cropland idle or fallow, and cropland used only for pasture. Acreages shown were obtained from the Census of Agriculture and adjusted for underenumeration.

[2] Grassland and other nonforested pasture and range.

[3] Exclusive of forest land in parks, wildlife refuges, and other special use areas.

[4] Includes such uses as urban areas, highways and roads, parks, wildlife areas, military reservations, and farmsteads.

[5] Includes deserts, swamps, bare rock, tundra, and similar areas generally having low value for agricultural purposes.

[6] Decreases in the land area mainly represent increases in the water area of artificial reservoirs. Changes in methods of area measurement used by the Bureau of the Census, together with revisions for Alaska, also account for part of the decrease.

Source: (*21*). Italicized numbers in parentheses indicate items in the Literature Cited, p. 51.

important changes have occurred in individual use components. Of particular interest is cropland used for crops. This category decreased from a record high of 387 million acres in 1949 to 335 million acres in 1964, remained near this relatively low level through 1972, and then increased sharply to 354 million acres in 1973.

The cutback in "cropland used for crops" came about because of great increases in cropland productivity. From 1949 to 1969, population increased a third but output per crop acre increased more than a half. Total crop production rose 41 percent. Thus, output per person actually gained, although there was a cutback of 14 percent in cropland used for crop production.

Cropland in soil improvement crops and other idle cropland trended upward as the acreage used for crops decreased. Idle land went from 22 million acres in 1949 to 51 million acres in 1969. This gain was closely associated with land diverted from crop production under Federal programs, although additional cropland was diverted to cultivated summer fallow and to various noncropland uses. In 1973, acreage diverted from crop production under Federal programs dropped by 43 million acres as farmers were encouraged to expand production to supply domestic and export demands for farm products. Cropland used for crops increased and there was a large but not completely corresponding decrease in idle cropland. Idle cropland, particularly that diverted from production to soil-conserving crops, represents a source of cropland as needed. The idle acreage tends to vary inversely with annual changes in the acreage used for crops. In 1974, the only remaining diverted cropland acreage will be about 2 million acres under long-term contract.

The great increase in cropland productivity since 1949 resulted from more efficient farm organization;

Table 3–Summary of major land uses, 1969

Major land uses	Acreage	Percentage of total
	Million acres	*Percent*
Agricultural:		
Cropland[1]	384	17.0
Cropland used for crops[2]	(333)	(14.7)
Soil improvement crops and idle cropland	(51)	(2.3)
Grassland pasture and range[3]	692	30.6
Forest land grazed	198	8.7
Farmsteads, farm roads	9	.4
Total agricultural land	1,283	56.7
Nonagricultural:		
Forest land not grazed[4]	525	23.2
Special uses	169	7.5
Urban areas, roads, and other built-up areas[5]	(61)	(2.7)
Primarily for recreation parks and wildlife[6]	(81)	(3.6)
Public installations and facilities[7]	(27)	(1.2)
Miscellaneous land[8]	28	12.6
Total nonagricultural land	981	43.3
Total land area	2,264	100.0

[1] Excludes cropland used only for pasture.

[2] Cropland harvested, crop failure, and cultivated summer fallow.

[3] Includes cropland used only for pasture.

[4] Excludes 32 million acres of reserved and other forest land duplicated mainly in parks and other special use areas. It was not feasible to eliminate all overlap that exists because of multiple use.

[5] Urban and town areas; highway, road, and railroad rights-of-way; and airports.

[6] National and State parks and related recreational areas, National and State wildlife refuges, and national forest wilderness and primitive areas.

[7] Federal land administered by the Department of Defense and the Atomic Energy Commission, and State land in institutional uses.

[8] Includes miscellaneous uses not inventoried and areas of little use such as marshes, open swamps, bare rock areas, deserts, and tundra.

Source: (*21*).

Table 4—Major uses of cropland, selected years, 1949-73

Cropland use	1949	1954	1959	1964	1969	1970	1971	1972	1973
	Million acres								
Harvested	352	339	317	292	286	289	301	290	318
Crop failure	9	13	10	6	6	5	5	6	5
Cultivated summer fallow	26	28	31	37	41	37	34	38	31
Total for crops	387	380	358	335	333	331	340	334	354
Soil improvement and idle cropland	22	19	33	52	51	53	45	48	28
Total cropland, excluding pasture	409	399	391	387	384	384	385	382	382
Cropland pasture	69	66	66	57	88	NA	NA	NA	NA
Total cropland, including pasture	478	465	457	444	472	NA	NA	NA	NA
Diverted acres[1]	–	–	22	55	57	57	37	62	19

NA = not available.

[1] Acreage diverted or set aside to comply with Federal farm supply management programs. This acreage is mostly included in the soil improvement and idle cropland category but some is included in the cultivated summer fallow category of cropland.

Based on data from the Statistical Reporting Service, U.S. Dept. Agr., and U.S. censuses of agriculture.

improved machinery; increased use of agricultural chemicals such as fertilizers, pesticides, and ration additives; improved crop and livestock species and management; more irrigation; and regional shifts in production. Some of these changes, particularly the increased use of agricultural chemicals, increased irrigation, and regional shifts in production, have had environmental as well as economic impacts.

Primary plant nutrients in fertilizer rose from 15 pounds per acre in 1950 to 76 pounds in 1970; while

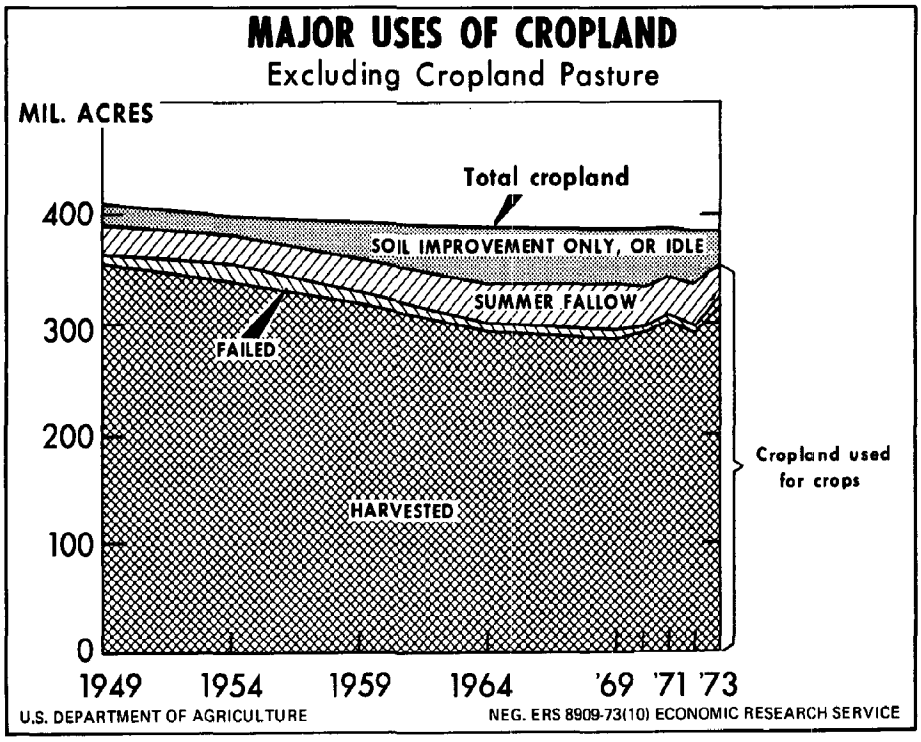


Figure 3

the active ingredients in the synthetic organic pesticides (excluding sulfur and petroleum), largely introduced since 1950, rose to 321 million pounds by 1964 and to over 450 million pounds by 1970. Much of the increase in land productivity can be attributed to the increased use of agricultural chemicals. However, agricultural chemicals may contribute to stream and lake pollution by runoff and may be leached into groundwater supplies.

Regional shifts in agricultural production have had appreciable environmental impacts, both in those areas where land is being newly developed or farmed more intensively and in those areas where cropland was abandoned. From 1944 to 1964, 868 counties gained a total of 27 million acres of cropland (harvested, plus soil improvement and idle cropland). During the same period, 2,204 counties lost a total of 54 million acres of cropland. This extensive regional change occurred during a time when total cropland showed only a small downtrend. Cropland in some areas increased 1.3 million acres a year, while in other areas it declined 2.6 million acres a year.

New cropland appeared in a number of well-defined areas (fig. 4). Reclamation in Florida was associated with both drainage and irrigation projects; in the Delta with clearing and drainage; and in the Texas High Plains, California, and Washington with expanded irrigation facilities. Expansion was associated with improved dryland farming techniques in northern Montana and with various farm-oriented techniques, such as drainage, clearing, contouring, and leveling, throughout the Corn Belt.

Cropland abandonment occurred on a large scale south and east of the Corn Belt, except in the Delta States and in southern Florida. Abandonment east of the Mississippi resulted from low soil fertility and a terrain that was not suited to efficient use of modern machinery. (Many fields are small, rough, and isolated.) In extensive areas of eastern Oklahoma and Texas, cropland has reverted to grass. This appears to be the best and most stable use of the land from the standpoint of efficiency as well as conservation. Preliminary findings of cropland use studies for the period 1964-69 show a continuation of the earlier rate of cropland abandonment. Major areas of recent cropland increase are the Mississippi Delta, Central Plains, and northernmost Great Plains. Major decreases in cropland acreage occurred throughout the Eastern States, Lake States, and parts of the Great Plains. Some of the cropland increases, notably in the Central and Southern Great Plains, appear to be closely associated with irrigation development. Some decreases in irrigated acreage also took place, mainly due to a decline in water supplies, as in parts of the Texas High Plains, and to more intensive nonagricultural competition for farmland and its water supply elsewhere in the Western States.

In 1969, crops were harvested from 34 million acres of irrigated land, about 12 percent of total harvested acreage. In addition, about 5 million acres of cropland pasture and improved pasture were irrigated. Hay harvested plus pasture accounted for about a third of the total 39 million acres irrigated.

Ninety percent of the irrigated land is in the 17 Western States. Concentrated areas include the Texas Gulf and High Plains, southern Arizona, and California's Central Valley. In addition, there is scattered irrigated acreage in a broad band extending from the Central Plains to the Northwest. In this drier part of the country, irrigation accounts for the difference between low-producing range and highly productive cropland. About 10 percent of the irrigated acreage is in the area from the Plains States eastward to the Atlantic. Concentrated acreages are found in Florida, Arkansas, and Louisiana; otherwise, small operations are scattered across the cropland areas.

Irrigated acreage has been on the rise for many years (fig. 5). From 1939 to 1969 the annual increase was 700,000 acres a year. Irrigated acreage in the East is still relatively small, but the 4.2 million acres irrigated in 1969 is six times greater than the acreage irrigated in 1939. Two-thirds of this increase has taken place in the Florida fruit and vegetable area, and in the rice and soybean areas of Arkansas and Louisiana. In recent years, irrigated acreage in these areas has continued upward, as has acreage in the Corn Belt and Lakes States. However, the increases have been offset by decreases in the Northeast and Appalachia that tend to coincide with declining agricultural activity in those regions.

Irrigated land use differs widely across the country. In the West, more than a third of the irrigated land is used for hay and pasture, compared with a tenth in the East (fig. 6). The major field crops account for about 40 percent of the irrigated acreage in the West; in the Southern Plains large acreages of cotton and sorghum are irrigated. The high-valued fruit and vegetable crops account for about a tenth of irrigated land use—mostly in California (72 percent), but southern Texas and southern Arizona account for about 9 percent and 5 percent, respectively. In the East, more than half of the total irrigated area is used for the production of rice, vegetables, and fruits.

Pasture and Range

Livestock graze on 890 million acres, or 39 percent of the land area of the 50 States (tables 5 and 6). This

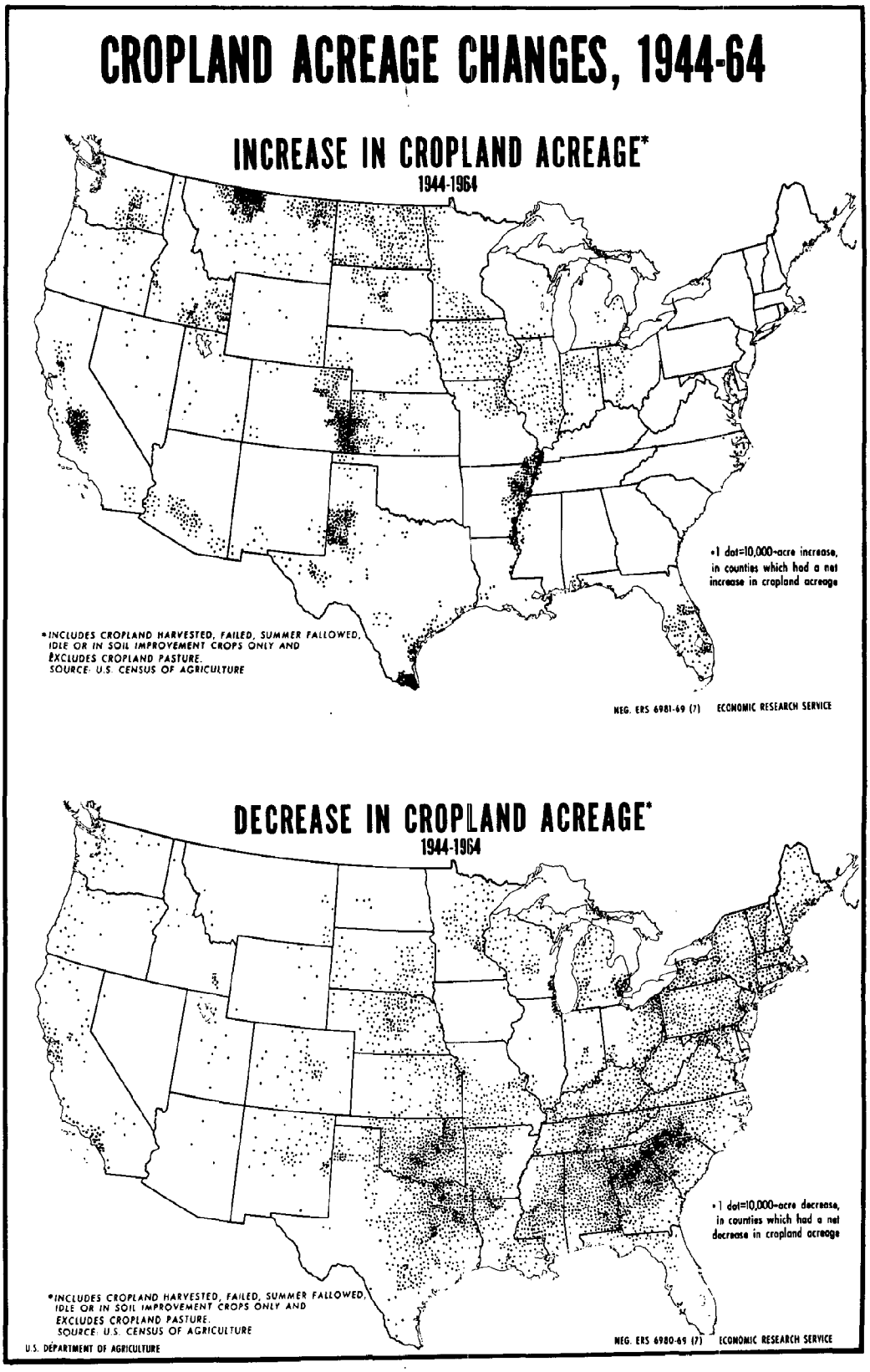

CROPLAND ACREAGE CHANGES, 1944-64
INCREASE IN CROPLAND ACREAGE*
1944-1964
•1 dot=10,000-acre increase, in counties which had a net increase in cropland acreage
*INCLUDES CROPLAND HARVESTED, FAILED, SUMMER FALLOWED, IDLE OR IN SOIL IMPROVEMENT CROPS ONLY AND EXCLUDES CROPLAND PASTURE.
SOURCE: U.S. CENSUS OF AGRICULTURE
NEG. ERS 6981-69 (7) ECONOMIC RESEARCH SERVICE
DECREASE IN CROPLAND ACREAGE*
1944-1964
•1 dot=10,000-acre decrease, in counties which had a net decrease in cropland acreage
*INCLUDES CROPLAND HARVESTED, FAILED, SUMMER FALLOWED, IDLE OR IN SOIL IMPROVEMENT CROPS ONLY AND EXCLUDES CROPLAND PASTURE.
SOURCE: U.S. CENSUS OF AGRICULTURE
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 6980-69 (7) ECONOMIC RESEARCH SERVICE

Figure 4

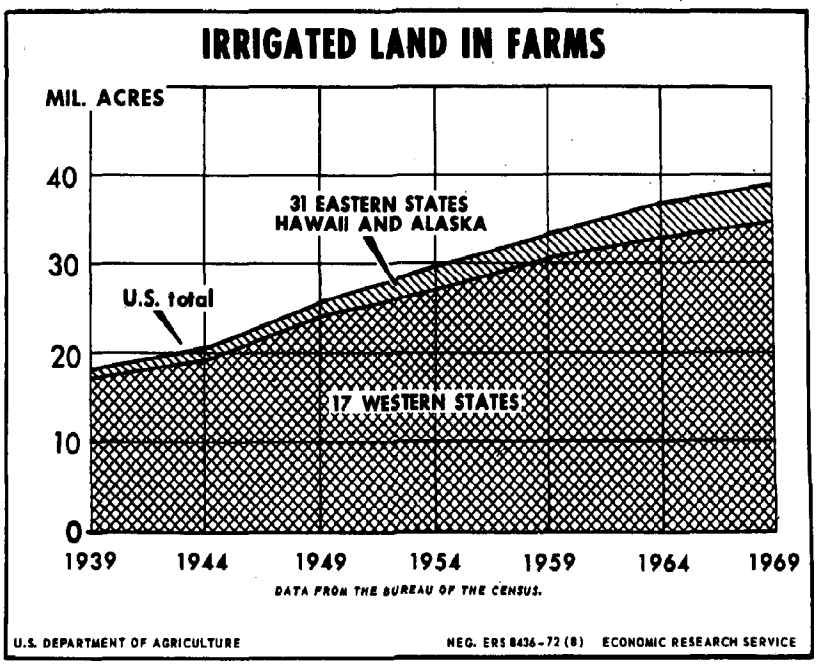


Figure 5

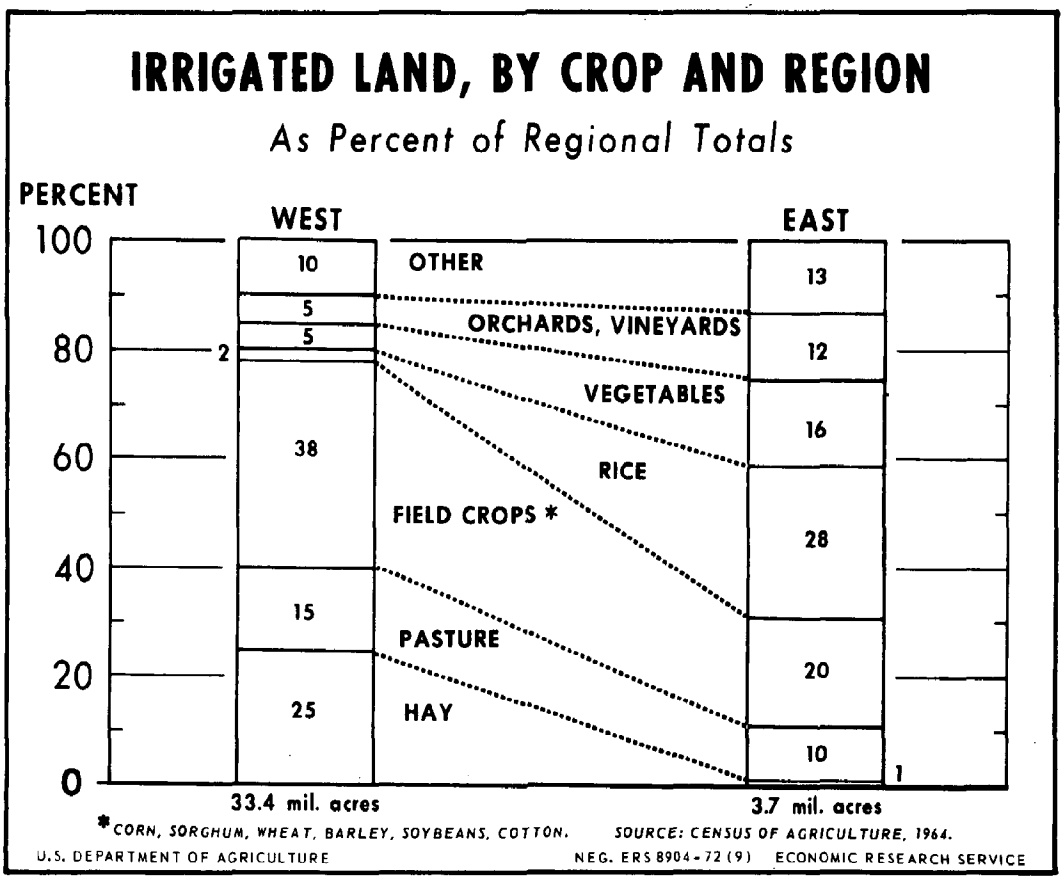


Figure 6

Table 5–Total pasture and range, selected years, 1949-69

Type	1949	1954	1959	1964	1969
	Million acres				
Grassland pasture and range	701	700	699	697	692
Cropland pasture	(69)	(66)	(66)	(57)	(88)
Open permanent pasture	(632)	(634)	(633)	(640)	(604)
Woodland grazed	319	301	245	225	198
Total pasture and range	1,020	1,001	944	922	890

Source: (*21*).

represents a decrease of 13 percent on land area grazed in the last two decades, despite a 46-percent gain in cattle numbers. However, most of the decrease can be attributed to a reduction in woodland grazed, including many areas of low forage productivity.

The total acreage of grassland pasture and range, which supplies practically all of the pasture feed produced, has remained virtually unchanged since 1950. Cropland pasture, which supplies probably half of the pastureland needs, increased 31 million acres from 1964 to 1969, while permanent pasture on farms decreased 36 million acres. This increase in cropland pasture is greater than might have been expected. It may be due partly to a change in census enumeration methods which may have led some farmers to identify permanent grassland pasture as cropland pasture.

About two-thirds of the 890 million acres of pasture is on farms. This includes 88 million acres of cropland used for pasture, 452 million acres of permanent pasture and range, and 62 million acres of woodland. Of the 288 million nonfarm acres used for grazing, about half is Federal grassland, a fourth is Federal woodland grazed, and a fourth is largely woodland in State or private ownership. Most of the Federal land used for grazing is located in semiarid portions of the 11 Western States and has low productivity. Nationally, Federal and other nonfarm grazing lands supply only a small part of total pasture feed. In the Mountain and Pacific regions, however, Federal range provides about an eighth of the livestock feed utilized, with higher proportions locally. Many ranchers in the Western States depend very heavily on public range as a source of feed or as a seasonal source of feed that complements or supplements other feed supplies.

Among major types of pasture, cropland pasture is by far the most productive. Although it accounts for only a tenth of pasture and range acreage, cropland pasture yields a very large share of total forage production. The 604 million acres of grassland pasture

Table 6–Pasture and range by type and region, 1969

Region	Cropland pasture[1]	Grassland pasture and range[2]	Forest land pasture and range[3]	Total[4]	
				Acreage	Percentage of land area
	..... *1,000 acres*				*Percent*
Northeast	3,669	3,162	2,238	9,069	8
Lake States	5,293	6,175	4,735	16,203	13
Corn Belt	16,886	13,948	11,975	42,809	26
Northern Plains	11,273	72,940	2,496	86,709	46
Appalachian	12,428	8,427	6,669	27,524	22
Southeast	5,634	10,498	13,619	29,751	24
Delta States	6,684	8,433	21,391	36,508	40
Southern Plains	16,833	111,349	26,341	154,523	73
Mountain	5,726	313,478	79,071	398,275	73
Pacific	3,755	52,594	29,084	85,433	42
48 States	88,181	601,004	197,619	886,804	47
Alaska	3	1,624	111	1,738	[5]
Hawaii	36	987	451	1,474	36
U.S. total	88,220	603,615	198,181	890,016	39

[1] Land in the crop rotation which is used some years for cultivated crops and other years for pasture.

[2] Excludes cropland used for pasture.

[3] An approximation of the acreage grazed to some extent during the year.

[4] Excludes 57 million acres in Federal land that has little or no use for grazing but which is intermingled and managed with productive Federal range.

[5] Less than 0.5 percent.

and range account for two-thirds of the total acreage grazed. Productivity of this grassland pasture and range varies greatly but averages much less per acre than cropland pasture. Two-thirds of this acreage is in low-producing rangelands of the Mountain and Southern Plains States where potential for improving land productivity is very limited. Grassland pasture in other regions is more productive, particularly in the humid East, but still yields much less than cropland pasture.

Forest Land

A third–754 million acres–of the Nation's total land area, including Alaska, is in forests (table 7). About a sixth of this area is in Alaska, where little timber is harvested for wood products. Of the 633 million acres of forest land in the 48 States, almost 80 percent, or 493 million acres, is commercially productive. During the period 1950-70, output of forest products increased 9.5 percent. Industrial wood consumption increased 30.5 percent while population increased 35 percent. The resulting trend is a per capita drop of 9.2 percent in industrial wood consumption. During this interval, net imports fell from 14 percent of consumption to about 8.5 percent.

The mix of industrial wood products consumed has undergone considerable change since 1950. Lumber now accounts for one-half, down from nearly two-thirds. Pulp products have increased from 24 to 37 percent; plywood, from 3.5 to 9.2 percent. Miscellaneous products have dropped from 7.8 to 4.3 percent (*18*).

Fuelwood consumption in 1972 was estimated at ½ billion cubic feet, a fourth of the amount so consumed in 1952. Other fuels have been substituted for use in home cooking, heating, and industry. In recent years, however, substantial markets have developed in metropolitan areas for fireplace wood. Even without rising fuel costs, growth in the market for fuelwood is projected because of increases in income, population, and residential construction. Wood plant residues also are a source of fuel. About a fifth of primary plant residues, a third of wood manufacturing plant residues, and a fourth of the bark at sawmills and wood manufacturing plants are used for fuel (*22*).

Table 7–Forest land, by region, 1970

Region	Forest land				Total land area
	Productive[1]	Nonproductive		Total	
		Reserved[2]	Other		
	Million acres				
North	178	4	4	186	628
South	192	2	18	212	513
Rocky Mountains	62	8	68	138	555
Pacific	61	3	32	96	204
Alaska and Hawaii	7	1	114	121	370
Total	500	18	236	754	2,270

[1] Produces 20 or more cubic feet of useful wood growth per acre per year.

[2] Parks, etc.

Source: (*22*).

Present and prospective supplies of wood appear to provide for modest expansion of consumption. The 1970 inventory of 650 billion cubic feet of growing stock (trees available for present harvest or future growth) supported annual cuts and removals of 14 billion cubic feet. Two-thirds of the Nation's growing stock is softwood, supporting just over two-thirds of the annual removals. This apparent close harmony of consumption with supplies masks potential problems related to the regional distribution of timber species and sizes. This problem is more severe for the Pacific region than for other regions (see the softwood growing stock columns of table 8). Softwood in the Pacific region is the principal remaining source of high-quality, large-size timber. These old forests are producing little or no growth. For some time growth has trailed annual cut, resulting in a 6.8-percent drop in growing stock. As old trees are harvested and replaced with vigorous young ones, and harvesting shifts to young stands, a better regional balance should be achieved in the production of softwood material. However, size and quality of softwood timber tend to be lower in young forests than in forests that presently make up much of the harvest.

Over 90 percent of U.S. hardwood supplies are located in the two eastern regions. These supplies are presently underutilized, particularly in the North. Both the recent increases in growing stock and the ratios of growth to removals make this clear (table 7). Part of the problem is due to the relative small size and low quality of these "second growth" forests. Another facet is the market emphasis on producing softwood timber for construction material and pulp for paper. A contributing factor also is the predominance of small ownership tracts in the East, which tends to inhibit efficient management and orderly marketing. Little improvement in the management of these forests can be expected until better markets are developed for small and lower grade trees.

Since 1950, timber growth has exceeded removals, resulting in an increase in total growing stocks. This has gone a long way toward repairing the effects of earlier exploitation and overcutting. These young stands are rapidly approaching the time when a closer balance must be sought between cut and growth,

Table 8–Distribution of commercial forest land, softwood and hardwood growing stock, growth and removals, by region, 1970

Region	Commercial forest land	Softwood growing stock (GS)[1]			Hardwood growing stock (GS)		
		Percentage of total GS, 1970	Ratio of net growth to removals, 1970[2]	GS change, 1952–70	Percentage of total GS, 1970	Ratio of net growth to removals, 1970[2]	GS change, 1952–70
	Percent	*Percent*		*Percent*	*Percent*		*Percent*
North	35.6	9.1	2.21	+40.8	53.7	2.30	+41.8
South	38.5	18.1	1.35	+42.3	37.4	1.29	+7.3
Rocky Mountains	12.3	20.3	1.38	+3.1	2.1	26.56	+13.8
Pacific[3]	13.6	52.5	.64	–6.8	14.8	4.09	+42.2
U.S. total	100.0	100.0	1.11	+5.1	100.0	1.79	+26.1

[1] Growing stock is the net volume of live sawtimber and pole timber trees larger than 5 inches in diameter at breast height.

[2] Net growth is change in volume of live sawtimber and pole timber trees. Removals include the net volumes harvested or removed by cultural operations and land clearing or from change in land use.

[3] Includes Alaska and Hawaii.

Source: (*22*).

especially for hardwoods. We could set an early goal to increase hardwood harvest by 50 percent and still have a comfortable excess of growth toward improved future supplies.

Special Uses

A fifth of the Nation's land area, 456 million acres, is not in agricultural or forestry uses. This includes 287 million acres of deserts, swamps, bare rock, tundra, and similar areas generally having low use value, and 169 million acres, or about 8 percent of total land area, in special purpose uses. These statistics do not include 9 million acres in farmsteads, farm roads, and related farm uses classified under special purpose use. A third of special purpose land not in farms is in intensive uses such as urban and transportation areas. Two-thirds is in extensive uses (with little change from previous use in the vegetative cover) and includes parks, wildlife areas, and public facilities such as military proving grounds.

Between 1959 and 1969, land in special uses increased 27 million acres, or almost 2.7 million acres a year (table 9). Urban areas grew at a faster rate than population, and removed about 750,000 acres a year from the rural environment. Rural transportation areas utilized about 130,000 acres a year, some for airports but mostly for interstate highway programs (fig. 7).

Rural land taken by reservoirs (about 300,000 acres a year) is not reflected in the land use data because this acreage is deducted from the total land area. If land loss to reservoirs is combined with the rural land shift to urban and transportation uses, nearly 1.2 million acres of rural land a year are shifting to intensive special uses that preclude agricultural use.

Extensive-type land use (two-thirds of the total in special uses) increased almost 2 million acres a year in the last decade. Virtually all of the increase was in recreation and wildlife areas, largely through reclassification of public domain land. Approximately 10 million acres in Alaska were reserved for wildlife in a single transfer. Apart from this action, recreation and wildlife areas increased only about 1 million acres a year. The latter rate of growth, regarded as more realistic, is used in figure 6.

Acreage in public installations and facilities changed little in the last decade, as small increases in State-

Table 9–Acreage of land in special uses, 1959 and 1969[1]

Special uses	1959	1969	Change
	Million acres		
Urban areas[2]	27.2	34.6	7.3
Transportation areas[3]	24.7	26.0	1.3
Recreation and wildlife areas[4]	61.5	81.4	19.9
Public installations and facilities[5]	27.5	27.4	–.1
Farmsteads and farm roads	10.1	8.4	–1.7
Total	151.0	177.8	26.8

[1] Estimates are not strictly comparable.

[2] Includes urbanized areas as defined by the Bureau of the Census, and other incorporated and unincorporated places of 1,000 or more population.

[3] Rural land in highway, road, and railroad rights-of-way and airports.

[4] Federal and State parks and related recreation areas and Federal and State wildlife refuges.

[5] Federal land used for national defense and atomic energy purposes, and State land in institutional sites and miscellaneous other uses.

Source: (*21*).

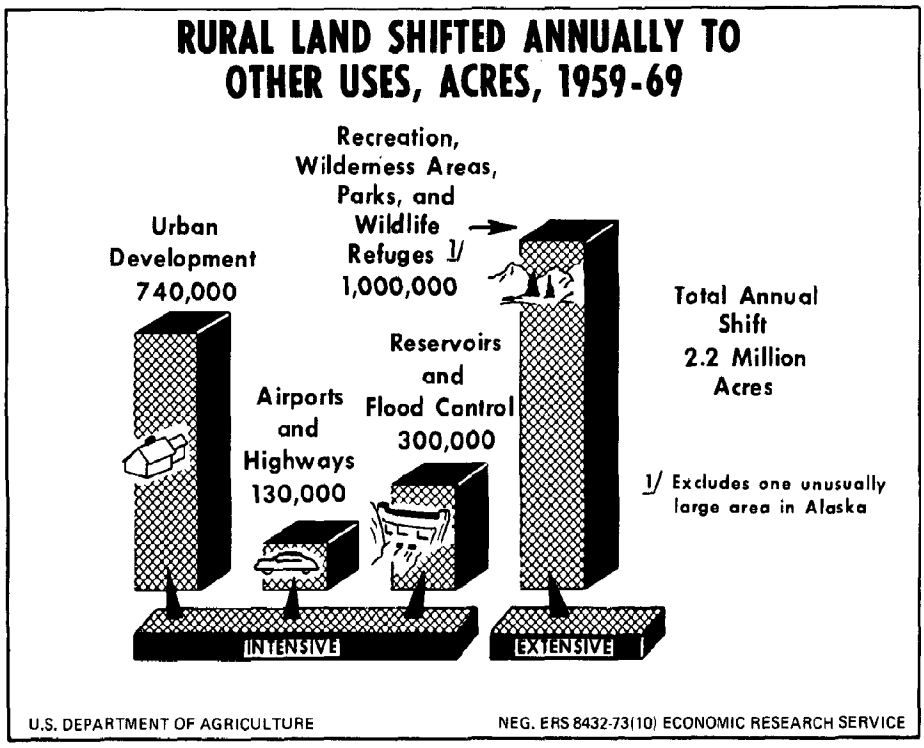


Figure 7

administered areas were offset by attrition in national defense land. Much of the latter acreage was assembled during World War II and may not be fully utilized now.

The 34.5 million acres in urban places include the central cities and adjacent suburban fringes, plus all other incorporated and unincorporated places of 1,000 or more population. Urban acreage includes residential, transportation, industrial, and commercial areas, and some vacant land within urban boundaries. As corporate boundaries are extended, they often enclose undeveloped land, either within developed areas or on the margin of development. Urban areas are very unevenly distributed, with high concentrations in the Northeast, across the heartland from Pittsburgh to Milwaukee, and on the west coast from San Francisco to San Diego. A more detailed discussion of rural land use near cities appears later in this report.

Transportation–The 21 million acres in rural highways and roads includes land in systems administered by State and local governments–rights-of-way as well as roadbeds. Except for the interstate system, the road acreage is stable, widely distributed, and reflects historical settlement patterns where adjustments have already been made.

The interstate highway system, started in the late 1950's, uses about a million acres, or 5 percent of the land in roads. Each year the system takes 100,000 acres of rural land, with substantial effect on the adjacent environment, both urban and rural. The social and environmental impacts of highways and roads in urban areas are well documented; the impacts in rural areas are less well known. They sometimes include such effects as disturbance of water courses and accelerated sediment delivery during road construction. Limited access and road width limit lateral movement. Farm units sometimes are divided or isolated, size and shape of fields are often altered, and the movement of people, machinery, and livestock is restricted. In addition, the movement and safety of wildlife is affected.

The rural airport area (1.8 million acres) excludes military and small private strips, but includes vegetated areas as well as runways. This use takes only about 35,000 acres a year from other uses. Some of the rural airports serve large cities but are still classed as rural because of low population density in the immediate area. Most airports of this type are eventually overtaken by urbanization.

Outdoor Recreation–In recent years the Nation has experienced a growing demand for outdoor recreation opportunities. From 1965-72, participation more than doubled in such vacation activities as camping in remote or wilderness areas and in developed campgrounds, picnicking, canoeing, nature walks, swimming, and fishing (*23*). Several reasons have been advanced to

explain why demand for outdoor recreation has grown so rapidly. Among them are increased income, more leisure time, changes in taste, and response to environmental education efforts. To some extent the demand derives from increased accessibility and utility of recreation areas brought about by improvements in transportation and facilities.

To accommodate the demand for outdoor recreation and preservation of unusual natural areas, governments at all levels have made a large acreage available for public recreation use. The Federal Government administers a particularly large acreage including most of the areas considered to be of highest recreation use quality. The aggregate acreage of public land available for public recreation use totals 319 million acres (table 10). In addition, the private sector operates many recreation areas for public use and an even larger acreage is available to some extent for public or semipublic recreation activities.

Not all of the public recreation area is uniformly available for recreation use. Limited use recreation areas such as some reservoirs and wildlife areas account for a high proportion of the public recreation estate. These uses serve a variety of purposes other than recreation. Thus, the total of 319 million acres is more inclusive than the 81 million acres shown in table 9, which is limited to the land area specifically designated as National and State parks or recreation, wildlife, wilderness, and primitive areas.

The resource base for outdoor recreation is one of contrast, reflecting geographic locations and development intensities. It includes municipal parks and baseball diamonds as well as remote mountains, forests, rivers, lakes, beaches, shoreline, and similiar features.

Table 10–Public recreation acreage, 1972

Administering jurisdiction	Total area	Parks[1]	Limited recreation use[2]
	Million acres		
Federal	266.7	19.1	247.6
State	41.8	4.4	37.4
County	8.2	1.3	6.9
City	1.6	.7	.9
Township	.6	.1	.5
Other[3]	.3	.2	.1
Total	319.2	25.8	293.4

[1] Area in national, regional, community, and neighborhood parks; playgrounds and playfields, and similar areas.

[2] Area available for recreation in public forests, fish and game areas, historic and cultural areas, wilderness and natural areas, etc.

[3] Includes parks and recreational districts and regional councils.

Adapted from (*23*, table 3-1).

These areas are widely distributed in terms of numbers but highly concentrated in area and quality. Three-fourths of the 319 million acres of public recreation land, including many of the most spectacular natural features, are located in the Western States, often in sparsely populated areas. In general, recreation areas in the Eastern States are not distributed in close conformity with population.

Many of the problems associated with public recreation lands arise from uneven geographic distribution of resources, different intensity of use, accessibility, competition and conflicts between uses, and the need to protect remaining resources having high recreation use value. These problems are often interrelated. For example, the uneven quality and geographic distribution of recreation areas relative to population leads to underuse of some areas and overuse of others. Popular areas have become crowded to the point of diminishing enjoyment. At the same time, many people have little or no opportunity to use remotely located recreation areas.

The issue of accessibility to outdoor recreation areas includes not only the problem of overcoming distance but frequently involves difficulties in acquiring convenient rights-of-way to recreation areas. This problem is particularly acute where increased recreation use would conflict with the interest of neighboring landowners. Problems relating to accessibility also may be associated with heavy visitor traffic and resultant pressures to extend roads and other improvements into valuable but limited natural areas.

Competition and conflicts between recreation and other uses historically have not been severe except in some localities. Due to different resource requirements, many of the natural areas valuable for recreation use were physically or locationally undesirable for agriculture and most higher uses of land. More recently, conflicts between recreation and other uses have become more common as particular areas have increased in value for both recreation and various special uses. Problems of this nature usually arise in new recreation areas rather than in older areas where adjustments have already been made. Exceptions occur, however, in areas such as the Everglades where an established wildlife area is adversely affected by agricultural, urban, and other activities beyond its boundary. Conflicts between recreation and agricultural uses occur in various localities but the larger acreage of public recreation land has had no appreciable effect on total agricultural production.

A final broad concern involves the need to protect and conserve additional areas having special scenic, historic, or scientific value and other areas less

physically or historically attractive for recreation but functional in terms of locational characteristics. In addition to preserving the inherent value of these resources, efforts in this direction will diminish the problems associated with unequal distribution of recreation resources and use. In the sense that problems relating to accessibility and conflicting uses are becoming more acute, many of these problems would be diminished by early protection and conservation actions.

Public Installations and Facilities–Public installations and facilities include national defense areas (23 million acres), Federal atomic development and test areas (2 million acres), and State-owned land in institutional and other uses (2 million acres). Locally significant acreages of fertile, level land–particularly in States east of the Rocky Mountains–have been taken for defense and atomic energy purposes. Acreage for these uses is not increasing, however, and only part is permanently lost to agriculture. Most of the land in this category is in areas of the West that have low value for other uses. Individual areas set aside for public installations and facilities usually include some intensively used land, but a higher proportion is in extensive-type use. This ratio is explained by the frequent use of land for buffer zones, particularly around defense and atomic energy installations.

Surface Mining–Over 3 million acres of land have been disturbed by surface mining–about half for coal mines. Only about a third of the land disturbed by surface mining has been reclaimed, approximately half of it through natural processes. Every year about 100,000 acres of land are disturbed for coal mining. Surface mining of coal has expanded steadily in recent years, and is expected to continue to grow due to increased energy needs and greater dependence on coal to meet these needs.[2]

The expected future growth in surface mining of coal has several implications for rural land use and environmental quality. The potential for surface disturbance is large, relative to the area disturbed so far. In 1951, 22 percent of all U.S. coal came from surface mines. By 1970, this share had risen to 44 percent. Originally, the United States had approximately 115 billion tons of coal lying within 100 feet of the surface. Less than 5 billion tons of this coal have been mined to date. Of the original total, 110 billion tons lie in 15 States with resources of over 1 billion tons each (table 11). Over half of these resources lie west of the 100th meridian, about one-fourth in the Midwest, and one-fourth in Appalachia.

[2] Data on surface mining are from the Bureau of Mines as reported in (*7*).

Some 77 percent of the country's reserves which can be stripped economically lie in 13 States west of the Mississippi (fig. 8). As utilities consume more low sulfur coal, surface mining in the West could assume major proportions, particularly if conversion of coal to gas should become extensive. The next largest concentration of strippable coal is an area encompassing the southern two-thirds of Illinois plus adjacent corners of Indiana and Kentucky. Since 1965, this region has led in strip coal production. The third largest concentration of strippable coal is in northern Appalachia, which was the largest producer up to 1964. Although there are large coal reserves in the Appalachian region, much of the easily stripped coal has been taken and equipment in use today is not well adapted to the Appalachian terrain.

Another implication of the energy situation is that pressures will build to locate generating facilities in rural areas, so that chemical and thermal pollution of air and water can be diffused. The Office of Science and Technology in the Executive Office of the President has projected a doubling of large thermal generating plants (500 megawatts and up) from 237 in 1968 to 492 in 1990 (*11*, p. 4). Some 60 percent of these would use fossil fuel and 40 percent, nuclear fuel. Of the 225 new sites, 100 would have capacities of 2,000 megawatts or larger. Many of these larger facilities may require cooling ponds of 2,000 acres or more to aid in dissipating surplus heat.

Location of large plants away from urban concentrations will mean more, and probably larger, trans-

Table 11–Estimated original resources of strippable coal in beds lying less than 100 feet below the surface, 15 leading States

State	Billion short tons
Montana	23.0
Illinois	15.5
North Dakota	15.0
Wyoming	13.0
West Virginia	9.5
Pennsylvania	8.0
Kentucky	6.0
Ohio	5.0
Indiana	3.5
Texas	3.3
New Mexico	3.0
Alaska	2.0
Colorado	1.2
Virginia	1.0
Missouri	1.0
	110.0

Source: (*1*, p. 23).

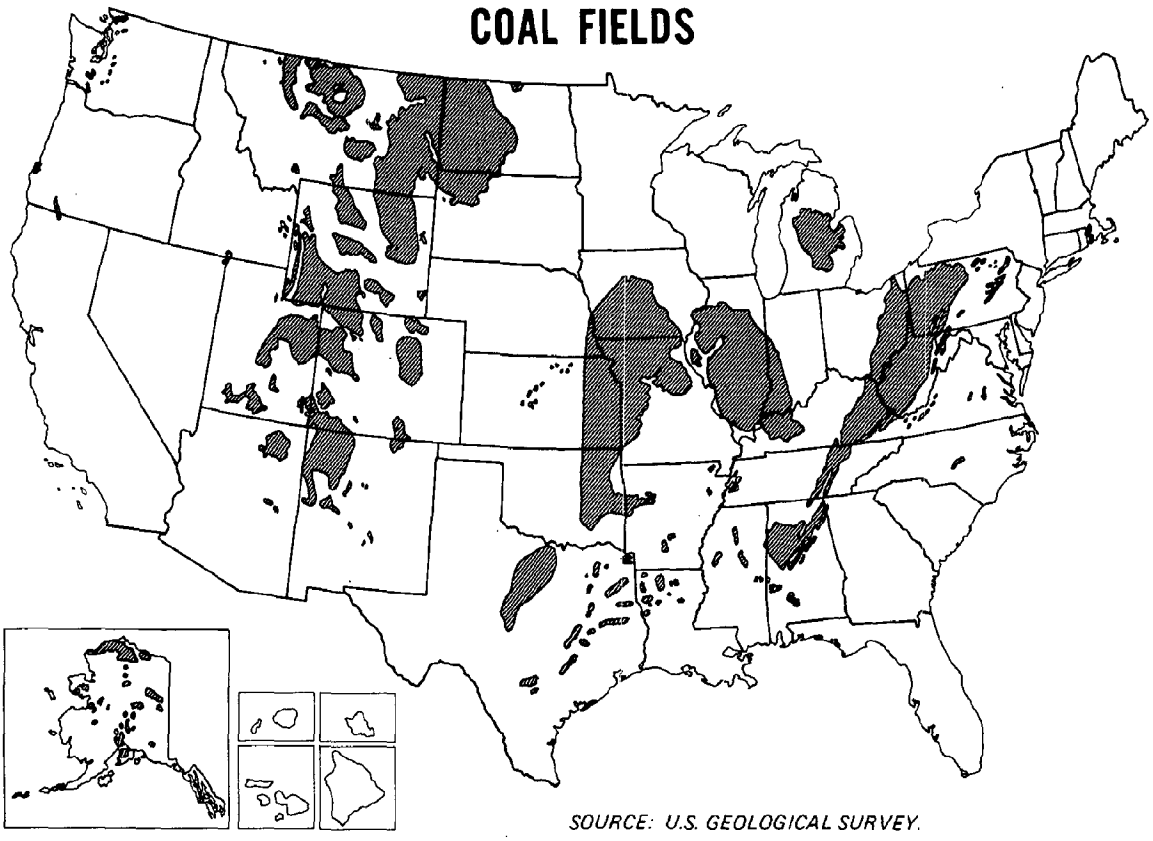


Figure 8

mission lines transecting the countryside. Currently, over 300,000 miles of overhead transmission lines cross about 4 million acres of right-of-way. It is projected that about 100,000 miles of new lines on 1.5 million acres of right-of-way will be constructed each decade for the balance of this century. Transmission lines may not remove much land from agricultural production but they impede farm operations where the support poles and towers are placed on cropland. They also contribute to a form of "visual pollution" of the scenic qualities of rural landscapes. Thus, their impact on agriculture may be greater than the mere taking of land.

Rural Land Uses Near Cities

Most of the increase in population between 1960 and 1970 occurred in and around cities. The geographic areas that best define the region in which cities exhibit their most pronounced direct effect are the SMSA's, defined on page 1. At the time of the 1970 census, there were 242 SMSA's in the 48 contiguous States, one in Hawaii, and four in Puerto Rico (fig. 9). Except for Alaska, Vermont, and Wyoming, each State had at least one SMSA. In 1970, the SMSA's had a total population of almost 139 million people, or about 70 percent of the U.S. population in the 48 contiguous States (table 12).

The 242 SMSA's gained 19.7 million people between 1960 and 1970–83 percent of the net increase of 24 million for the 48 States. Population within the SMSA's is concentrated largely in the urbanized parts, where population density averages 3,137 persons per square mile. The rural parts of the SMSA's average 42 persons per square mile, while population density outside the SMSA's averages 24 persons per square mile.

Gross statistics indicate that large areas of open space–cropland, pasture, woodland, other extensively used land, and idle land–lie within or near the urban centers. Much of this land is beyond any practical access by many urban residents, particularly those who live in the central cities. However, much of the underdeveloped land could be better utilized to provide open space in urbanizing areas.

Land use in the SMSA's varies by region (table 13). In the Appalachian, Southeastern, and Delta States, more than half of the nonurban SMSA land is wooded. In the Northeast States, the wooded share approaches 50 percent; in both the Lake and Pacific States, it is over one-third. Over 80 percent of the population of

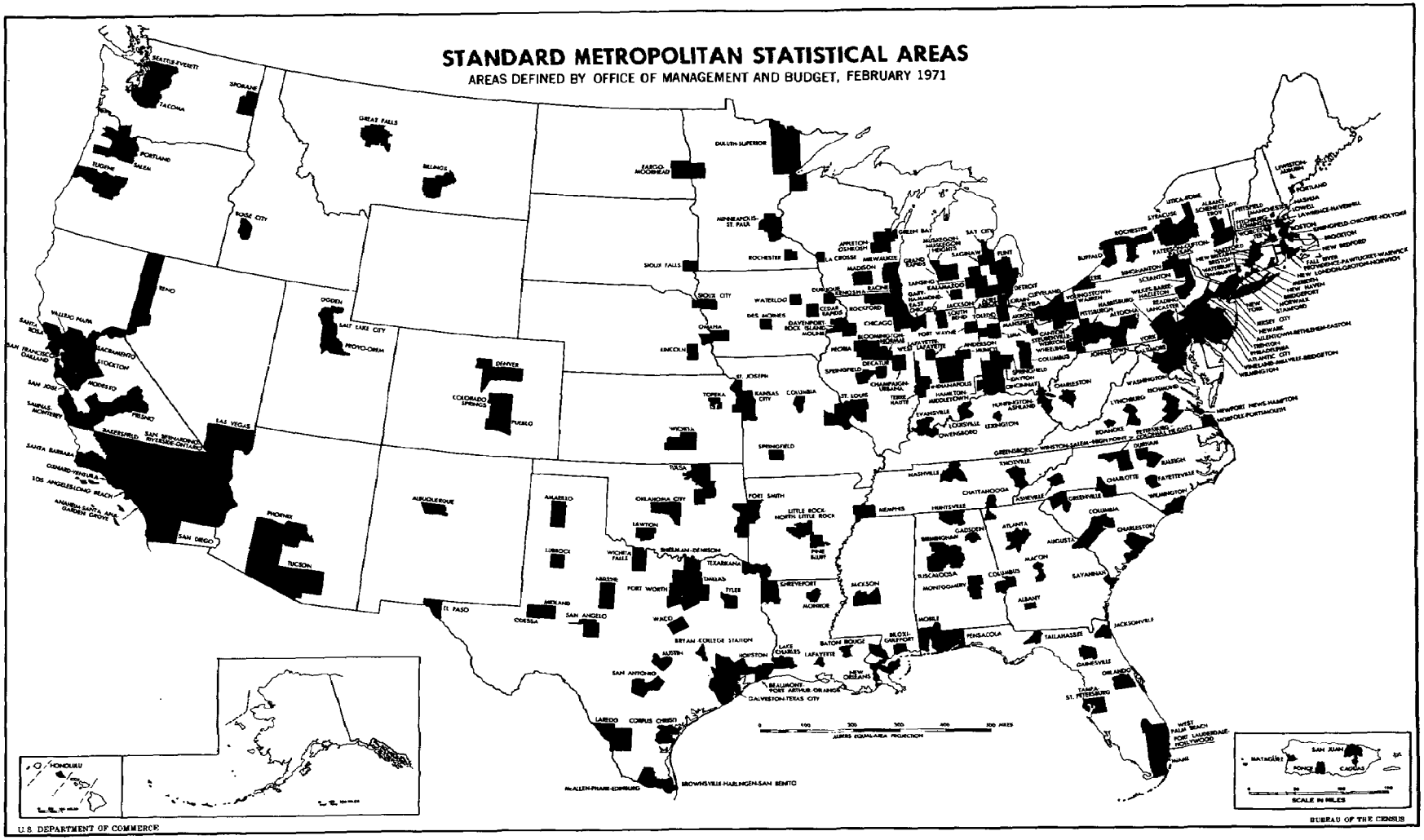

STANDARD METROPOLITAN STATISTICAL AREAS
AREAS DEFINED BY OFFICE OF MANAGEMENT AND BUDGET, FEBRUARY 1971
U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

Figure 9

Table 12–Population in SMSA's as a percentage of the total population, by region, 48 States, 1970

Region	Percentage of population in SMSA's
Northeast	80.4
Lake States	79.4
Corn Belt	70.8
Northern Plains	34.9
Appalachian	45.6
Southeast	56.0
Delta States	38.3
Southern Plains	69.2
Mountain	56.9
Pacific	86.6
48 States	69.7

Source; (2).

the Northeast, the most populous area of the country, is in SMSA's. Yet more than 15 million acres, or almost half of the entire region's SMSA acreage. is woodland.

Half of the acreage in SMSA's in the Northern Plains and the Corn Belt is in cropland. In the Lake States, the share is over one-third. Pasture and other open land (including mountains, deserts, and wastelands) occupies over 70 percent of SMSA's in the Mountain States and almost half in the Southern Plains and Pacific States. Figure 10 shows the average use of land within all SMSA's.

Agricultural Production in the SMSA's

Altogether, about 13 percent of the land area of the 48 contiguous States lies within SMSA's. The Northeast has about 30 percent of the total and the Pacific, 27 percent. In the Northern Plains, less than 3 percent of the land area is within SMSA's. Generally, average size of farms is smaller in the more urban counties than in the surrounding counties.

About 14 percent of cropland harvested is found in SMSA's but the percentage of irrigated cropland in these areas is higher. This is particularly true of the Northeast and Pacific States and probably reflects the concentration of irrigated fruit and vegetable crops in or near the population centers (table 14).

All of the major U.S. crops, measured in terms of total value of production, are important in SMSA's. About 17 percent of the corn crop is produced in SMSA's. Vegetable production especially is concentrated near population centers. Ten years ago, about 60 percent of the vegetables and 43 percent of the fruits and nuts marketed came from SMSA's. Only 16 percent of cropland in the Southeastern States is within SMSA's, but 66 percent of vegetables sold come from those areas. The Pacific and Northeastern States reported that 71 percent and 65 percent, respectively, of vegetables sold in 1964 came from SMSA's.

The SMSA's have a little more than a proportionate share of the better agricultural land–land use-capability classes I-III. Overall, the SMSA's comprise 13 percent of the land area of the 48 contiguous States and have a little less than 15 percent of the total land in these classes. With minor exceptions in the Southeast and Mountain States, a similar situation exists in the individual regions (table 15).

Table 13–Average land use, SMSA's, 1970

Region	Total for SMSA's	Urban part[1]	Rural part				
			Total	Cropland	Pasture-range	Forest woodland	Other
	1,000 acres						
Northeast	614	116	498	134	35	288	41
Lake States	911	113	798	393	37	308	60
Corn Belt	763	104	659	387	62	104	106
Northern Plains	868	58	810	538	179	30	63
Appalachian	596	76	520	120	58	330	12
Southeast	874	94	780	124	75	510	71
Delta States	579	50	629	137	73	364	55
Southern Plains	1,211	106	1,105	326	529	199	51
Mountain	2,377	78	2,299	216	947	343	[2]766
Pacific	2,605	170	2,435	339	474	940	682
Average, 48 States[3]	1,044	104	940	250	198	336	156

[1] Includes "urbanized area" plus additional land in "urban places over 2,500 population."

[2] Includes some Federal land used as range.

[3] 242 SMSA's.

Source: (2) and (15).

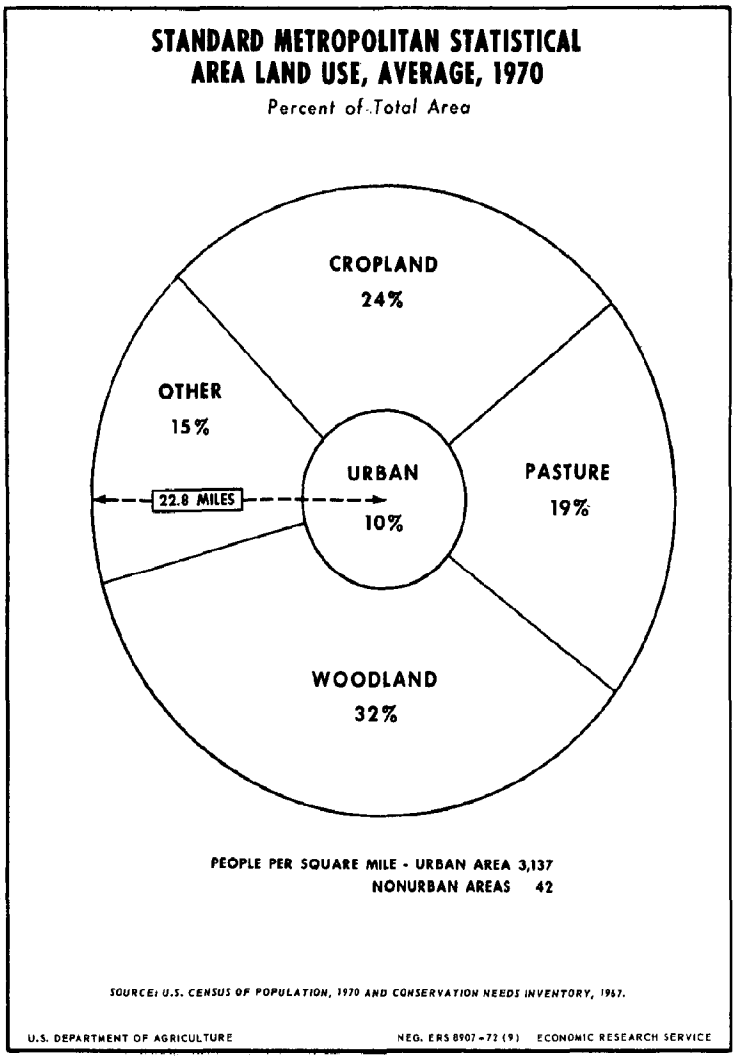


Figure 10

Table 14–Farming activity in SMSA's as a percentage of the total land area, by region, 48 States, 1969

Region	Total land area	Number of farms	Land in farms	Cropland harvested	Irrigated land in farms
			Percent		
Northeast	30.3	41.7	33.7	37.9	64.6
Lake States	13.2	17.6	13.2	14.2	16.2
Corn Belt	18.0	19.4	16.1	18.9	12.0
Northern Plains	2.6	4.9	2.4	3.6	.5
Appalachian	10.5	10.2	9.4	10.7	14.5
Southeast	16.7	14.4	12.1	15.6	32.9
Delta States	9.2	7.4	8.2	7.2	8.4
Southern Plains	14.5	19.9	13.3	18.7	18.8
Mountain	6.1	11.8	6.0	7.2	8.5
Pacific	27.1	47.7	29.2	34.0	40.3
48 States	13.0	17.2	11.2	14.4	18.9

Source: (*3*).

Table 15–Quality of land resources within SMSA's, by region, 1967

Region	Percentage of total land area in SMSA's	Percentage of acreage in land use capability classes I-III
	Percent	
Northeast	30.3	35.4
Lake States	13.2	13.2
Corn Belt	18.0	19.2
Northern Plains	2.6	3.3
Appalachian	10.5	11.5
Southeast	16.7	15.7
Delta States	9.2	10.4
Southern Plains	14.5	16.6
Mountain	6.1	5.3
Pacific	27.1	31.7
48 States	13.0	14.7

Source: (*15*).

Land Capability and Conservation Needs

The Conservation Needs Inventory, conducted by the U.S. Department of Agriculture in 1967, inventoried the land capability and land treatment needs of all rural non-Federal land and estimated that 631 million acres, or 44 percent, are suitable for regular cultivation (table 16). Only 365 million acres of this total are now used as cropland. Of the remaining 266 million acres suitable for regular cultivation, about half are in forest and a little less than half are in grass. However, most of the land would require improvement, including drainage or irrigation, some at such great cost that it would be done only of extreme necessity. Further, part of this land is in areas where the growing season is too short to produce crops with a high enough value to justify investments in land development. The total cost of development would include benefits foregone from converted forest and grasslands.

About an eighth of the Nation's cropland (50 million acres) is considered suitable only for limited cultivation because of erosion or climatic hazards. About 5 percent of the Nation's cropland (23 million acres) is on land considered not suitable for cultivation because of severe erosion hazards, and it is recommended that this land be shifted to more stable uses.

The Conservation Needs Inventory indicates that additional conservation measures are needed on about two-thirds of all the land in each of the land use categories–cropland, pasture, and forest–to adequately stabilize the soil. These conservation measures include terracing, contouring, sod waterways, and strip cropping. Erosion not only impairs the soil base through loss of soil but it is the source of silt and other pollutants, which have various and appreciable environmental effects.

Water erosion is the dominant problem on 179 million acres of cropland and a secondary problem on an additional 50 million acres. Some 4 billion tons of sediment are washed into tributary streams in the United States each year. About one-fourth of this sediment is transported to the oceans. At least half of the sediment originates on agricultural land (*14*).

It is estimated that about 4 tons of soil loss per acre (5 tons in deep soils, 3 tons in other soils) could be tolerated without impairing the soil base. About two-thirds of the cropland in the tillage rotation is within this range. But of the total cropland, 19 percent loses 6 to 10 tons per year from the soil base, 9 percent loses 11 to 19 tons per year, and 4 percent loses 20 or more tons per year (table 17).

Table 16–Land capability and conservation treatment needed, 1967[1]

Item	Total land inventoried	Land use			
		Cropland	Pasture	Forest	Other
	Million acres				
Land capability:					
Suitable for regular cultivation	631	365	117	126	23
Suitable for limited cultivation	180	50	60	65	6
Not suitable for cultivation	627	23	305	272	28
Total	1,438	438	482	462	56
Conservation treatment needed:					
Acreage	899	278	321	284	16
	Percent				
Percentage of total	63	63	67	61	29

[1] Excludes Federal and urban land.
Source: (*15*).

Table 17–Cropland erosion rates and soil losses: Average erosion loss per acre as share of total land in tillage rotation, by soil loss class, 1967

Soil loss class (tons)	Land in tillage rotation		
	Average erosion loss per acre	Acreage	Percentage of total acreage
	Tons	*Million acres*	*Percent*
0-5	3	298	68
6-10	8	81	19
11-19	15	39	9
20 or more	25	19	4
Total	[1](6)	437	100

[1] Calculated.

Source: Soil Conserv. Serv., U.S. Dept. Agr.

The Conservation Needs Inventory identified nearly 265 million acres, or about 18 percent of all rural non-Federal land, as having a wetness problem (table 18). However, this classification includes 76 million acres of land in capability classes II and III, much of which has been artificially drained and is highly productive cropland. From the standpoint of developing land for crop production, of primary interest are the 104 million acres reported as suitable for crop production but not being used for crops. One-half of this acreage lies in the Northeastern and North Central States and a fourth in the Southeastern States and the Mississippi Delta.

About 55 million acres, or 21 percent of all wet soils, occur in the coastal counties. Of this total, 11 million acres are used for crops, 25 million are potentially suitable for crops, and 19 million (classes Vw-VIIIw) have no potential for crops. About two-thirds of the 25 million acres of the potential cropland acreage is distributed along the Atlantic and Gulf coasts. Most of the rest is in counties bordering the Great Lakes.

Contemporary Wetlands Development

Very limited information is available regarding the annual rate of change in total wetland area and the kind of development and drainage occurring on these lands. The Council on Environmental Quality, in its second annual report in 1971, gave several partial estimates of agricultural and nonagricultural conversions of wetland to commercial uses:

Table 18–Lands with wetness problems, by capability class and region, 1967[1]

Land resource region	Total wet soils	Used for crops[2]	Not used for crops	
			Not suitable for cultivation[3]	Suitable for cultivation[4]
	Million acres			
North:				
Northeastern	14.2	3.8	2.5	7.9
Northern Lakes	22.3	3.2	5.2	13.9
Southern Lakes	15.9	10.1	.2	5.6
North Central	50.0	38.8	2.4	8.8
Total	102.4	55.9	10.3	36.2
South:				
South Atlantic and Gulf Slope	48.9	8.5	14.4	26.0
Coastal Lowlands	61.6	14.9	21.8	24.9
Atlantic and Gulf Coast	(30.9)	(5.1)	(14.3)	(11.5)
Florida Subtropical	(15.2)	(1.6)	(5.0)	(8.6)
Mississippi Delta	(15.5)	(8.2)	(2.5)	(4.8)
Total	110.5	23.4	36.2	50.9
Other regions	51.8	21.2	14.0	16.6
Total, all regions	264.7	100.5	60.5	103.7

[1] Excludes Federal and urban land.

[2] Includes 2.9 million acres classified as unsuitable for cultivation (land capability classes Vw-VIIIw).

[3] Land capability classes Vw-VIIIw.

[4] Includes 76 million acres in land capability classes IIw-IIIw (suitable for regular cultivation) and 28 million acres in land capability class IVw (suitable for limited cultivation).

Source: (*15*).

> Between 1959 and 1966, nearly 138,000 acres of wetlands were drained each year for agricultural purposes just in the States of North Dakota, South Dakota, and Minnesota. This loss of wetlands, however, has been partially offset by the creation of new wetlands. . . . Urban and industrial development of wetlands has been particularly heavy in coastal States. From 1954–1964, about 8 percent of coastal wetlands in Atlantic Coast States from Delaware northward was drained for development. (*6*, pp. 236–238)

Major concentrations of land draining and clearing for crop production are found in the lower Mississippi Valley and southern Florida. The environmental effects that accompany this development appear to differ somewhat between the two areas.

Lower Mississippi Valley–A recent ERS study of land use changes in the Lower Mississippi Valley found that 4.1 million acres of forested wetlands were cleared and drained during 1969 (*16*). The forest cover was reduced from 48 percent to 31 percent of the total area. Several counties in the middle and upper reaches of the Valley were further deforested to less than 10 percent of their area. Most of the newly cleared land is used for soybeans.

The most obvious environmental change has been reduction in total wetlands. Drainage projects thus far appear not to have contributed significantly to increased flooding downstream. Consequences of continued agricultural development in the Lower Mississippi Valley could include movement of sediment and agricultural chemicals, both of which would be detrimental to marine life and related economic and recreational activities in the Gulf of Mexico. However, the alluvial portion comprises only a small part of the total Mississippi drainage basin and consequently contributes liitle to pollution discharged by the river.

Lake Okeechobee Area–Much of the wetland development in south Florida is concentrated around Lake Okeechobee, where about 6 million acres are subject to direct developmental pressures from either agricultural or nonagricultural uses. Agricultural land developers in the Lake Okeechobee area are attracted more by the climate than the soils. In general, the soils tend to be difficult to manage. The humid, near tropical conditions permit production of a variety of high-value crops, particularly tomatoes, sweet corn, snap beans, and other vegetables for the winter market.

The accumulative and potential impact of agricultural development in the Lake Okeechobee area is indicated by data on land use in 1965 and projections of land use for 1985 (table 19). The net effect of these land use changes would be to reduce the undeveloped wetland area from 64 to 45 percent of the available area. The impact of wetlands development in south Florida is important because the water supply of the entire overflow area, not merely the developed part, has been affected to some extent. The truly unique flora and fauna of the nearby Everglades is dependent on periodic overflows from Lake Okeechobee. Both the quantity of water and the time frame of the water supply have been modified by agricultural and nonagricultural development.

Water quality also is affected by the land drainage. Chemicals and other pollutants entering the water supply originate from both agricultural and urban areas. The entry points for these pollutants tend to be concentrated in the eastern portion of south Florida. Since the drainage pattern is southward, the eastern portion of the overflow area may be more seriously affected than the western portion.

Agricultural Drainage–Many farm drainage systems have been in place since before the turn of the century. New farm drainage systems include additions to total acreage drained and improvement and renovation of existing systems. The total acreage of farmland with artificial drainage is large–nearly 60 million acres. Over half of the drained acreage is in five States–Illinois, Iowa, Minnesota, Indiana, and Ohio (*4*). In 1969, 1.4 million acres were drained by new systems, of which more than 500,000 acres were in these same five North Central States. Minnesota and Iowa together drained nearly 300,000 acres in 1969. Additions or improvements in drained land of 50,000 acres or more were made in Arkansas, Florida, Louisiana, North Dakota, and Texas.

Ownership and Land Use

The land law of the United States was inherited from Europe, almost entirely from the English. The English system of land holding emerged as a reaction to feudal tenures and reflects the spirit of personal freedom which attended the organization of parliaments and the reformation of the church. Freedom

Table 19–Land use, Lake Okeechobee area, Florida, 1965 and 1985 (projected)

Land use	1965		1985 (projected)		Change
	1,000 acres	*Percent*	*1,000 acres*	*Percent*	*Percent*
Urban	368	6	748	12	103
Cropland	739	12	1,143	19	55
Improved pasture	1,179	19	1,600	26	36
Undeveloped area	3,998	64	2,793	45	–30
Total	6,284	100	6,284	100	–

Source: (*12*, app. II, tables 8–10, p. B-30A, serial No. 310).

was closely associated with landownership in England. In colonial America and later, when independence was declared and a new Constitution was formed, sole proprietorship was given a high station in land policy. Jefferson's view that land ownership should be distributed widely was as much a reflection of his time as of his personal ideas. Jefferson was influential and articulate, and thus was able to translate his philosophy into a land policy that was expansionist, developmental, egalitarian, and laissez-faire. Jefferson's policy gave the dominant role in land ownership to the States rather than to the Federal Government. Consequently, widely distributed landownership has been an underlying objective of the Nation's land policy throughout most of our history.

The basic pattern of the U.S. land system was established by the Constitution and the Northwest and Southwest Ordinances. The land policy that emerged favored the distribution of land from public to private ownership as quickly and extensively as possible, free alienability and easy transfer of land, minimal governmental restrictions on holding, the recovery or control of land by eminent domain or police power, and the right of States only to tax land. Programs favoring settlement included the Preemption Acts of the 1830's and 1840's and the Homestead Act of 1862. These were supported later by research, extension, and credit programs initiated in the late 1800's and continued to the present. Inevitably, our inherent attitude toward the desirability of widespread landownership must come to terms with the fact that farmers now constitute only 5 percent of the population, instead of 95 percent as in colonial days.

Categories of Ownership

About two-fifths of the land area of the United States is government owned and three-fifths (1.3 billion acres) is held by individuals and corporations. The Federal Government holds 50 million acres in trust for Indian tribes and individuals. There are 897 million acres of public lands, divided into 763 million acres of Federal land and 134 million acres of State, county, and municipal land (table 20, fig. 11). Nearly two-thirds of the Federal lands and over half of the State-owned lands are located in the West. The proportions of total area owned by major classes of owners, public and private, have been remarkably stable for the past 50 years.

Most of the present public lands were acquired as a result of original territorial expansion. Approximately 55 million acres were later acquired and added to the public domain. Large parts of the original public lands were disposed of in grants to States for support of schools, for drainage and transportation, to railroads, and to individuals–largely for agriculture. Land disposal actions currently involve only small acreages, except in Alaska, where a transfer of large grants of land from the Federal Government to the State is in progress.

Data about the number and other characteristics of private landownership are seriously inadequate. With few exceptions, neither regulatory nor service agencies, nor offices of recorders and assessors, can assemble aggregated data on landownership, area, or value. The last national survey of rural landownership in the United States was undertaken in 1946. In the late 1950's a study was made of landownership in the Great Plains States, and in 1960 a similar study was conducted in the Southeast States.

Based on a 1966 Census of Government survey, it is estimated that about 81.6 million "parcels" (as defined for tax purposes) of property were on tax assessment rolls in 1971. Ownership of several parcels by one owner, and common interests of several owners in a single parcel, obscure the picture of the actual number of landowners in the United States. Excluding joint owners and corporation stockholders, there are probably no more than 50 or 60 million landowners. Most of these ownership parcels are located in urban areas, as might be expected. Perhaps 50 million parcels are used for housing units. Rural recreation or second homes are growing in importance and have generated another 1.5 million parcels; they are mostly owner-used and many are in rural areas.

Farmland Ownership and Use

Farm operators totaled 2.7 million in 1969. For the most part, the land they farm or graze livestock on is privately owned (table 20). There are 2.4 million farm operators who own at least some of the land they farm (as full or part owners). It is not known how many other people own farmland but do not operate it themselves (i.e., nonoperating landlords) but the number probably does not exceed 1.4 million. Thus, there are less than 4 million people who own farmland.

In 1969, there were slightly over 1 billion acres of land in farms (1,063 million acres). About half (52 percent) of the land was operated by part owners, that is, persons who own some of the land they farm and rent some. Over a third (35 percent) of the land in farms was operated by full owners. About 13 percent was operated by tenants–farm operators who do not own any of the land they farm (fig. 12). Altogether, farm operators owned about 68 percent of the total land in farms.

Table 20–Major classes of land, by use and ownership, 1969

Ownership	Cropland	Grassland pasture and range	Forest land[1]	Special use and other land[2]	Total land area
	Million acres				
Federal	1	165	278	319	763
State and other public[3]	2	41	38	53	134
Indian[4]	2	32	13	3	50
Private[5]	467	366	425	59	1,317
	472	604	754	434	2,264

[1] Includes reserved forest in parks and other special uses.

[2] Includes urban and transportation, recreation, wildlife, public facilities, farmsteads, and farm roads, and swamp, mountain, and desert areas.

[3] Excludes State-grant land in process of transfer from the Federal public domain to the State of Alaska.

[4] Trust land held by tribes and individual Indians. About 4.7 million acres of federally owned land, located mainly in Alaska, are also used by Indians.

[5] Federal, State, local government, and Indian land acreages are based on public records and reports. Private land is the residual of the land area in each major use.

Source: (*21*).

Concentration of Farmland Ownership and Operating Units

Currently at issue is the concentration of control over agricultural resources, particularly land, and the associated distribution of economic power, income, and wealth in agriculture. According to the 1969 Census of Agriculture, direct managerial control of the land is in the hands of some 2.7 million farm operators. Among operators, however, resource ownership and control are further concentrated. For example, less than two-thirds of the operators (1.7 million) operate 86 percent of the farmland and account for 98 percent of all farm sales.

One unit by which concentration can be measured is ownership of farmland. In many cases, ownership and control are synonymous; the holder of legal title to a parcel of land also holds the authority to make decisions concerning the use of the land. This authority may be delegated but, ultimately, control of land rests with ownership.

The 1946 ownership survey estimated there were approximately 5 million private owners of farmland in

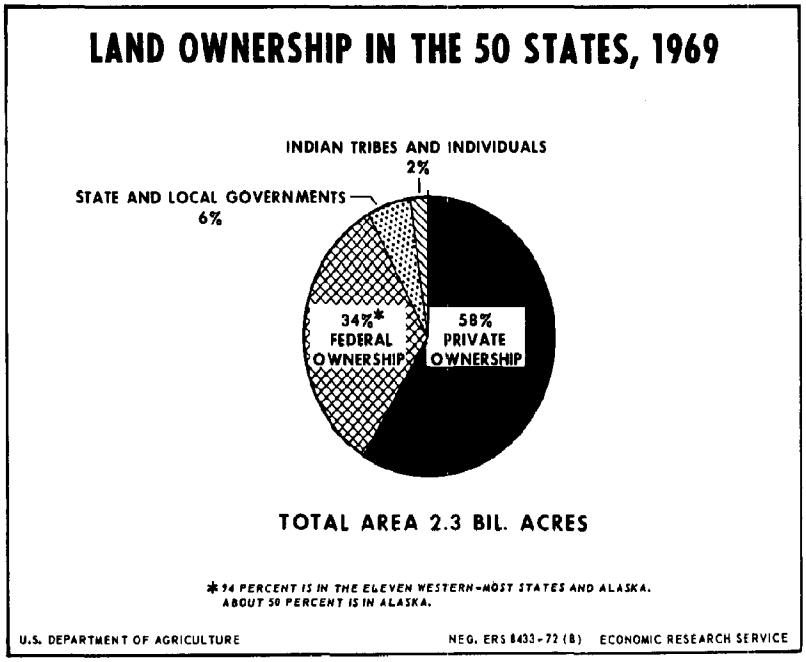


Figure 11

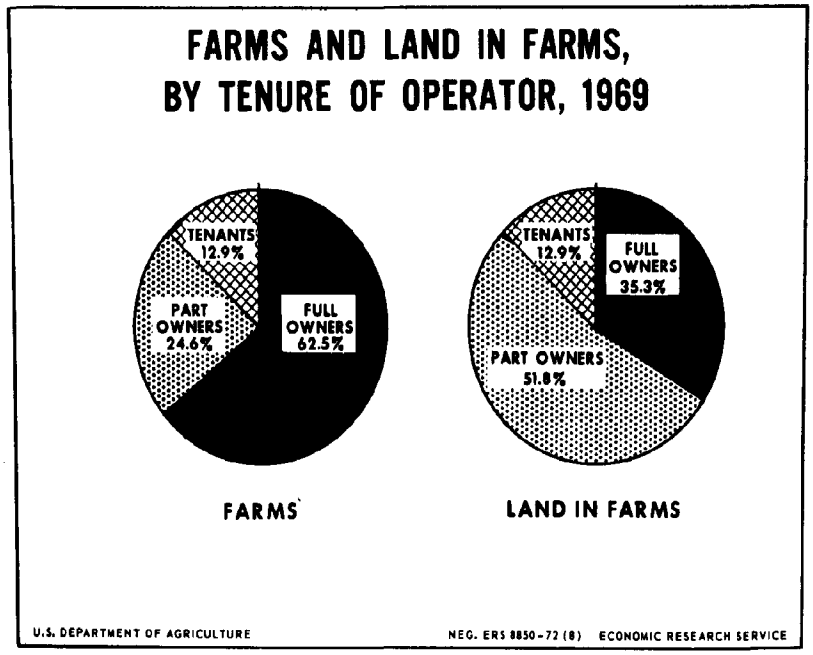


Figure 12

the United States. About half of these owners accounted for less than 10 percent of all the farmland, and 95 percent owned less than half the land. Conversely, owners of the largest tracts made up only 5 percent of all owners but they accounted for over 50 percent of the land. A similar distribution was found in the Great Plains in 1958. The distribution in the Southeast in 1960 was only slightly less concentrated.

Data on the concentration of farm operating units are more abundant than data on ownership. Table 21 shows the distribution of farm numbers and land in farms in 1935 and 1969. In 1935, nearly 50 percent of farmers operated farms that were under 70 acres in size, accounting for about 9 percent of the total farmland. But 30 percent of the land was held by only 88,000 farmers (1.3 percent), who operated farms of more than 1,000 acres. By 1969, the number of farmers had declined 4.1 million and average farm size had increased from 155 acres to 389 acres. In that year, some 151,000 farmers (5.5 percent of all operators) operated more than 1,000 acres and accounted for over half (54.4 percent) of all land in farms.

Table 21–Number of farms and percentage distribution of farms and land in farms by size classes, 1935 and 1969

Size of farm (acres)	1935			1969		
	Number of farms	Distribution		Number of farms	Distribution	
		Farms	Acres		Farms	Acres
	Thousands	*Percent*		*Thousands*	*Percent*	
Under 10	571	8.4	0.3	162	5.9	0.1
10–49	2,128	31.2	5.3	473	17.4	1.2
50–69	581	8.5	3.2	177	6.7	1.0
70–99	863	12.6	6.7	283	10.1	2.2
100–139	754	11.1	8.2	279	10.2	3.0
140–179	684	10.1	10.2	263	9.7	3.9
180–219	294	4.3	5.5	165	6.0	3.1
220–259	212	3.1	4.8	142	5.2	3.2
260–499	473	6.9	15.6	419	15.4	14.0
500–999	167	2.5	10.8	216	7.9	13.9
1,000 and over	88	1.3	29.4	151	5.5	54.4
Total	6,812	100.0	100.0	2,730	100.0	100.0

Source: (*3*).

A measure of the concentration implied in these figures is expressed by *concentration coefficients*, which measure relative degrees of equality or inequality in the distribution of land or other assets. If land were equally distributed among all farm operators, the concentration ratio would be zero. If one person operated all the land, the ratio would be 1.0. Figure 13 shows the trends in farm concentration since 1900. The ratio for the concentration of farmland among farm operators was 0.57 in 1900. It dropped to about 0.53 in 1910 and then rose steadily until 1954. Since 1954, the ratio has been around 0.71. The ratio for farmland ownership in the 1946 survey was 0.68.

There is little doubt that concentration of farm operations increased from 1900 through the mid-1960's. Since 1954, the trend toward further concentration among farm operators appears to have abated. However, this concept of concentration tends to be conservative because it refers only to the distribution of land among operators at a particular time. Since 1954, the number of farm operators has declined by 2 million. Thus, in terms of absolute numbers of farm operators, concentration of operating control of farmlands has continued.

One way in which the changes in concentration of farmland among farm operators may be visualized is in changes in the size distribution of farms (fig. 14). The greatest decline by far in farm numbers has occurred among farms under 100 acres. The number of farms between 100 and 259 acres has also declined.

The number of farms exceeding 260 acres in size has held steady or increased. Most of the increase in the number of large farms has resulted from the combination and merging of smaller units, as operators of these units expanded operations or left agriculture. The dramatic decline in numbers of farms under 260 acres since 1935 was an important factor in the rise in concentration ratios. The number of these small farms has now diminished to the point that changes in their numbers since 1954 have had relatively little influence on concentration ratios.

Relationship of Ownership and Control of Farmland

In the past, small, independent ownership units predominated in U.S. agriculture. This was the setting for the concept of the "tenure ladder" by which a man could eventually achieve full ownership of his farm. Today, resource control, rather than resource ownership, appears to be the operational concept of

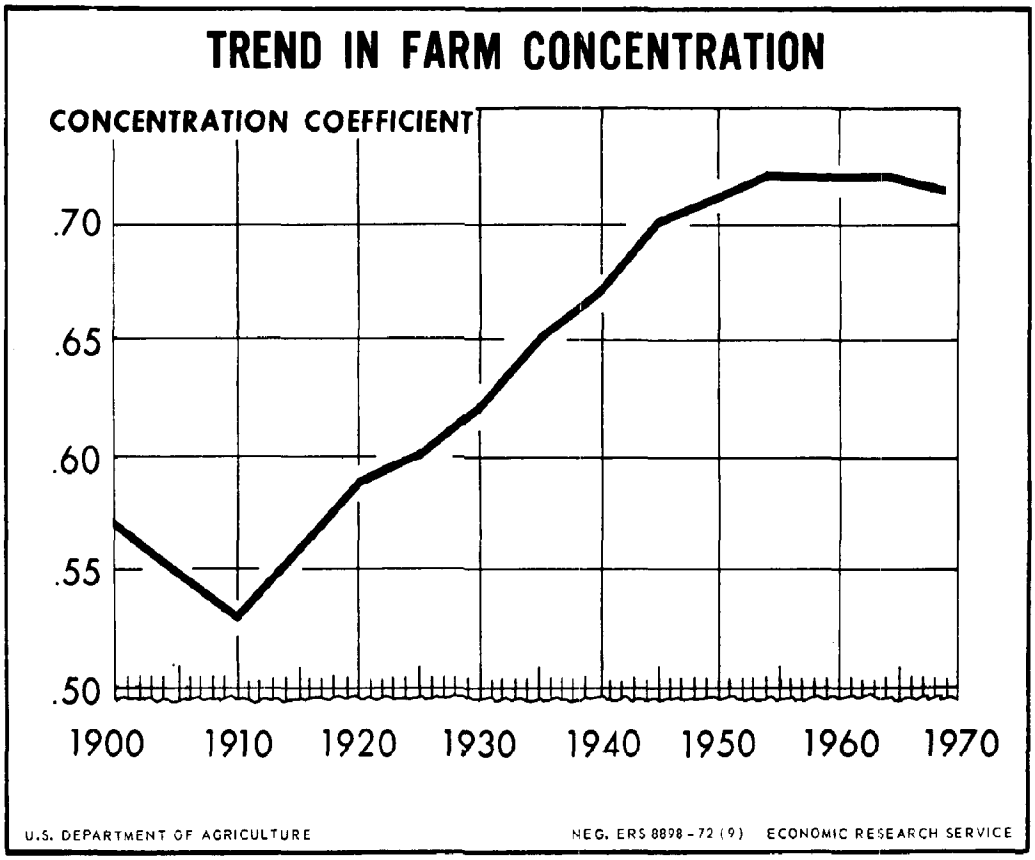


Figure 13.

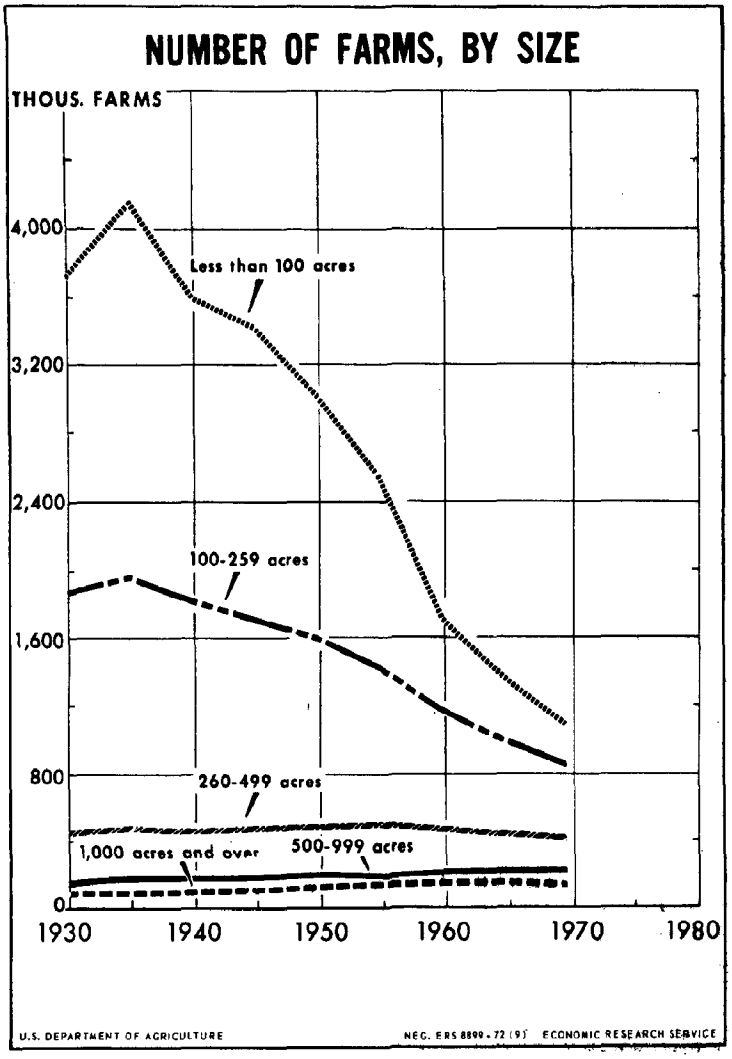


Figure 14

many farmers. This is especially true for land resources. In 1969, persons who own part and rent part of the land they farm accounted for 24.6 percent of all farms, and 51.8 percent of the land in farms. In addition, tenant operators increasingly are associated with high-valued commercial farm operations. A comparison of the number of farm operators in each tenure group and the amount of land operated by each group is shown in figure 12.

By renting land, a tenant or part owner may be able to gain operating control (for the period of the lease) or more land, or of more valuable land, than if he had to purchase the land. Data from the 1969 Census of Agriculture indicates that about 38 percent of all land in farms is rented.

Another relatively unknown group of resource owners in agriculture are the landlords. Some farm operators also rent land to other farmers but, for the most part, the rented land is owned by nonoperator landlords. Landlords outnumber both part owners and tenants. In 1964, nearly a fourth of the part owners rented from two landlords, and about another fourth rented from three or more landlords. Many large tenant operations are also assembled on land rented from several landlords. Many landlords are widows, retired farmers, heirs, investors, and others who have no intention of becoming active farmers. Nevertheless, these landlords are a very important source of capital to the operating farmers. The value of farmland and buildings rented from nonfarm landlords was estimated at one-third of the total market value of real estate assets in farming in 1969.

Because of the greater emphasis on rental land by larger operators, control of farmland is more concentrated than ownership; this, in turn, has implications for the concentration of economic power within

agriculture. In the 1930's there was considerable concern about the rise in farm tenancy. To many, this rise was associated with the concentration of economic power in the hands of landlords, bankers, and other suppliers of capital, and many of the remedial programs were designed to provide low-cost capital to active farmers. Today, the balance of power may be swinging in the opposite direction. The decline from 6.8 million farms in 1935 to a total of 2.7 million farms (1.7 million commercial farms) in 1969 means that, on the average, there is now one active farmer where formerly there were three or four. The advent of large-scale, rubber-tired equipment has given farmers greater mobility and has made contiguous farm units less essential, particularly for crop farming. In this situation, the well-capitalized part owner or tenant may be in a superior bargaining position to the prospective landlord.

Farmland Control by Type of Organization

Individual or family proprietorship is the predominant form of farm business organization in the United States. Such farms account for about 85 percent of all farms with farm product sales of $2,500 or more and 72.5 percent of the land. Partnerships account for 12.8 percent of the farms and 18 percent of the land. Farm corporations totaled 21,500 or 1.2 percent of all commercial farms, but accounted for nearly 9 percent of the land operated. Over 90 percent of the farm corporations were "closely held" by 10 or fewer shareholders. There were less than 1,800 farming corporations with more than 10 shareholders, but they operated 14.3 million acres of land (1.6 percent) and accounted for 3 percent of sales from all commercial farms in 1969.

The top farm corporation States were California, Florida, and Texas with some 4,800 corporate farms of all types. These three States also claimed more than a fourth of the farm corporations with more than 10 shareholders. About half of all corporate farms in these States had sales in excess of $100,000.

Several States, including North Dakota, Kansas, Minnesota, and Texas, place restrictions on farm corporations. Corporations also tend to be less prevalant outside the major agricultural areas. Large-scale farming corporations (those with sales over $100,000) are engaged mainly in cattle feeding, poultry and livestock ranches, and in fruit and nut farms.

Concentration of Agricultural Output

Concentration of control and economic power may also be viewed in terms of agricultural output. A recent ERS study on the economic status and potential for large and family-sized farms in the Midwest noted that of the 3.1 million farms enumerated by the 1964 Census of Agriculture, 142,000 were economic class I farm units (gross sales of $40,000 or more) and provided nearly 44 percent of the value of all products sold (table 22). Class I farms probably produced over half the U.S. output in 1969.

The number of large farms increased sixteenfold during 1929-64. In 1929, there were less than 8,000 farms with $30,000 or more in value of products sold. This sales value is equivalent to $48,450 per farm in 1964, when adjusted by the index of farm prices received. An estimated 126,000 of the class I units had sales this high in 1964.

Production of several farm products now appears to be concentrated in a few large firms (table 22). In 1964, six of the 12 census types of farms had over 60 percent of the output produced by farms with gross sales of $40,000 or more: vegetable, 81 percent; other field crops, 74 percent; poultry, 68 percent; fruit and nut, 68 percent; miscellaneous, 65 percent; and ranches, 64 percent. The same types of farms with sales of $100,000 or more accounted for 38-67 percent of the production.

The increase in number and the market dominance by large farms is part of the general trend associated with the decline in farm numbers and the increase in

Table 22—Distribution of farm production on large farms, as a percentage of total farms, by type and size of farm, 1929, 1959, and 1964

Type of farm	1929, Large[1]	1959, Class I[2]	1964	
			Large[3]	Class I[2]
	Percent			
Vegetable	20.0	73.3	67.1	81.4
Other field crops	5.1	55.8	49.1	73.7
Poultry	3.3	55.4	38.0	67.9
Fruit and nut	19.9	45.1	46.7	67.6
Miscellaneous	1.0	62.1	44.6	65.4
Ranches	29.2	59.8	46.5	64.0
Cotton	1.4	46.8	31.3	55.2
Livestock	2.1	33.9	26.8	46.8
General	.2	20.7	18.3	33.6
Cash grain	1.8	16.7	6.4	23.9
Dairy	3.0	15.3	9.9	23.4
Tobacco	–	3.9	3.9	8.2
Total	5.0	32.8	24.8	43.7

[1] Farms with sales of $30,000 or more in 1929, which is comparable with $48,600 in 1959 and $48,450 in 1964.

[2] Class I: Census of Agriculture farms with sales of $40,000 or more.

[3] Farms with sales of $100,000 or more. They are part of the total number of class I farms.

Source: (*17*).

per farm inputs of land and capital. Some midwestern farms now approach equity levels of $500,000 or more. Nationwide, the average value of assets used in agricultural production in 1970 was $54,100 per farmworker and $91,700 per farm. Just three decades earlier, the figures were $3,300 and $6,200, respectively. The growth of these large, highly capitalized, and efficient units is one reason the average American farmworker can now supply himself and about 50 other people. The converse of these trends, however, is that farming opportunities for people seeking a livelihood from the soil continue to decline.

These data suggest both opportunities and potential problems in formulating land use policies affecting agricultural lands. Since farm population and farm operators now comprise such a small share of the U.S. population, it should be possible to implement program and policy changes more easily than would have been the case when a considerable share of the population was engaged in agriculture. On the other hand, the large acreage and high capital investment associated with today's typical commercial farm make it imperative to consider the consequences of program or policy changes on the viability of agricultural firms and opportunities for people in rural areas.

Not all farms are large-scale commercial operations, of course. In 1969 about 1 million farms had annual sales below $2,500. These include many semiretirement or part-time operations. The general presumption is that these small operators probably do not consider farming their major source of livelihood.

Noncommercial farming does not necessarily imply poverty or deprivation. Operators may include, in addition to the semiretired and the part-time farmers, the hobby farmer and farmowners with other income sources. These farmowners may present special opportunities for implementing land use policies. For example, they may be particularly attuned to the idea of land stewardship and the need for land and water conservation. Furthermore, they may be in better financial position to bear or share the costs than other farmowners. They may also manage their farms in a way that preserves open space and scenic amenities that a monoculture, highly mechanized type of agriculture cannot provide.

Ownership and Use of Forest Land

Forest land is widely distributed over the United States. Unlike cropland, a sizable portion is publicly owned. Thus our needs for the products and services of forest land must be met through a combination of public and private decisions.

The major uses of forest land are for timber and grazing. Public forest lands are mostly managed by policy and planned decisions to provide for multiple use. Water is often considered a byproduct of forest land, and management may be modified to protect water quality and flow. Other uses of forest land include recreation, mining, and fish and wildlife habitat. Various uses are often compatible to some degree with each other and occur on the same area. For example, recreation may be combined with management for timber, forage, and/or water. However, by law or policy, recreation may be the only purpose for forest management, particularly on some public land.

Data on commercial forest land (about two-thirds of the 753 million forested acres) are assembled from periodic inventories made by the U.S. Forest Service (table 23). Commercial forest land is capable of producing at least 20 cubic feet of usable wood per acre each year. Noncommercial forests (254 million acres) are located predominantly in the western mountains and dry lands and in Alaska (112 million acres). About four-fifths is in public ownership. Some 16 million of these acres are legally withdrawn for National and State parks and wilderness areas. Nearly three-fourths, or 500 million acres, of the commercial forest land is privately owned. Eighty percent of this land is east of the Great Plains. Nationally, about 19 percent of the private commercial forest land is owned by industrial owners, 36 percent is in farm woodlots, and 45 percent is owned by "other" (nonfarm, nonindustrial) individuals. These distributions of private ownerships vary considerably by regions. In the Pacific States, industrial ownership predominates; in the Southern and Northeastern States, small farm and other private ownership units prevail.

To the extent that potential problems of forest land use can be identified with ownership, it appears that increased wood production in the East depends heavily on the management decisions of small-tract owners. In the western regions, management decisions will be dominated by public agencies together with industrial owners.

Over the last two decades forest ownership patterns have changed considerably (table 24). Changes have been greatest in the two small ownership categories in the North and South regions, which account for nearly three-fourths of the total forest land. Clearly, forest industry and especially the ownership categories classified as "other" have expanded at the expense of farm forests. Some of the apparent losses in farm forest ownership are due to a change in definition of farms

Table 23–Commercial forest land: Area and percentage distribution by ownership and region, 1970

Region	Area						
	Total commercial forest	Public forest		Private forest			
		National forest	Other	Forest industry	Farm	Other	Total
	1,000 acres						
North[1]	177,902	10,458	21,453	18,168	51,023	76,799	145,990
South[2]	192,542	10,764	6,515	35,325	65,137	74,801	175,263
Rocky Mountains[3]	61,632	39,788	7,181	2,234	8,379	4,051	14,664
Pacific[4]	67,622	30,915	9,047	12,219	6,602	8,839	27,660
Total, United States	499,698	91,925	44,196	67,946	131,141	164,490	363,577
	Distribution						
	Total commercial forest	Public forest		Private forest			
		National forest	Other	Forest industry	Farm	Other	Total
	Percent						
North	100	5.9	12.0	10.2	28.7	43.2	82.1
South	100	5.6	3.4	18.3	33.8	38.9	91.0
Rocky Mountains	100	64.6	11.7	3.6	13.6	6.6	23.8
Pacific	100	45.7	13.4	18.0	9.8	13.1	40.9
Total, United States	100	18.4	8.9	13.6	26.2	32.9	72.7

[1] All States east of the Great Plains lying north of the approximate line running east along the south border of Kansas to the Atlantic Ocean, except Virginia.

[2] Remainder of Eastern States, including Texas.

[3] All States west of the Great Plains and east of the Pacific States.

[4] Pacific States–those bordering the Pacific Ocean, including Alaska and Hawaii.

Source: (*22*).

since 1950. Nevertheless, a sizable share of this change represents an increasing trend toward absentee ownership of woodlands, and toward ownership essentially for nonfarm purposes.

Typically, public and industrial forests are managed for long-term sustained yields of wood of high quality and volume. Management purposes on the small ownerships are highly diverse. They may range from high-intensity management for wood to total reservation of forests for recreation or wildlife uses. Farm woodlots are typically understocked with trees suitable for timber production and frequently lack planning for sustained production. In some regions, especially in the North, markets are very limited for small-sized and low-grade hardwood trees, which make up a large part of growing stock. Many owners have difficulty marketing small volumes from scattered small tracts because of high harvesting costs. Many absentee owners have little understanding of forest management with the result that many tracts are cut over destructively or held without any intention of cutting. Undoubtedly, many of these tracts are held partly for speculative

Table 24–Percentage changes in commercial forest area, by ownership classes, 1952-70

Region	Total commercial forest	Public forest		Private forest			
		National forest	Other	Forest industry	Farm	Other	Total
	Percent						
North	+4.5	+1.1	−2.6	+28.6	−23.2	+34.1	+5.9
South	+.2	+3.4	−1.8	+10.2	−28.7	+44.1	+[1]
Rocky Mountains	−6.3	−9.5	−.7	−.7	−.7	−.7	−.7
Pacific	−1.7	+1.4	−13.4	+9.0	−11.2	−4.1	−1.8
Total, United States	+.6	−3.0	−4.1	+13.9	−24.5	+34.3	+2.2

[1] Less than 0.05 percent.

Derived from preliminary data in U.S. Forest Service 1970 inventory, Dec. 31, 1952, to Jan. 1, 1970.

reasons, with little incentive to manage for any purpose. Small-tract owners–farmers and others–have varied objectives for their forest land. It often appears that such owners use their forest land primarily for recreation or for wildlife habitat rather than to produce merchantable timber. In fact, timber harvest, recreation, and wildlife habitat are not mutually exclusive, but can often be combined on a given area over time.

Forest ownership purposes are probably most stable for the two large owner categories, public and industrial. Wood production dominates on most acres, although multiple use is a management objective on most of the public lands. Uses for recreation, forage, and water probably do not seriously reduce timber production. However, reductions could occur later, especially in western national forests, if a major shift in requirements for recreation should occur.

Public Land Use and Management

Over 755 million acres, one-third of the land area of the United States, is federally owned. This land is diverse in character, ranging from the tropical soils and vegetation of Florida and Hawaii to the tundra of Alaska. Each State contains some federally owned land. Administration of this land is distributed among 37 Federal agencies. Management is complicated by the diversity of the land, its location, and the multiagency administration.

Most of the Federal lands are located in the Western States; nearly half of the area is in Alaska (table 25). Over 90 percent of the Federal land outside of Alaska is in the 11 Western States. In those States where the Federal Government is a principal landowner, how the land is managed and used significantly affects State and local economies.

Nearly 100 million acres of Federal land are classed as commercial forest, mostly managed to maintain a continuous yield of timber. This area represents about 20 percent of the total commercial forest land. Nearly 40 percent of the Nation's supply of merchantable timber and over 60 percent of its softwood sawtimber are located on Federal land.

Domestic livestock grazing, the most widespread economic use of Federal lands, occurs on more than a third of the area, including unproductive areas intermingled and managed with the productive range. Although Federal lands provide only about 3 percent of the total forage consumed by U.S. livestock, they provide at least seasonal grazing for over 4 million

Table 25–Comparison of federally owned land with regional land areas, 1970

Region	Total land area	Federally owned land	Federally owned land as share of region
	1,000 acres		*Percent*
Northern:			
Northeast	112,285	2,352	2.1
Lake States	122,709	8,511	6.9
Corn Belt	165,284	3,306	2.0
Northern Plains	194,877	6,923	3.6
Total	595,155	21,092	3.5
Southern:			
Appalachian	124,450	8,048	6.5
Southeast	124,069	7,693	6.2
Mississippi Delta	92,690	5,767	6.2
Southern Plains	212,305	4,428	2.1
Total	553,614	25,935	4.7
Western:			
Mountain	548,449	270,321	49.3
Pacific	204,499	89,144	43.6
Alaska	365,482	348,467	95.3
Hawaii	4,106	397	9.7
Total	1,122,535	708,330	63.1
Total, 48 contiguous States	1,901,716	359,466	18.9
Total, 50 States	2,271,304	755,357	33.3

Adapted from State data in (*10*, app. F).

cattle and 9 million sheep, or about 30 million animal-unit months of grazing. The importance of Federal grazing land varies greatly by States and local areas. For example, Federal lands provide about 45 percent of the total feed requirements for beef cattle and sheep in Nevada and 30 percent in Utah. In some areas, many ranches would cease to be economic operating units if public range use were prohibited.

Federal lands are an important source of minerals. In 1968, over 64 million acres were under lease for oil and gas, and over 6 percent of the Nation's oil production came from Federal lands. More than 8,200 producing mineral leases generated over $92 million in royalties to the Federal Government. Much of the national production of copper, nickel, silver, lead, molybdenum, potash, and mercury comes from Federal land. Deposits of oil shale, located principally on public lands, are of great potential strategic importance and pose unique resource management problems in guiding their development and utilization.

Over 33 million acres of federally owned land—national parks, monuments, scenic and wild rivers, wilderness areas, and seashores—are truly unique in terms of scenic or natural attributes. These lands constitute a tremendous resource for outdoor recreation and require special management policies and practices. Much of the remaining Federal land, especially in National Forests, is also used or available for outdoor recreation. The Government, by reserving and managing lands for recreational purposes, may be considered the Nation's principal supplier of outdoor recreation facilities. Federal lands provide not only much of the fish and wildlife habitat but also much of the access to fishing and hunting in the United States. Seventeen million acres are set aside for resident game species, and 9 million acres are designated as migratory bird refuges. Big game depends largely on Federal lands for habitat.

Federal lands, mainly the National Forests, are the principal source of water in much of the arid West, providing about three-fifths of the natural runoff in the 11 conterminous Western States. Water quality, sedimentation, erosion, and distribution of runoff are significantly affected by management practices on these lands.

The Bureau of Land Management (BLM), Department of the Interior, administers over 60 percent of all Federal lands (fig. 15). About two-thirds of the BLM land is in Alaska. The Forest Service administers about one-fourth of the Federal lands. Smaller acreages are administered by the Department of Defense and by the Fish and Wildlife Service and the National Park Service, Department of the Interior. Administration of the remaining 2 percent is distributed among more than 30 separate agencies.

Lands acquired by many Federal agencies are devoted to specific purposes, administered under specific legislation, and present few management options. Examples are military installations, public works facilities, research installations, and Federal building sites. Problems and opportunities for management alternatives and public use of federally owned land center on the over 700 million acres administered by the Bureau of Land Management, Forest Service, National Park Service, and Bureau of Sports Fisheries and Wildlife. For the most part these lands are managed within the multiple-use concept. This is not a precise concept; however, it recognizes that public lands produce a variety of valuable products for public consumption, and it implies that management should maximize "net public benefits."

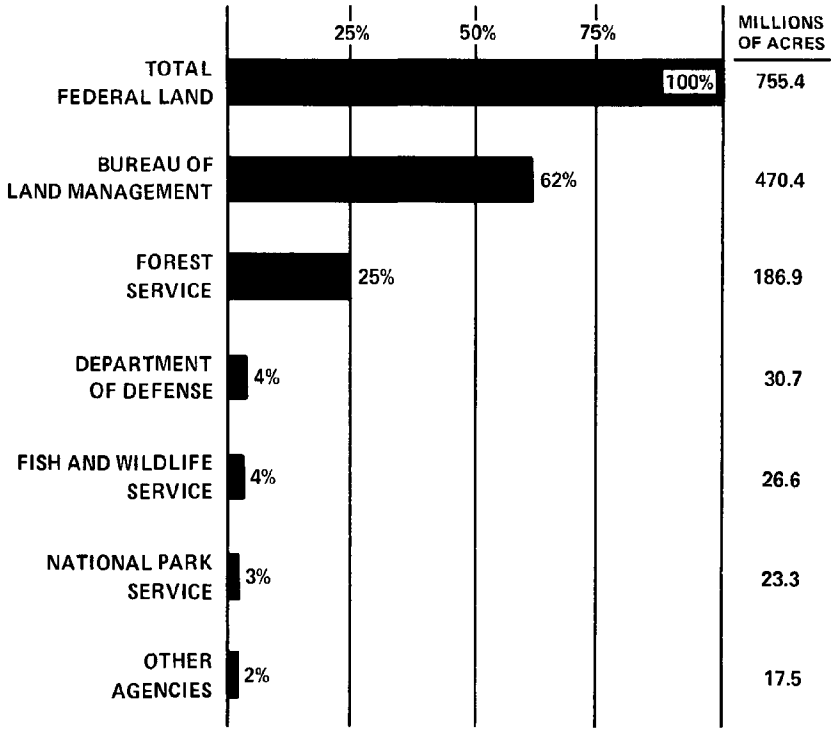
Public lands are a vast reserve of potential resource benefits to the American people. The enjoyment of these benefits for future generations will require management policies which safeguard resources from deterioration, recognize public choice and desires in products produced, and anticipate and respond to changing public demands over time. A critical part of such a system is a program that will explore and display the supply potential of public lands in terms of both single-product and multiproduct alternatives. Public choices and desires, based on this information, can then be translated into management policies and multiproduct mixes that will maximize the utility of our federally owned resources.

Other Ownership and Use Categories of Rural Land

A comprehensive accounting of major landownership or use categories would be difficult. Changing habits, life styles, and occupational composition of our population have radically altered the relative importance of agricultural and nonagricultural land. Small holdings no longer farmed may provide residence for urban workers. In terms of land area occupied, rural housing may not occupy much land but such use may be expensive in terms of providing government services or protecting the environment.

In determining future policies for rural land use, nonfarm parceling promises to increase in importance. In recent years large shifts have occurred in the ownership of private forest lands from the category of "farm" to "miscellaneous private" in the Atlantic and Gulf Coastal States. For the five coastal States from Virginia through Florida, the "miscellaneous private" acreage increased approximately 2½ times in 17 years.

ADMINISTRATION OF FEDERAL LANDS BY AGENCY, 1968



SOURCE: PLLRC STUDY, INVENTORY INFORMATION OF PUBLIC LANDS, TABLE A2a, 1969.

Figure 15

How this shift related to purposes of ownership and levels of management is largely unknown. In response to the growing demand for land for recreation and second homes close to urban areas, and the demands for public parks and reservoirs, sizable acreages are likely to be removed from timber and commercial agricultural uses.

The Council on Environmental Quality, in its first annual report to Congress, noted that the growth of vacation homes is the instrumental force in the development of the Nation's coastal lands. Shorefront homes account for over 68 percent of the total recreational property values along the coasts and the Great Lakes. They occupy over 90 percent of the recreational land on developed coasts. Only 6 percent of the land that can be classed as recreation shoreline is in public ownership and not all of that is accessible to the public (*5*).

Data on second-home ownership is limited. In 1967, according to a Bureau of Census sample survey, 1.7 million households, or nearly 3 percent of the total, owned second homes. Nearly 80 percent of these second homes were within 200 miles of the primary home and about a third were within 50 miles. A third were classified as houses, 9 percent as cabins, and the rest as cottages. Over 90 percent had electricity, 58 percent had complete plumbing, and 36 percent had some type of heating system.

The land area involved in recreation subdivisions and second homes is not known precisely. Probably 2.5 to 3.0 million acres are used as sites for second homes. According to the census survey of 1967, 12 percent of the second homes and recreation subdivision lots were 10 acres or more in size. Private estimates indicate 650,000 or more recreation lots were sold in 1972. Approximately 100,000 second houses are built each year on lots already in the hands of owners. A continuation of the current energy shortage could lead to a sharp reduction of demand for second homes and development of recreation subdivisions.

In view of the large number of rural parcel sales for second home and recreation home sites, serious service and environmental impact problems could develop in the future. Often there is little or no preplanning in consideration of environmental impacts and service needs of contemporary urban life, and the fragmentation of land ownership will complicate future planning for land use. Water supplies and waste disposal for the Nation's rural homes and small communities already are difficult problems. Many areas do have good water

and waste disposal systems, but elsewhere, including both recreation subdivision and long established rural communities, domestic waste disposal is inadequate and a source of water pollution.

The boom in rural recreation and second home developments is also creating new demands on public lands. Many recreational developments are being located on private lands adjacent to National and State parks and forest lands, thus adding to the already heavy use-demands on the public lands.

Public Controls Over Private Land Use

In 1940, Ely and Wehrwein, in *Land Economics*, stated in regard to policies of public control over land:

> Insofar as land and resources are affected by public interest, no landowner holds title to land to the exclusion of the rights of the public, including future as well as present generations. Our political philosophy must give meaning and content to the vague idea of "public vs. private rights" to land. The right to control land uses exists and lies in the sovereign power of the state and may be exercised through the police power, eminent domain, and taxation. The real question is whether the people are willing to make use of these powers within the rule of reasonableness, as decided by the courts and American traditions. (*8*)

This statement can hardly be improved upon today. If government spending is added to those powers enumerated by Ely and Wehrwein, we have a full listing of forces that can be used to implement land policy. What the statement does not specify, however, is that these powers or forces are variously distributed among different levels of government in our system. Until public attention began to focus recently on the issue of a national land use policy, little official effort was made to integrate the powers available at different levels of government to address land use problems.

In general, the powers of government may be characterized as follows: The Federal Government has immense power to tax and spend; the State governments have lesser powers to tax and spend, but they have broad regulatory power; and the local governments have more limited power to tax and regulate, but they have a unique opportunity to hear or express the views of individual citizens.

In addition to alternate sources of constitutional authority available to governments for asserting the public interest in private land use, an almost limitless variety of tools or devices exists for expressing this authority. These include various forms of public ownership; fee ownership, fee ownership with lease-back, or easements; contractual arrangements such as those used in cost-sharing; regulatory devices such as zoning ordinances and subdividion regulations; adjustments of both income and property taxes; and organizational forms such as special purpose districts.

This section focuses on the regulation of land use through the police power. With minor exceptions, the police power is among the powers reserved to the States under the Tenth Amendment to the Constitution. State governments, therefore, have the inherent authority to regulate land use. Historically they have delegated this authority to local governments. However, recent developments suggest there is a trend toward direct exercise by the States of certain of their land use regulatory powers. The major land use regulatory devices under the police power are zoning, subdivision regulation, and the official map. Other more limited but widely used types of regulation are building codes, housing codes, and health regulations.

The delegation of power to regulate rural land use varies widely among the States. But, in general, county governments are in control in the South and West, towns or townships in the Northeast, and both counties and towns or townships in the Lake States. Figure 16 breaks down rural zoning legislation by States. All 50 States authorize the zoning of some unincorporated or rural areas. Rural land in three-fourths of the Nation's 3,000 counties can be zoned by some unit of local government (*19*).

Information on enabling legislation presents only part of the picture, however. Enabling acts generally leave to local government units the decision whether or not to adopt land use regulations. National statistics on the numbers of local governments regulating land use are not regularly or systematically collected. The only information currently available was collected in a sample survey conducted by the Governments Division of the Bureau of the Census in 1967 and reported by Allen D. Manvel of the staff of the National Commission on Urban Problems (*9*). Table 26 summarizes part of that report.

While there has been a significant increase in rural land use planning and regulation during the last 10 years, the survey shows that rural local governments lag considerably behind urban jurisdictions in these activities. In 1967, for example, 80 percent of the county governments within SMSA's had planning boards, compared with only 48 percent of the counties outside SMSA's. Within SMSA's, 49 percent of county governments had a zoning ordinance, but this was true for only 19 percent of those outside SMSA's. In a great many cases, the failure of local governments to act in these areas cannot be explained by lack of legislative authority.

The decision by a local government to plan and regulate land use is an important first step; however, the

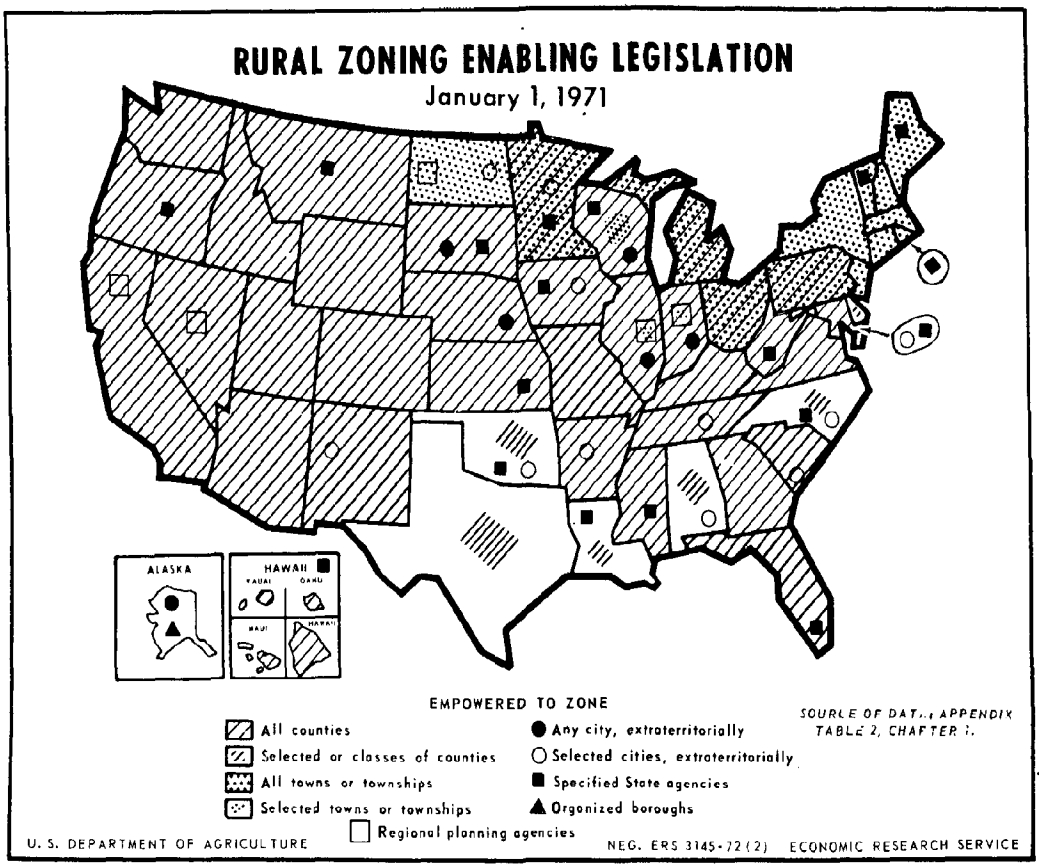


Figure 16

effectiveness of these activities may be determined by commitments of resources to execute and administer them. According to the 1967 survey, almost $300 million is spent annually by local governments in planning and regulatory activities. Of this amount, over $42 million is spent by governments outside SMSA's. While these figures are impressive, they account for only a small part of total local government expenditures–less than 1 percent in urban areas. Total planning and regulatory expenditures are also small compared with the property values and dimensions of the real estate development industry that is to be regulated.

As might be expected, areas outside SMSA's spend less per capita for regulatory activities than areas within SMSA's. The average for all regulating governments outside SMSA's is only one-third of the average expenditure within SMSA's (fig. 17).

In addition to the problem of level of expenditure is the problem of level of employment; less than one-fourth of all jurisdictions attempting to regulate land use had any full-time employees engaged in this activity in 1967. The pattern of part-time employment in planning and regulatory activities was particularly significant in rural areas. For all governments outside SMSA's, 70.5 percent of total employment was part-time; within SMSA's, it was 28 percent.

The reason frequently given for our current land use problems is the inherent inadequacy of the tools or devices available to the public for controlling land use. Although tools could and should be improved, a more general problem, particularly in rural areas, is failure to use the tools available. Further, those local governments using the tools apparently do not devote sufficient resources to make them effective.

In the decade ahead, the need to plan and regulate land use will increase as greater emphasis is placed on meeting environmental quality standards. This will require greater coordination and integration of the powers available to the various levels of governments in our Federal system.

WATER RESOURCES

Water Supplies and Uses

Water is a renewable and mobile resource. The average annual basic supply of precipitation for the 48 conterminous States is 30 inches, or about 4.2 trillion gallons per day. Some 70 percent of the precipitation, or 21 inches, evaporates or is transpired from

Table 26–Number and percentage distribution of governments with planning, zoning, and building regulation activities, by SMSA location, and type and size of government, 1968

Type of government and 1960 population[1]	Number of governments	Planning board	Zoning ordinance	Subdivision regulation	Building code	Housing code	Any building regulation[2]
	Within SMSA's						
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Municipalities:							
50,000 or more	314	98.4	98.7	92.7	98.7	85.3	100.0
5,000–49,999	1,303	92.9	97.0	90.0	91.8	53.3	99.9
Under 5,000	3,360	54.9	54.0	47.7	57.4	37.8	79.5
New England-type townships:							
5,000 or more	765	79.1	81.0	74.0	58.7	22.7	91.5
Under 5,000	1,463	45.7	44.8	44.0	33.5	20.4	63.3
Counties	404	80.0	49.3	62.9	39.4	18.6	86.1
	Outside SMSA's						
	Number of governments	Planning board	Zoning ordinance	Subdivision regulation	Building code	Housing code	Any building regulation[2]
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Municipalities:							
5,000–49,999	1,352	91.8	90.5	81.9	73.5	54.4	98.4
1,000–4,999	1,675	56.5	52.9	31.3	51.3	27.6	89.3
New England-type townships:							
5,000 or more	333	79.3	73.9	72.7	52.9	16.2	84.4
1,000–4,999	2,399	37.9	20.1	18.8	15.2	7.9	69.4
Counties	2,645	48.1	19.4	23.9	9.7	5.1	54.7
Total							
Within SMSA's	7,609	65.2	68.3	59.3	59.5	36.5	82.3
Outside SMSA's	10,384	55.4	42.3	34.4	36.8	20.5	75.3
All governments	17,993	59.6	53.3	44.9	46.4	27.3	78.3

[1] Data relate to governments subject to sample survey representation, and thus omit (a) all municipalities and townships of less than 1,000 population located outside of SMSA's; and (b) township governments located in States where the governments lack municipal-type powers.

[2] Data cover units reporting any of the other specified types of activity or a local building-permit system.

Adapted from (*9*, p. 24).

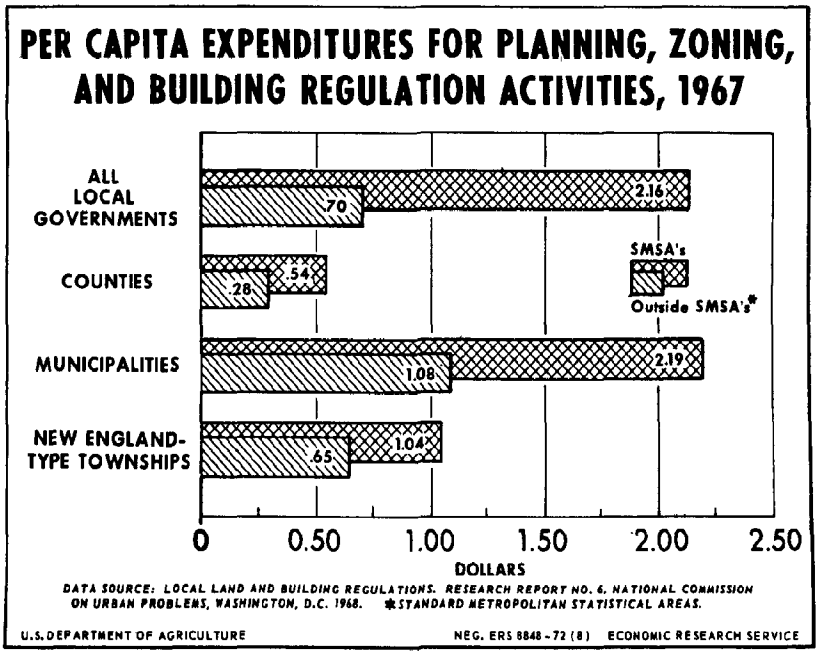


Figure 17

vegetation. Roughly two-fifths of this evapotranspiration is a natural loss. The other three-fifths provides the moisture for four-fifths of our supply of food and fiber and nearly all of our forest products.

The remaining 30 percent of the precipitation, or 9 inches, is natural runoff. This is equivalent to 1.2 trillion gallons per day for the 48 States and can be considered the effective renewable supply. But substantial accumulated groundwater, a stock resource, augments this effective supply. Groundwater reserves, not all of which can be economically tapped, are equal to about 30 years of runoff.

Alaska's water resources represent the largest block of undeveloped water supply for the United States. The natural runoff is about 580 billion gallons per day, almost half that of the 48 States.

The time and spatial distribution of water resources, while contributing to the unique and varied character of different parts of the country, poses important management problems. For any one region or location, rainfall can vary widely from season to season and from year to year. Even greater variations occur in runoff and streamflow and thus in the dependability of the effective supply of water actually available for use at a particular time and place. The dependability of runoff can be expressed by comparing the runoff in the driest year in, say, 20 years, with the average for 20 years. In general, the areas of greatest dependability in runoff are the Northwest, the Northeast, and the Southeast. The areas of greatest variability or least dependability are the Southwest and the Great Plains. But even in areas of high precipitation and runoff, a series of dry years may occur, resulting in serious drought problems such as those in the Northeast from 1961 to 1966.

Floods and droughts of varying severity and duration occur sporadically across the country. As might be expected, flood damage is heavy on intensively developed flood plains; but historically, the bulk of the total damage has actually occurred in numerous, less intensively developed areas. The adverse effects of droughts are particularly felt in areas that use a high portion of their water supply each year, or where storage and distribution facilities are inadequate to meet prolonged shortages or increased water requirements.

While ground water use is vital to the economy of some areas, its mining will decrease as pumping from greater depths becomes uneconomic or local reserves are exhausted. Desalination, although presently in limited use, may become an economically feasible means of augmenting local water supplies in some areas. Increasing precipitation and runoff through weather modification offer some possibilities for the future, but many questions remain to be answered by further trials and research. Other opportunities for more effective regulation of runoff include watershed management, snowpack management, evaporation suppression, and elimination of undesirable forms of vegetation.

Water quality must also be considered in discussing water supply. Natural water quality is affected by

geologic, hydrologic, and biologic factors. The most important natural impurities are sediment and dissolved minerals. The natural quality of surface or ground water varies considerably from one area to another, and in some situations the water is unsuitable for most uses. Moreover, man-caused pollution has seriously impaired water quality over wide areas. This pollution consists primarily of waste discharges from domestic and industrial sources; salinity of irrigation return flows; sediment and other diffused wastes in runoff from urban, mined, industrial, and agricultural lands; and sediment from logging operations and roadway construction.

National Trends in Water Withdrawal and Consumption

Water uses may be classified as instream or withdrawal. Instream uses such as navigation and fishing are not considered in this report. Withdrawal includes water taken from surface or underground supplies. Consumptive use is the portion of withdrawal that is not directly returned to surface or ground supplies because of evaporation, transpiration from plants, absorption, or incorporation with animal, plant, or manufactured products.

Withdrawal uses involve some actual consumption or dissipation, but may return large quantities of water to stream courses or ground water where it is available for reuse. The returned water may be altered very significantly or very little in quality, depending on its use and treatment before return. These are the principal reasons for focusing on water uses that require withdrawal in assessing use trends and pressures on available supplies.

Table 27 indicates the national trends in water withdrawals, and the relationship of withdrawals to the average annual supply of runoff that replenishes both streamflow and ground water. Withdrawals in 1970 in the 48 conterminous States totaled about 323 billion gallons per day. This was 27 percent of the available supply in those States. Withdrawals in 1970 were about 2.8 times the 1940 volume, and net consumption in 1970 was about 2.3 times the 1940 volume. Rural uses accounted for 85 percent of all consumption in 1970. This was due to the large demand for water in irrigated agriculture, which, on the average, uses up about 60 percent of the water withdrawn for that purpose. Withdrawal for uses with low rates of consumption (industrial, municipal, steam-electric cooling) increased faster than withdrawal for uses with high rates of consumption, such as irrigation. This accounts for the lower increase factor for consumption.

The final column of table 27 indicates roughly the degree to which water use impinges on the quantity and quality of our available supplies of streamflow and

Table 27—Water supplies, withdrawals, and consumption, 1940–70

Year	Annual runoff[1]	Total withdrawals[2]	Total consumption[3]	Relative to 1940	Share consumed in urban areas[4]	Share consumed in rural areas[5]	Ratio of consumptive use and withdrawals[6]
	Billion gallons per day			*Percent*			
1940	1,793.8	115.2	38.1	100	7	93	2/6
1945	1,793.8	142.8	42.8	112	8	92	2/8
1950	1,793.8	171.4	52.0	137	8	92	3/10
1955	1,793.8	214.3	56.8	149	10	90	3/12
1960	1,793.8	256.2	64.9	170	11	89	4/14
1965	1,793.8	269.6	77.7	204	13	87	4/15
1970	1,793.8	326.8	86.5	227	15	85	5/18

[1] Proportion of precipitation reaching streams or recharging ground water.

[2] Includes gross diversions or pumping for any purpose.

[3] Proportion of gross actual withdrawals not available for subsequent withdrawal. Includes transpiration from irrigated vegetation, biological transpiration, and some evaporation.

[4] Mainly water consumed by municipal water systems, self-supplied industrial or manufacturing uses, and steam-electric power plants.

[5] Includes farm domestic water use, livestock consumption, and irrigation consumption.

[6] Ratio of consumptive use and withdrawals as a percentage of annual runoff supply. The latter indexes can range over 100, in which case they mean that annual runoff supplies in the region are normally inadequate to service all withdrawal needs, and there must be reliance on return flows and runoff originating in other regions.

Sources: Data for 1940–60 are mainly from the Bureau of the Census, the U.S. Geological Survey, and the Economic Research Service as described in (*13*). Data for 1965 and 1970 are mainly cited or derived from (*25*). Data should be interpreted as orders of magnitude than as precise figures.

additions to ground water. Net consumption and total withdrawals are expressed as percentages of the total runoff supply. Water consumption for the entire United States in 1970 was 5 percent of annual supply, and withdrawals were 18 percent of total supply. Both indexes have increased over time but the relationship between them has changed little. As will be shown further on, the regional pattern of consumption and withdrawal, and the relationship between them, varies between regions, reflecting great differences in water supplies and the development of the supplies.

Water Withdrawals–Source of Supply and Purpose

From a policy and management standpoint, we need to know how the different uses of water impinge on different sources or forms of supply. In 1970, two-thirds of all U.S. withdrawals were from fresh surface sources, one-fourth were from ground sources, and about one-tenth were from saline sources (table 28). The heaviest users of saline water are steam-electric power generation plants, which require water mainly for cooling purposes.

Fresh surface water provides two-thirds of all rural water needs, which in turn account for one-third of the water withdrawn for all purposes. Ground water is used for more than a third of our rural water needs; agricultural pumping accounts for about three-fifths of the ground water pumped for all purposes in the United States. Despite problems of overdraft in some regions–the Texas High Plains and California, for example–the general trend is for agriculture to increase its use of ground water, relative to surface supplies, and for municipalities and industry to decrease their proportionate use of ground water. Although the changes are not radical, they are nevertheless steady. We can expect an increasing relative emphasis on groundwater management in agriculture, as well as an increasing emphasis on the problem of surface water supply and treatment in the nonagricultural sectors.

Regional Supplies, Withdrawal, and Consumption of Water

Water supplies and uses differ greatly among the water resource regions of the conterminous States, and Alaska, Hawaii, and Puerto Rico (table 29 and fig. 18). In some regions, notably the Lower Mississippi and Lower Colorado and Rio Grande, more water is withdrawn than is normally available from runoff, indicating that there must be reliance on return flows and runoff originating in other regions. In four other regions–Great Lakes, Texas-Gulf, Great Basin, and California–total withdrawals are half or more of total annual runoff supply. The percentage of runoff supply that is consumed also ranges widely and, where it is highest, is generally indicative of regions where there has been major development of water supplies.

Special Importance of Agricultural Water Use and Development

Agriculture accounts for at least half and in many cases for nearly all water consumption in 13 of the 18 water resource regions of the 48 conterminous States, not counting evapotranspiration from nonirrigated crops, pasture, range, and forest land. Urban consumptive use predominates in the North Atlantic, Great Lakes, Ohio, and Tennessee regions, although gross withdrawals are primarily for urban uses in all

Table 28–Water withdrawals: Principal uses and sources of supply, 1970

Principal withdrawal uses of water	Volume withdrawn per day	Water withdrawals from–		
		Fresh surface sources	Ground sources	Saline sources
	Bil. gal.	*---- Percent ----*		
Rural domestic	2.391	15	85	0
Livestock	1.942	42	58	0
Irrigation	119.184	65	35	0
Total rural	123.517	64	36	0
Municipal	27.028	67	33	0
Self-supplied industrial	55.944	65	17	18
Steam-electric power	120.311	73	2	25
Total urban	203.283	70	10	20
Total withdrawal uses	326.800	66	24	10

Derived from (*25*).

Table 29–Regional water supplies, withdrawals, and consumption, 1970

Water resource region*	Annual runoff supply[1]	Total withdrawals[2]	Total consumption[3]	Share consumed in urban areas[4]	Share consumed in rural areas[5]	Ratio of consumptive use to withdrawals[6]
	---- *Billion gallons/day* ----			---- *Percent* ----		
North Atlantic	163.0	43.3	2.3	81	19	1/26
South Atlantic-Gulf	197.0	31.4	2.9	30	70	1/16
Great Lakes	63.2	32.7	1.4	82	18	2/51
Ohio	125.0	32.7	1.3	71	29	1/26
Tennessee	41.5	7.9	.4	68	32	1/19
Upper Mississippi	64.6	10.4	.9	40	60	1/16
Lower Mississippi	48.4	7.9	2.0	28	72	1/16
Souris-Red-Rainy	6.2	.6	.1	20	80	2/10
Missouri	54.1	20.6	11.4	3	97	21/38
Arkansas-White-Red	95.8	12.0	6.7	12	88	7/12
Texas-Gulf	39.1	20.6	8.0	20	80	20/52
Rio Grande	4.9	7.6	4.5	5	95	86/155
Upper Colorado	13.5	4.6	2.2	2	98	16/34
Lower Colorado	3.2	7.4	3.7	9	91	26/231
Great Basin	5.9	5.7	2.6	6	94	37/96
Columbia-North Pacific	210.0	33.6	11.5	3	97	5/16
California	65.1	43.6	23.7	12	88	34/66
Alaska	580.0	.3	.1	92	8	0/0
Hawaii	13.3	1.9	.6	10	90	5/14
Puerto Rico	NA	2.0	.3	17	83	NA
Total, all regions	1,793.8	326.8	86.5	15	85	5/18
Total, 48 contiguous States	1,200.5	322.6	85.6	15	85	7/27

NA = not available

*See figure 18. Water resource regions as currently delineated by the Water Resources Council do not correspond exactly with those used for the First National Assessment. The New England and Middle Atlantic regions were formed from the North Atlantic region and several smaller boundary adjustments were made.

[1] Proportion of precipitation reaching streams or recharging ground water.

[2] Includes gross diversions or pumping for any purpose.

[3] Proportion of gross actual withdrawals not available for subsequent withdrawal. Includes transpiration from irrigated vegetation, biological transpiration, and some evaporation.

[4] Mainly water consumed by municipal water systems, self-supplied industrial or manufacturing uses, and steam-electric power plants.

[5] Includes farm domestic water use, livestock consumption, and irrigation consumption.

[6] Ratio of consumptive use and withdrawals as a percentage of annual runoff supply. The latter indexes can range over 100, in which case they mean that annual runoff supplies in the region are normally inadequate to service all withdrawal needs, and there must be reliance on return flows and runoff originating in other regions.

Derived from (*25*).

the eastern regions. In the western regions and Hawaii, withdrawals are mostly for irrigation and other rural uses.

About 10 percent of the farms and ranches in the United States are irrigated. In the West, irrigation is often the difference between low production and uncertain income, and high production and good farm income. In the humid East, irrigation can prevent crop failures, increase yields, and improve product quality even in average years. Irrigation is also used for frost protection and to control high temperatures on specialty crops.

Water withdrawals for irrigation accounted for about 36 percent of all U.S. withdrawals in 1970, but irrigation accounted for 81 percent of the total water consumption. Although total withdrawals for irrigation will continue to fall relative to withdrawals for self-supplied industrial, municipal, or steam-electric power purposes, irrigation is expected to remain the principal consumptive use of water. In contrast to industrial uses, where continued gains in water use efficiency are expected, efficiency in irrigation is expected to improve only modestly. But in many areas now being irrigated, greater efficiency in water use may be the only economic means of providing adequate water for optimum crop growth and for good use of water supplies.

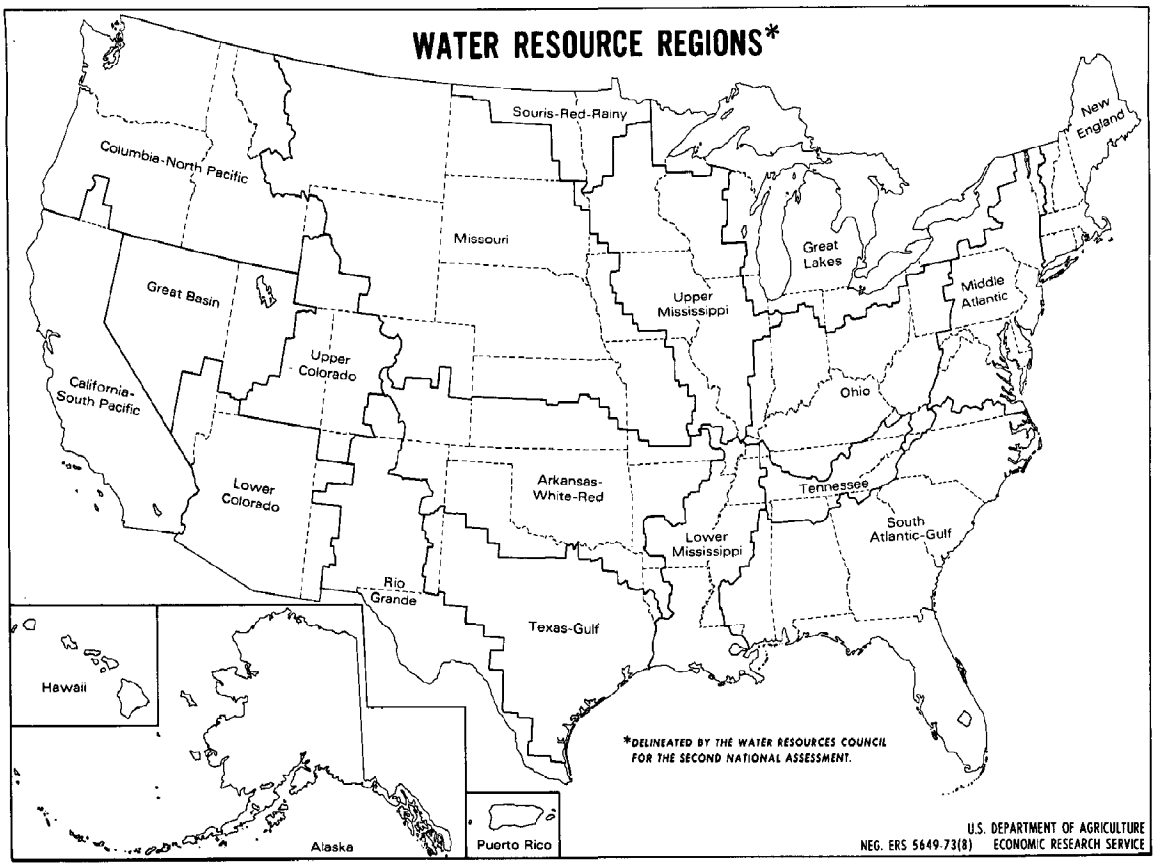


Figure 18

Because of urbanization, there is a decided trend toward increased use of water for nonagricultural purposes in nearly all regions. The trend is not sharp, however. Considering its current role, the agricultural sector will probably remain the principal consumptive user of water for many years, and management and development of water resources in the rural sector of the economy will continue to be important issues in public policy.

Water Rights and Regulation

Federal, State, and local levels of government exercise control over water resources. Authority may stem from constitutional provisions, statutory legislation, or judicial decisions. Federal authority is limited to powers expressly granted or reasonably implied by the Constitution. Within the sphere of delegated power, the Federal authority is paramount. All remaining powers are reserved to the States or to the people.

Insofar as it is consistent with Federal, interstate, and international limitations, each State may adopt its own system of water law. State laws have established property rights in water, as well as conditions for the use, development, and management of water by individuals, firms, local government bodies, and the public. The acquisition, exercise, transfer, and loss of water rights have been primarily governed by such laws. While all water supplies may be more or less interrelated, rights to use them may vary according to their particular classification for various purposes.

The riparian doctrine accords rights to the use of a natural watercourse to particular land on the basis of the land's contiguity to the supply. The owner of a tract of land adjoining the watercourse has certain rights to use the water in place, or on the riparian land.

In several States the owner may divert any water he needs for domestic use, but for irrigation and other purposes the use ordinarily must be reasonable with respect to the requirements of others under the particular circumstances. In some instances, elements of the natural flow doctrine may be employed. These principles may pertain to both the quantity and quality of the water. In water pollution cases, the nuisance doctrine also may be applied. Water storage may be permissible during high-flow periods for use during low-flow periods if this causes no damage to others. But liability may arise if water is impounded during low-flow periods. The law is unsettled in these and other respects in a number of States.

Riparian land usually must adjoin the watercourse, lie within its watershed, and be one contiguous ownership tract. Some courts have added that it may not exceed the tract originally acquired from the Government and if a nonadjoining part is separately conveyed to another, that part may lose its riparian status unless a contrary intention has been shown. A number of States allow limited use of the water on nonriparian land if the rights of riparian owners are not adversely affected or, in a few States, if such use is reasonable under the circumstances.

The riparian doctrine usually applies to both navigable and nonnavigable watercourses, but the exercise of riparian rights may be subject to uses of navigable watercourses by the public for navigation, fishing, or other purposes. Definitions of a navigable watercourse may vary from State to State.

Under the appropriation doctrine, the earliest right to water from a particular watercourse usually has priority over later rights, regardless of the location of one's land with respect to the stream. Each appropriator may be limited to the amount of water needed for his beneficial use without unnecessary waste.

However, several appropriation doctrine States have preference lists which usually give domestic and municipal use the highest preference. In several States, domestic use is exempt or treated as a vested right. Irrigation often is next in line on such lists and industrial and other uses often are lower, although this ranking may vary by States. These preference provisions may operate in one or more of the following three situations: (1) when there are two or more applications pending for the same water, (2) when a shortage of water develops for holders of appropriative rights, and (3) when one's appropriative right is desired by another for a superior use. In the second and third situations, payment of compensation is usually required.

Appropriative rights usually attach to specified quantities of water and often to specific times, places, and methods of diversion. The right ordinarily is of unlimited duration, but it may be lost through nonuse for a certain period in most States. The right usually attaches to particular land. The place of use or point of diversion usually may not be changed if it would be detrimental to other water rights. Some States have rather severe restrictions on such changes.

The riparian doctrine is generally applied to natural watercourses in the 31 States lying east of Texas and the Dakotas. Permit requirements and minimum streamflow or lake-level provisions are superimposed in some cases upon the basic riparian system. Permits issued often have been of rather limited or uncertain duration and effect. The permitted water use has been restricted to riparian lands in some States but not in others. Most Eastern States have at least some permit requirements, such as those regarding dams. Some have rather comprehensive water-use permit systems. Some have provided for State agency regulation of water use in portions of the State only when and where regulation is shown to be needed by certain criteria. Moreover, some States allow or require local government regulation of water use.

The riparian doctrine is recognized in varying degree in the tier of six Western States extending from the Dakotas to Texas and in the four States bordering the Pacific. It exists along with ancient water rights in Hawaii. Riparian water use rights are not generally applicable in the other eight, generally more arid, Western States. The appropriation doctrine applies in these States, and in varying degree in most of the 19 Western States. Elements of the doctrine also exist in some Eastern States, notably Mississippi.

Other common features of western water laws include provisions for mass adjudications of water rights and for State officials to issue permits and licenses and to physically distribute the water. Complicating factors in Western and Eastern States may include prescriptive water rights and the permissible use of voluntary contractual agreements and eminent domain powers. In two States, California and New Mexico, pueblo water rights of certain municipalities have been recognized. A municipality which is a successor of a Spanish or Mexican pueblo has a priority right for its inhabitants to use water occurring naturally within the old pueblo limits.

Underground streams ordinarily are governed by the same principles as surface watercourses. But ground water is presumed to be "percolating" ground water rather than an underground stream, unless there is sufficient evidence to the contrary.

The English "absolute-ownership" type of rule is still followed in some States, both Eastern and Western. But it has been replaced in many States by the American rule of reasonable use or by the rule of correlative rights. The appropriation doctrine applies to percolating ground water in a number of Western States, although in some it only applies to watercourses. Eastern States may have various permit requirements.

So-called "diffused surface water" primarily includes rainwater which has not reached a natural watercourse. Most cases on diffused surface water have dealt with the drainage of such water, rather than rights to use it. Most of the relatively few cases in point suggest that a landowner originally may impound and make use of such water about as he wishes.

Each of the principal doctrines and related laws may present varying degrees and kinds of ease or difficulty, security or insecurity, and flexibility in acquiring, exercising, and regulating water use and related rights and permits for particular kinds of use and development. Each may have certain advantages and limitations for various purposes, depending on their structure and application in particular States. For example, the riparian reasonable use principle, as well as some permit systems, may be more flexible but not as definitive as the prior appropriation principle. The riparian doctrine generally is more restrictive than the appropriation doctrine regarding the use of water from a watercourse on distant lands, but the appropriation doctrine may restrict changes in the place of use or point of diversion.

General State statutes and court-made rules often are intended to serve a variety of purposes in the more or less uncertain future. Some other laws are more specifically designed to facilitate, regulate, or inhibit particular types of activities, or to pertain to certain areas. Modifications of such laws or their operation may be needed in various States, within State and Federal constitutional limitations, so as to incorporate features that are more likely to attain desired purposes.

Some broad and interrelated issues may concern the respective roles of courts, governments, and administrative agencies; the timing, level, and organization of government regulation; which kinds of water allocation and pollution control measures to adopt; the coordination of water allocation with pollution control, water development, water conservation, and drainage measures; private versus public water rights; and the coordination of rights in or regulation of interconnected water resources and interrelated land and water use. These issues may have implications in regard to private and public water use and related land use, watershed or river basin management and development, and the quality of water and the environment.

In addition to applicable State laws, there are various Federal regulatory provisions (particularly regarding navigable waters of the United States) and other Federal laws and programs that affect the exercise of water rights. Sources of enabling authority for Federal activities provided in the Constitution include the commerce power, the proprietary power, the war power, and the general welfare power. Federal regulatory functions include regulation of the erection of structures or other activities affecting the navigable capacity of waters, licensing non-Federal development of power, and administration of Federal water quality provisions.

Conversely, some Federal programs and projects may be affected by the operation of State laws. Federally built improvements on navigable waters or on Federal property often may be the least affected by, although they may affect, the operation of State water rights laws. However, any State or local participation in such projects may depend materially on State laws. The respective roles of Federal and State Governments in regard to water rights and related laws have been a subject of controversy.

The operation of State water laws also may be limited or otherwise affected by interstate and international arrangements or considerations such as compacts, treaties, applicable Federal laws, differences in State laws, and U.S. Supreme Court decisions in interstate disputes. Such considerations may be particularly significant in dealing with the interrelated problems of a large river basin or region in which several States and the Nation, and perhaps an adjoining country, may have important stakes.

PROSPECTIVE LAND AND WATER RESOURCE REQUIREMENTS AND POTENTIALS

Sound planning is oriented to the future and the best path to it. Planning for future use of land and water resources requires the most accurate estimates possible of future supply and demand factors: trends in population growth, economic activity, technology, crop yields, imports and exports of agricultural products, and the resource requirements of other uses that compete for land and water resources. Projections of these factors have several uses: They serve as a basis for estimating future needs for land and water; they aid in identifying emerging problems in resource use, conservation, and development; and they provide a framework for evaluating resource development measures that will be used over long periods of time.

Baseline projections of these indicators were prepared in connection with economic and water resource planning studies administered by the U.S. Water Resources Council and developed jointly by the Departments of Commerce and Agriculture (*26*). The studies included projections of land and water use under specified conditions. Alternate projections have since been developed to incorporate the effects of recent changes in population and export demand.

Assumptions and Economic Framework

The baseline projections prepared for the Water Resources Council were based on longrun trends in those factors that affect the supply and demand for

land and water resources. Major assumptions underlying these projections were a low rate of population growth (the Census Bureau Series E, December 1972 population projection), a high level of employment, no foreign conflicts, and a 3-percent annual growth in labor productivity. An implied assumption was that total demand would be sufficiently strong to maintain high employment. Principal economic indicators for selected years are summarized in table 30.

Total U.S. population was projected at about 264 million for the year 2000, an increase of more than 30 percent over the estimated 1969 population. In the same period, total personal income was projected to increase by about three times and per capita personal income by about two and a half times. The value of crop and livestock output, measured in 1967 dollars, was projected to increase by 31 and 36 percent, respectively, while the gross national product should nearly triple.

Two alternative projections were developed to estimate the sensitivity of cropland requirements to variations in food and fiber demand. The expected impact of reduced total demand for crop production resulting from a continuation of lower birth rates observed since the late 1960's (the Census Bureau Series F, December 1972 population projections) is reflected in the first alternative. The second alternative reflects a higher level of export demand for farm products, consistent with market conditions that appeared after 1972. Except for population and export levels, assumptions on supply and demand factors are the same in the alternative and the baseline projections. No consideration was given at this time to the impacts of the current energy crisis, environmental factors, and the many other factors which influence agriculture demand and land use patterns.

Table 30–Selected U.S. economic indicators, historic and projected, 1959-2000

Item	1959	1969	Projected	
			1980	2000
Population, mil.	177.1	201.9	224.1	264.4
Total personal income, bil. 1967 dol.	432.3	689.7	1,072.6	2,158.8
Per capita income, 1967 dol.	2,441	3,416	4,786	8,165
Total employment, mil.	66.4	81.0	99.3	120.9
Index of crop production (1969 = 100)	94	100	117	131
Index of livestock production (1969 = 100)	90	100	115	136
Index of major manufacturing production (1969 = 100)	66	100	158	341

Source: (*26*).

Agricultural Projections

Baseline agricultural projections of resources were derived from projected national demands for food and fiber. It is assumed that shortages or sharp increases in prices of agricultural products relative to other consumer products, such as those experienced in 1972 and 1973, will not be sufficient over the projection period to materially change patterns of consumption, and that exports will continue to increase after 1980.

Under the assumed economic framework, the domestic use of farm products should rise approximately 35 percent in the next three decades. This would provide for the projected population increase of 30 percent and a small increase in total per capita use of food. With a projected per capita increase of 140 percent in real income by the year 2000, a continued upgrading of the diet and a change in the structure of the per capita use of food could be expected. The continuation of recent trends suggests an increase in per capita red meat and poultry consumption and a slight decline in the consumption of wheat, Irish potatoes, noncitrus fruit, and dairy products (table 31).

Other categories of agricultural production are export market uses and domestic nonfood uses. Nonfood uses consist mainly of seed, livestock feed, and manufacturing. Other nonfood uses of agricultural products except for livestock feed are projected to grow at a slower rate than food uses.

Livestock feed uses are projected to rise in relationship to the increased demand for livestock products (table 32). Feed concentrates should increase faster than roughage because of the extensive gain in beef and veal requirements and the increasing importance of beef production from fed cattle. Some improvement in feeding efficiency, predicated on improved technology and better management, is projected. Pasture and range production to meet grazing requirements should increase over the projection period but at a lower rate than concentrates.

Timber Demand and Supplies[3]

Timber supplies from U.S. forests in the year 2000 are projected to be 19.0 billion cubic feet (11.6 billion, softwood and 7.4 billion, hardwood). Three alternate projections of demand were made. Assuming constant relative prices for wood products, total consumption is estimated at 22.8 billion cubic feet

[3] All data in this paragraph are from (*22*).

Table 31–Per capita consumption of selected farm products, averages 1963-65 and 1968-70, and projections for 1980 and 2000

Product	Average 1963-65	Average 1968-70	Projected	
			1980	2000
	Pounds			
Beef and veal	103	115	130	135
Poultry	39	47	59	63
Dairy	627	570	475	450
Citrus fruit	66	88	110	118
Noncitrus fruit	102	101	99	92
Potatoes	110	117	110	110
Wheat	158	153	150	141

Source: (*26*).

(15.9 billion, softwood; 6.8 billion, hardwood). This would require net imports of 3.8 billion cubic feet, all softwood. Assuming prices of wood products rise annually relative to other goods by 1.5 percent for lumber, 1.0 percent for plywood and particle board, and 0.5 percent for pulp and paper, consumption would be slightly less than projected supplies. A more conservative estimate for rising relative prices would bring about a near balance, with a slight shortfall for softwood. The latter two assumptions of rising prices are expected to result in only small supply responses in U.S. production. Deficits are presumed to be made up from increased net imports, entirely of softwood. If prices are to be held relatively constant, there must be rapid improvements in utilization of underused hardwoods (with some substitution for softwood), recycling of paper wastes, as well as improved timber management, especially on small ownerships.

Agricultural and Forest Land Projections

The land use projections that follow focus mainly on the cropland base and its uses, additions to the cropland base from resource development, and withdrawals of cropland as it is converted to nonagricultural uses. Estimates of pasture and forest land reflect the available acreages if other uses occur as projected. Possibilities for substitution among land uses are great and some selected uses such as recreation can be achieved through multiple-use management of land. Some land uses, such as for private recreation or for public purposes, cannot be related easily to a national economic framework, since they are related more closely to social goals of the population.

Table 32–Index of projected U.S. livestock feed consumption, by feed component, 1980 and 2000

(1962-66 = 100)

Feed component	1980	2000
Concentrates	134	151
Roughage	110	122
Total feed	120	134

Source: (*26*).

Cropland Requirements

Projected cropland requirements were derived from State estimates of output and yields of individual crops. The projected trend of land used for crops shows a decrease of nearly one-fourth from 1949 to 2000. From 1969 to 2000 a decrease of one-tenth is projected (table 1). These acreages include cropland harvested, crop failure, and cultivated summer fallow.

The distribution of crops grown is projected to change substantially between 1969 and the year 2000. Much of the expected change in the acreage of crops harvested over this period is in the decrease in acreage required for roughage and food grain production, each down by around 10 million acres. The total acreage is projected to decrease by 14.7 million acres. Offsetting a larger downtrend are oil crops, principally soybeans, which are projected to increase by 7.8 million acres. Nationally, all of the other major crop groupings show minor changes in total acreage harvested (table 33).

The area of land available and required for future agricultural uses depends, in part, on the extent to which improvements in technology and resource development increase land productivity. The availability of land for agriculture also is influenced by other com-

Table 33–Acreages of crops harvested, 1969, and baseline projections for 1980 and 2000

Crop	1969[1]	1980[2]	2000[2]
	Million acres		
Feed crops:			
Grains	95.6	102.9	91.1
Roughage	74.3	68.8	64.4
Food crops:			
Grains	51.0	44.0	40.3
Vegetables, fruits, and sugar	8.5	9.0	9.1
Other	3.3	3.1	3.0
Other crops:			
Oil	45.0	53.0	52.8
Cotton, tobacco, and miscellaneous	11.9	14.8	14.4
Total crops harvested[3]	289.8	295.6	275.1

[1] (*20*).
[2] (*26*).
[3] Exceeds cropland harvested because of double-cropping.

peting uses. Historically, the effects of technological advance and resource development on yields and land use have outweighed the effect of other competing uses. This relationship continues to exist in the projections made for the Water Resources Council.

Some conversion of forest and pasture to cropland is projected to continue in the Delta and Southeast and in some Corn Belt States. However, no net land resource development for crops is assumed for the New England or Middle Atlantic States. Little land resource development for agriculture has taken place recently in these areas, and land in farms has decreased steadily for many years. Irrigation development in the Central and Western regions on areas currently not cropped will tend to maintain the available cropland near present levels.

Nationally, a net increase of 13 million acres in total cropland due to land development and irrigation is projected to the year 2000. This increase is offset by projected conversions of 13 million acres of cropland to other competing uses. Most land development by clearing and drainage will occur in the South, while irrigation development will continue mainly in the West. Increases in conversion of cropland to nonagricultural uses are generally projected over the entire Nation in areas where major population growth is expected, or in response to major resource developments such as for surface mining.

As mentioned previously, alternative projections of harvested cropland were prepared in order to illustrate the effect of changes in population growth and export demand. Under the baseline projections, population would grow from 204 million in 1970 to 224 million in 1980 and about 264 million in the year 2000. Series F projections are based on birth rates more nearly approximating 1973 levels. Population would be just under 222 million in 1980 and about 251 million in 2000. About 292 million acres of cropland would be harvested in 1980 and 272 million in 2000 under the baseline population projection, compared with 294 million acres in 1972. With the Series F population, 291 million acres would be harvested in 1980 and 261 million in 2000.

The baseline projections of cropland are consistent with exports which continue to increase throughout the projection period. The 1968-70 average is valued at $7.5 billion; 1980 shows a 50-percent increase and 2000 a 65-percent increase from the 1968-70 average when valued with constant prices. The dramatic rise in exports in fiscal year 1973 emphasizes the need to consider long-term increases of major proportions.

Alternative levels of future export demand for farm products and the associated cropland requirements have been explored. A higher level of exports was based on assumed freer trade policies and continued growth in world meat consumption.[4] For this report, cropland needed to produce enough food and fiber to meet the same baseline domestic market but at the higher export demand was estimated. Exports assumed for the baseline projection and for the high export level were valued in constant dollars. It appears that about 6-7 million acres of harvested cropland would be required for each billion dollars of farm exports above that assumed for the baseline projection. Prices associated with the high export level for the projected yields of major export crops were (1967 prices): wheat, $3.11 per bushel; corn, $1.13 per bushel; soybeans, $4.04 per bushel; and cotton, 23 cents per pound.

Total acreage of harvested cropland at the high export level would be approximately 304 million acres in 1980, and 309 million acres in 2000. It is expected that much of the increased acreage of cropland would be planted to soybeans and feed grains. Total acreage in food crops, especially wheat, would not decline to the extent shown in the baseline (table 33). Technological changes not reflected in historical trends, such as development of hybrid varieties of soybeans, could alter the expected need for additional cropland. However, the projection of 309 million acres is well within the projected supply of cropland. The range between the lowest projections based on low (Series F) birth rates and a moderate increase in exports, and the highest projection, based on higher (Series E) birth rates and higher exports, is 48 million acres in 2000.

Pasture and Rangeland

The long-term trend in total acreage available for grazing will decline slightly from the current acreage if other projected nonagricultural uses are fulfilled (table 1). The current inventory acreage does not take into account the extent to which land now grazed is fully utilized or land which could be converted to grazing. Projection of continued increases in per capita meat consumption implies a need to improve pasture and range productivity, more fully utilize land now available for grazing, and increase pasture acreage by converting woodland and idle farmland to pasture. If these management procedures for carrying larger numbers of beef cattle are not economically feasible, other means of increasing beef production might be used, such as greater substitution of feed grains for range or

[4] Rojko, A. S. *Future Prospects for Agricultural Exports.* Paper presented at Midwest Agricultural Outlook Conference, Purdue University, Aug. 15-16, 1973.

pasture forage, devising livestock management practices to increase weight gains of cattle being grazed, and further research to maintain high range and pasture productivity. The possibility of improving livestock breeds and feeding efficiency through research is a potentially important means of increasing beef production without large-scale conversion of land to pasture.

Forest and Woodland

Acreage of total forestland is estimated to decline in the future if other uses occur as projected (table 1). Improved forest management will be necessary to meet forest product needs. In recent years, the area of commercial forestland has declined as land has been converted to urban development, highways, airports, reservoirs, parks, wilderness areas, and cropland. The trend is expected to continue and to intensify the problem of meeting the Nation's need for timber. Wood production from some commercial forests may also be reduced to meet mounting demands for wildlife protection, recreation, and wildlife habitat. The prospective shortage of timber will mean increasing competition for available supplies and rising prices. Steps that can be taken to raise forest productivity include reducing losses from fire, insects, and disease; increased salvage of dead timber; planting improved species; improving timber utilization; improving timber stands, fertilization, and forestation; and improving access and logging methods.

Nonagricultural Land Requirements

By the year 2000 urban and related intensive land uses are projected to increase by 20 million acres, a 40-percent increase over 1969 (table 1). Included are residential, commercial, industrial, and transportation uses for metropolitan area expansion, and outlying land uses required to support this expansion. Interstate highways and airports are required to meet emerging transportation and communication needs. Reservoirs for water supplies, flood control, and recreation have required even more land in recent years than roads and airports. The amount of land disturbed by surface mining is estimated to increase to 170,000 acres annually by the year 2000. The environmental impacts of these uses will become even more important in the future because of the greater concentration of population and intensity of land use that is implied by expected urban, industrial, and transportation development. Heretofore, these uses have not significantly affected the total amount of land used to produce farm and forest products. Only a part of the land required for urban and related intensive land uses has been taken from operating farms, and agricultural land use adjustments have, on the whole, greatly exceeded shifts of land to nonagricultural uses. Whether future conversion of rural lands will have a noticeable impact on agricultural production will depend on the use and quality of land that is converted.

More land will be required for recreation, parks, wilderness areas, defense facilities, and other public purposes. To some extent, these requirements may be met by reclassification and reservation of public lands now in other uses, or by multiple uses of land; however, total acquisitions of land for these uses is projected to be over 20 million acres by 2000. Much of the land will be acquired for recreation use.

Water Requirements

Total renewable water supply for the 48 conterminous States is estimated at 1.2 trillion gallons per day. Water requirements against this supply were projected for 1980 and the year 2000 by the U.S. Water Resources Council in its 1968 National Water Assessment (table 34). Withdrawal in 1965 was estimated at 22 percent of annual runoff supply, and is projected to rise to 37 percent in 1980 and to 67 percent in 2000. Withdrawal uses include water for public supplies, irrigation, rural use, self-supplied industrial use, and water power. Water power is included because water is diverted through the turbines and frequently affects streamflow.

Water consumption in 1965 was estimated to be 6 percent of total annual runoff supply, and is projected to be 9 percent in 1980 and 11 percent in the year 2000. Consumptive use includes the water discharged into the atmosphere or used by growing plants, in food processing, or incidental to an industrial process. While quality changes may occur during the use of water, consumptive use is only concerned with the loss or depletion of water in processes or activities that generally bring about an economic gain.

Although a comparison of national requirements and supplies indicates an adequate water supply, there are and will continue to be severe problems in localized areas. Problems of water quality and quantity could constrain growth of the regional economy in several areas of the country. Water quality problems are serious in parts of the Northeast and in some areas of the West; limited water supplies are a threat in the West and Southwest. These potential problem areas can be alleviated somewhat by treating waste water properly, recycling water in industrial plants, supplementing existing supplies through desalinization, and building additional storage and treatment facilities.

Water resource development has had a profound effect on the location and productive capability of U.S. agriculture. For instance, cotton production has

Table 34–Estimated water withdrawals by type of use, 1965, and projected requirements, 1980 and 2000

Type of use	Withdrawals			Consumptive use		
	Used 1965	Projected requirements		Used 1965	Projected requirements	
		1980	2000		1980	2000
	Billion gallons per day					
Rural domestic	2.4	2.5	2.9	1.6	1.8	2.1
Municipal (public supplied)	23.7	33.6	50.7	5.2	10.5	16.5
Industrial (self-supplied)	46.4	75.0	127.4	3.8	6.1	10.0
Steam-electric power:						
Fresh	62.7	134.0	259.2	.7	1.7	4.5
Saline	21.8	59.3	211.2	.2	.5	2.0
Agriculture:						
Irrigation	110.8	135.8	149.8	64.7	81.6	90.0
Livestock	1.8	2.4	3.4	1.6	2.2	3.1
Total	269.6	442.6	804.6	77.8	104.4	128.2

Source: (*24*).

shifted from the Southeastern States to the Mississippi Delta, the High Plains of Texas, and Arizona and California. Irish potato production has shifted from Maine and other Eastern States to the Pacific Northwest because of the comparative advantage that irrigation has given this region. Irrigation development will continue to influence the regional patterns of agricultural production and land and water use.

Changes in future water requirements are implicit in the land use projections discussed earlier. Slightly more than 36 million acres of cropland were irrigated in 1969 in 17 Western States and in Mississippi, Arkansas, Louisiana, and Florida. This area is projected to increase by nearly 5 million acres by 1980 and by 7 million acres in the year 2000, as authorized Federal projects and privately financed irrigation systems are installed. One of the consequences of irrigation development, of course, is that additional agricultural production capacity is created; at the same time, competition among water uses is intensified as urban, industrial, and recreational demands for water grow.

CURRENT PROBLEM AREAS AFFECTING LAND USE POLICY

Efforts to bring about a better use of land invariably identify conflicting needs. Decisions about present uses of land also affect the ability to supply future needs. Economic and environmental aims conflict in many resource use decisions. We seek more amenities as well as necessities of life from our natural resources. The growing demand and tight supply of energy has many implications for land use and environmental quality.

Land use problems differ among States, but some occur widely or have widespread impact. These problems, several of which have already been discussed in some detail, are basic to much of the current interest in land use policy.

Changing Demand for Food and Fiber

U.S. agricultural policy in the 20th century has had to deal more frequently with insufficient demand and surpluses than with short supplies of agricultural products. In the early 1950's, a USDA publication, *The Fifth Plate,* discussed our ability to meet national food production needs in view of expected growth in population. Within a few years that "fifth plate" was filled to overflowing, and the Nation was concerned with crop surpluses. More recently the rate of population growth has dropped, and the growth rate projected for domestic demand for food and fiber has slowed.

Of course, population changes are not the only factors affecting the demand for food. Changes in consumer income and preferences also must be considered. As incomes rise, consumers upgrade their diets, eating more animal protein and less high calorie, low protein foods. Recent developments in the international markets have had a significant effect on demand.

How the export market develops and how public policy responds will have a major impact on future demand and supply. All of these factors affect the structure of agriculture and the way it uses its resources, including land.

The Nation has been fortunate in having an abundance of land for its needs. Perhaps even more important is the intrinsic management ability of American farmers. Part of this good fortune, however, is the result of public investments in agricultural research and rapid application of new technology to farm production. Fertilizer, improved crop varieties, and more productive strains of livestock have all contributed significantly to the increase in yields per acre and per unit of livestock, poultry, and dairy animals over the years. In effect, there has been an increase in the supply of agricultural land.

The upward trends in productivity per unit of input are expected to continue, although possible at a lower rate than in recent years. These trends, along with an abundance of land with potential for agricultural use, make us confident that we can continue to provide an abundance of food and fiber for the domestic market and still have land available for other uses through the remainder of this century. The export market will play a key role in the determination of total demand, and a large export market can bring about full utilization of available agriculture resources, including land, capital, technology, and management.

Competing Uses for Land

Urban Growth

Critical land use problems--"ribbon" development, unmet open space and recreation area needs, transportation deficiencies, and inefficient public services--exist in the environs of growing metropolitan centers. These problems, caused in part by skip-development, profoundly affect the quality of the environment for urban residents. Urban growth's impact on the rural economy has created an entirely different set of problems associated with unplanned urban encroachment. They include speculative idling of productive agricultural land, isolation of farming enterprises, rising land values with associated high taxes, unsightly urban waste installation, and various other land use incompatibilities.

During the last decade, population in SMSA's increased by 20 million people. (See discussion on page 14). The net increase for the United States as a whole was 24 million people. SMSA's now include about 70 percent of the total population but only an eighth of the land area. Eighty-nine percent of the people live in only 10 percent of the SMSA area--an average density of five persons per acre. In the remaining 90 percent of the SMSA area, there is only one person to each 16 acres. A considerable amount of agriculture and much open space is found in the SMSA's.

In the rural portions of the SMSA's, half of the land is still in farms and half of the farmland still produces crops. SMSA farms account for 14 percent of all U.S. cropland harvested, 60 percent of all vegetables sold, 43 percent of all fruit and nuts sold, 27 percent of dairy income, and 24 percent of farm income. In these areas the problem is to maintain agricultural production while providing land for living, recreation, and open space for the expanding urban population.

Recreation--Open Space

With our rising standard of living has come an increasing demand for leisure time activities, including recreation in rural areas. It is estimated there were over a billion visits to public areas in 1965--about half to Federal land and half to State and county land. This number does not include visits to local areas, which were largely in urban locations; and it does not include the billion visits to the 132,000 private recreation areas. Large rural acreages are involved--an estimated 81 million acres are in Federal and State parks, recreation areas, and wildlife refuges. The number of visits to public areas increased 50 percent from 1960 to 1965. By the year 2000 the Bureau of Outdoor Recreation projects that the demand will be about three times the present level. Much of the Federal acreage is relatively remote from population centers, and receives less use per acre than State and county areas.

Open space in urban areas--small parks, recreation areas, or simply vacant land between buildings--is receiving increasing emphasis and attention as a necessary factor in the well-being of people living in congested areas. Most agricultural uses of land are compatible with open-space use. Land use planning decisions should include provision for both recreation and open space.

Second Homes and Parceling of Land

Various problems have their origin in the rapidly increasing sales of rural parcels of land for second homes or recreation purposes. By 1965, about 2 million second homes had been constructed. Problems of pure water supply and hygienic waste disposal are serious in some areas because of isolation and scattering of developments. Rural parcel sales are up sharply, particularly in recreation areas or within commuting distance of population centers. Many parcels are held merely for speculative purposes. To a

large extent, there has been no preplanning in consideration of environmental impact or service needs, such as water and sewer requirements.

Land Needs for Rural Deveiopment

In 1971, farming provided only about 11 percent of the earnings of persons employed outside SMSA's–less than half the 26 percent provided by manufacturing jobs. The Rural Development Act of 1972 underscored the national policy of stimulating the development of job opportunities in rural America. Development of nonfarm business in rural areas will require rural people to face many of the same issues of reconciling conflicting uses for land that now confront urban areas. Expansion of employment in new or existing rural towns may result in increased conversion of farmland for housing, expansion of business and commercial activities into formerly agricultural areas, and similar problems. Effective development of rural areas may require planning on a multicounty scale and force difficult decisions–locating industries in areas which may create commuting problems for workers, for example. All of these issues will raise new problems for nonmetropolitan local government and those responsible for land use planning.

Environmental Concerns and Rural Land Use

Environmental problems and goals weigh heavily in current discussions about land use. Some urgent environmental problems originating in rural areas have a close relationship to land use.

Restrictions on Agricultural Chemicals

Restrictions on agricultural use of pesticides and commercial fertilizers would tend to lower both crop yields and quality of product, and to increase production costs. Farmers have turned to pesticides and fertilizers to increase output and to reduce land, labor, and other farming costs. Restrictions or shortages could slow down or even reverse this trend. Alternatively, research could seek to develop safe substitutes for restricted chemicals. Economic information about costs of production, land development, and conservation is essential for the thorough analysis of this issue.

Agricultural Use of Wet Soils and Flood Plains

According to USDA's Conservation Needs Inventory, 265 million acres of private and Federal cropland have an excess of water, which limits their suitability for regular cultivation. Much of this land is located in the Delta and northern Lake States regions and in the southeastern coastal area. From 1944 to 1964, about 2.6 million acres of land were reclaimed for cropland use in Florida and the Delta. Large acreages of wetlands remain in these regions, but there is some thought that continued draining and dredging activities will result in a net loss in ecological values. This loss must be weighed against the need for land and other uses.

Flood control programs have various impacts on land use. Water impoundments which flood land upstream also permit agricultural use of land downstream. The modification of water levels and flows often affects land use. The trade-offs between development needs and environmental concerns will influence decisions for land use plans.

Alternative Timber Harvesting Systems

In some areas, timber harvesting and management is conducted by clearcutting. Elsewhere timber is harvested by selective cutting procedures. Each method has its merits and its disadvantages. Which method is employed is a function of the particular physical and biological conditions present and of trade-offs between economic and esthetic goals. In some cases, clearcutting is the only practical way to perpetuate forests of commercially desirable species that demand a high degree of light. Clearcuts can be esthetically undesirable, particularly when done in large blocks or geometric shapes, or if they are incorrectly designed or located. Various types of selection cutting result in reproduction of more shade tolerant trees, sometimes the most commercially desirable species in a particular area. Selection cuttings also result in smaller openings with a correspondingly reduced visual impact. Identification of ecologic and economic results of alternative cutting practices under specific conditions is necessary to evaluate their relative merits.

Animal Wastes as a Land Use Problem

Animal wastes contribute to environmental and land use problems because of the huge amounts of waste produced, because animals are increasingly found at central production facilities, and because the wastes pollute air as well as water. Animal production results in 2 billion tons of waste annually, a third of which is liquid.

When agriculture was more widely dispersed, animal waste was a minor problem; it was returned to the land as fertilizer. An increasing proportion of the waste now comes from central points–feedlots holding more than 100,000 animals, and poultry operations involving more than 250,000 birds. A feedlot with 10,000 head of cattle produces

260 tons of manure a day. Manure which finds its way into streams is a serious pollutant because of its high biological oxygen demand. Economic restrictions prevent hauling manure long distances to use as fertilizer. Legal restrictions are being considered to preclude spreading manure on frozen ground to avoid surface movement into water courses. Potential air and water pollution from animal wastes may influence the location of the livestock feeding industry away from populated centers. Decisionmakers need information on the potential for relocating feeding facilites as well as for developing plans to minimize environmental problems.

Solid Waste Disposal on Rural Lands

Residential, commercial, and institutional solid waste totals some 250 million tons a year. About 190 million tons or nearly 1 ton per person are collected annually. Three-fourths of this waste goes into 14,000 open dumps, mostly in rural areas. Since these dumps average 34 acres in size, they occupy a total land area of about 476,000 acres. Their environmental impact is much greater than the area they occupy, however, because their locations are so scattered. Hence, they have esthetic effects over large areas. Solid waste also pollutes land, water, and air. Three-fourths of the dumps are classed as unsightly, and 57 percent are in areas of active agriculture. At the present rate of filling, about 500 new dumping sites will be needed each year. This is in addition to other unsightly uses of rural land, such as automobile graveyards, which mar the landscape. Planners need information on how to include landfills and related facilities in their land use plans.

Sediment

The sediment load in our waterways is at a troublesome level because it causes silt problems, carries plant nutrients which cause eutrophication, and contaminates drinking water. About 3 billion tons of sediment are carried by rivers to the ocean. About half of the sediment is estimated to come from cropland. Sediment is a serious problem not only because of deposition in streams but also because of the loss of topsoil from our cropland base. It is estimated that soil loss is excessive on about a third of our cropland. In time, the land's productivity will be seriously impaired. Conservation practices can be applied that will deter erosion, but their adoption is not always profitable for individual farmers. Regulation of land use to control sediment could result in marked changes in cropping patterns and production practices, particularly on sloping lands. Information on the effects of sediment regulations on land use is needed to guide land use plans.

Surface Mining and Land Use

The impact of mining on the rural environment is causing increasing concern because of the mounting problem of slag heaps from pit mining, and particularly because of the rapid increase in surface mining of coal. About 600 million tons of coal are produced annually in the United States. Surface mining now accounts for more than a third of total coal production, and is gaining because of economic and safety factors. In addition to serious pollution effects, such as acid mine drainage into streams, almost 2 million acres of rural land have been disturbed, creating unsightly scars that affect much greater areas. Because of our increasing need for energy and because our coal reserves are so huge relative to other energy sources, rural acreage disturbed by surface mining could total 5 million acres by 1980, and may involve an area equal in size to the State of Maryland by 2000. With adequate information, planners can minimize the land use problems associated with surface mining.

Energy Supplies and Land Use

Modern agriculture relies on relatively cheap power, particularly petroleum and electricity, to support farm mechanization, greater use of chemicals, manufactured inputs, and transportation services. With the decline in use of horses and mules (feed and pasture requirements for these animals have dropped from 80 million acres to 5 million acres), energy needs have soared. Mechanization has brought about more effective use of labor and land on farms and a resultant steady decline in total farm employment; only 2 percent of the total population today is engaged in farming. Cutbacks in energy supplies or sharp increases in energy prices are certain to have far-reaching effects on land use in this highly complex economy. For example, reduced fertilizer supplies emanating from energy shortages could lead to lower crop yields and a reduction in overall output unless acreage planted to crops can be increased.

Other rural land uses, such as for outdoor recreation, transportation, and urban expansion, will also be affected by reduced energy supplies and price increases. But other factors are already affecting these land uses, notably State and local government policies about urban growth and recreation land use, credit availability, construction costs, costs of public services, and environmental requirements. Additional assessments of all these factors are needed to provide information for decisionmaking by property owners and public officials.

Institutional Change

Many institutions–laws, practices, and contractual arrangements–and market forces interact to influence decisionmaking about use, ownership, and management of resources. Changes in existing institutions and new arrangements are sometimes necessary to achieve desired objectives. One such example is enactment of land use planning legislation by States. Local governments, mainly municipalities, have been engaged in land use planning for many years, but interest in land use planning on the State level is comparatively recent. Legislation has been introduced in the Congress which would provide assistance to States in developing statewide land use planning processes and programs. The legislation also would require State and Federal coordination of land use planning.

There are many techniques for guiding land use decisions, ranging from full public ownership to voluntary agreements with individual owners. Within this broad range are many regulatory and incentive measures. Zoning and land use regulation, which restricts specific uses or designates areas for certain activities, is used both by local and State governments. Highways, water and sewer systems, and other public facilities are recognized as having major influences on area development. Several States offer property tax relief as an incentive to retain land in agricultural, forestry, and other open-space uses. Tax incentives also have been used to encourage desired land and economic development.

Citizen participation in setting objectives for land use and acceptance of measures to achieve these objectives, including State and local planning, is a vital ingredient to land use policy. Countless examples can be given of the conflicts between public goals and private gain that result from land use decisions. Economic criteria alone cannot resolve these issues, even though economic considerations are often uppermost in community and individual objectives for land use.

A broad base of citizen participation in setting and achieving the objectives for using land and other natural resources is an important addition to the institutional structure for making decisions about land use. The demonstrated broad interest in environmental improvement, which directly touches on many land use decisions, is cause for optimism about obtaining similar interest in land use planning–particularly when it concerns immediate problems. Broad participation also is needed in addressing longer term problems, such as coordinating objectives for land use with objectives for economic growth, environmental quality, transportation, and soil and water conservation. The objectives for resource use cannot be static. An important aspect of the institutional structure for resource decisionmaking is to continually renew support for the process. Ideally, through this continuing renewal, there will be review and updating of objectives and improvement in the techniques used.

LITERATURE CITED

(1) Averitt, Paul
1970. Stripping-Coal Resources of the United States–January 1, 1970. U.S. Geol. Survey, Bul. 1322.

(2) Bureau of the Census
1971. U.S. Census of Population 1970. "Number of Inhabitants." Final Rpt. PC (1) - Al, United States Summary, U.S. Govt. Print. Off., Washington, D.C., Dec.

(3) ———
1972. Census of Agriculture 1969. "Area Reports." Vol. 1, U.S. Govt. Print. Off., Washington, D.C.

(4) ———
1973. Census of Agriculture 1969. "Irrigation and Drainage on Farms." Vol. II, Ch. 9, U.S. Govt. Print. Off., Washington, D.C.

(5) Council on Environmental Quality
1970. Environmental Quality, The First Annual Report. Washington, D.C., Aug.

(6) ———
1971. Environmental Quality, The Second Annual Report. Washington, D.C., Aug.

(7) ———
1972. Environmental Quality, The Third Annual Report. Washington, D.C., Aug.

(8) Ely, Richard T. and George S. Wehrwein
1940. Land Economics. The Macmillan Company, New York.

(9) Manvel, Allen D.
1968. Local Land and Building Regulation. The National Commission on Urban Problems, Res. Rpt. No. 6.

(10) Public Land Law Review Commission
1970. One-Third of the Nation's Land, A Report to the President and to the Congress. U.S. Govt. Print. Off., Washington, D.C., June.

(11) Resources for the Future, Inc.
1970. Resources. No. 33, Washington, D.C., Jan.

(12) U.S. Army, Corps of Engineers
1968. Water Resources for Central and South Florida. Survey-Review Rpt. on Central and Southern Florida Proj., Mar.

(13) U.S. Department of Agriculture
1962. Land and Water Resources: A Policy Guide. May

(14) ———
1968. Wastes in Relation to Agriculture and Forestry. Agr. Res. Serv., Misc. Pub. No. 1065, Mar.

(15) ———
1971. Basic Statistics–National Inventory of Soil and Water Conservation Needs, 1967. Soil Conserv. Serv., Statis. Bul. No. 461. Jan.

(16) ———
1971. Land Use Changes in the Southern Mississippi Alluvial Valley, 1950-69: An Analysis Based on Remote Sensing. Econ. Res. Serv., Agr. Econ. Rpt. No. 215, Oct.

(17) ———
1971. The Competitive Potential for Large Midwestern Corn Farms. Econ. Res. Serv., Agr. Econ. Rpt. No. 216, Nov.

(18) ———
1971. The Demand and Price Situation for Forest Products, 1970-71. Forest Serv., Misc. Pub. No. 1195, May.

(19) ———
1972. Rural Zoning in the United States: Analysis of Enabling Lesislation. Econ. Res. Serv., Misc. Pub. No. 1232, July.

(20) ———
1973. Agricultural Statistics 1972. U.S. Govt. Print. Off., Washington, D.C.

(21) ———
1973. Major Uses of Land in the United States, Summary for 1969. Econ. Res. Serv., Agr. Econ. Rpt. No. 247, Dec.

(22) ———
1973. The Outlook for Timber in the United States. Forest Serv., Forest Res. Rpt. No. 20, Oct.

(23) U.S. Department of the Interior
1973. Outdoor Recreation–A Legacy for America. Bur. of Outdoor Recreation, Nov.

(24) U.S. Water Resources Council
1968. The Nation's Water Resources: Summary Report. Washington, D.C., Dec.

(25) ———
1968. The Nation's Water Resources: The First National Assessment. Washington, D.C., Dec.

(26) ———
1974. 1972 OBERS Projections; Regional Economic Activity in the U.S. Series E Supplement. Washington, D.C., Apr.

APPENDIX

UNITED STATES DEPARTMENT OF AGRICULTURE

OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

October 26, 1973

SECRETARY'S MEMORANDUM NO. 1827

Statement on Land-Use Policy

1. *PURPOSE* The Department recognizes that major responsibility for land-use policy (planning and regulation) rests with local and state governments. The Department also recognizes the rights and responsibilities of landowners and users in making land-use decisions within this framework. Fifty-eight percent of America's land is in private hands, 75 percent held by farmers and ranchers. Another 8 percent in National Forests and National Grasslands is managed by the Department, while 6 percent is owned by state or local governments. Through its agencies the Department administers some 80 programs that influence private as well as governmental landholders' land-use decisions–urban as well as rural. This memorandum establishes Departmental policies to help assure sound public policy to maintain and improve the nation's natural resources.

2. *BACKGROUND.* Land, water, and air are basic assets to be used and managed wisely to protect, conserve, and enhance their productivity and quality for all Americans. Public interest in these basic assets calls for an effective planning and decision-making mechanism that complements local governments' responsibilities for land-use limitations. The nation is challenged to reconcile competing uses for land, and the impacts of such uses on water and air to assure the maximum possible advantage to the nation.

3. *DELIVERY SYSTEM.* The Department's research, educational, technical, and financial assistance services are available in every county and state of the nation. Its agencies now assist all levels of government in land-use planning and implementation efforts. The Department's nationwide delivery system for land-use information includes several thousand county offices of agencies, more than 3,000 conservation districts, research centers of all State Land Grant Universities, and cooperative efforts with State Forestry and State Agriculture Departments. At local and state levels, the Department has unparalleled working relationships with decision-makers. The Department has capability to obtain new land-use information (research), to deliver the information to those who can use it (education and action programs) and permit the Department to administer effectively technical, consultive and financial assistance to local and state units of government.

4. *DEFINITION.* Land-use policy is a facet of our general decision-making process on the use of our resources. It is a tool to carry out governmental development policies evolving from decisions on interrelated policies arising from economic, social, or environmental problems. Land-use policy and its consequences provide a focal point to identify and resolve conflicts growing out of competing land uses. Land-use policy is the expression of society's determination of how its resource, land, is used. Land-use policy refers to the total of all those national, state, and local laws, ordinances, and attitudes affecting the short-term or long-term uses of land, private or public, through such mechanisms as ownership, inheritance, taxation, condemnation, zoning, redevelopment, building regulation, master planning and legislative fiat.

5. *POLICY.* The Department will:

Adapt present pertinent programs to help enhance and perserve prime agricultural, range, and forest lands for those uses.

Promote and help influence the management of

rural lands to assure adequate sources of high quality water.

Intensify establishment of permanent soil and water conservation on the erosion-vulnerable lands returned to cultivation to help increase production of crops and livestock.

Expand the Department's efforts to assure wider understanding of how its programs and responsibilities contribute to improved land uses.

Cooperate fully with other Departments in terms of responsibility for policy and leadership.

Further coordinate the work of the Department's agencies at the state level to make all its land-use efforts relevant and harmonious.

Provide timely information and assistance including non-farm interpretations of soil surveys, small watershed hydrologic data, and economic information to local, county, and state land-use decision makers.

Strengthen and expand the Department's capabilities in harmony with others for surveying and monitoring land and related natural resources and to provide resource condition evaluations to local, county, state, and federal governmental land-use decision-makers.

Help protect rare and endangered plant and animal species and their ecological systems as well as historic, cultural, scientific and natural systems.

Help conserve and develop significant waterfowl habitat lands.

Assist in the reclamation of land surfaces used for the extraction of non-renewable resources such as coal, minerals, oil, and gas.

Work with other agencies to discharge fully the responsibilities authorized and directed to the proposed Interagency Advisory Board on Land Use Policy.

6. *LAND INVENTORYING AND MONITORING.* In providing additional resource information to local and state governments the Department will expand at the earliest feasible time its surveys and studies to include:

A nationally recognized system of land classification.

County, state, regional, and national inventories of available soil, water, and related resources and projections as to land-use potentials.

Guidelines to identify critical environmental problems to be considered in state and local land-use policy planning.

Physical, social, economic, and institutional information for evaluating national policy questions concerning agricultural, forestry, and other rural land uses. Also analyses of factors producing land-use changes.

Identification, location, and productivity ratings of farm, range, and forest land.

Research on emerging issues concerning land resource and water use, supplies, and requirements. In so doing take into account alternative environmental, institutional, and demographic factors and both short- and long-term national and international needs.

7. *PROGRAM EMPHASIS.* Department agencies will direct their programs to the extent possible—including redefinition or modification of their policies—to:

. . . Increase production of detailed soil surveys.

. . . Establish land-capability criteria to help direct the flow of urbanization to land areas least suited to crops and forests.

. . . Help guide urban growth to preserve prime farm lands, minimize fragmentation of land holdings, provide adequate water supplies, equalize taxes, dispose waste properly, and provide adequate public health, recreation and safety services.

. . . Plan and guide effectively land-use in the rural-urban fringe areas, and in recreation or second home subdivisions.

. . . Control erosion and reduce sedimentation.

. . . Minimize the impact of surface mining on rural land uses.

. . . Locate sites for solid waste disposal as an increasingly important land use.

. . . Give attention to need for small watershed, flood plain, wetlands, and coastal zone management programs based on comprehensive land-use planning incorporating ecological considerations.

. . . Encourage multiple-use management of forest lands to assure a continuous supply of forest goods and services with environmental objectives.

. . . Manage farm, ranch, and forest practices to minimize adverse effects on the environment.

8. *IMPLEMENTATION GUIDELINES.* The Department and its agencies will be guided by the following purposes in policy implementation:

(1) To conduct programs within state and Federal environmental standards.
(2) To conserve and improve land and related resources.

(3) To enhance the amenities and social assets of rural America.
(4) To seek fair returns for farms, forests, and ranches as economic units.
(5) To support research and education on land-use planning.
(6) To promote economic development in the rural areas.
(7) To assist all citizens and agencies to obtain technical data needed for planning.
(8) To continue to act in concert with Federal, state, multi-jurisdictional planning and development agencies and local agencies. Also with quasi-public and private organizations and individual landowners and operators.

Earl L. Butz

Secretary of Agriculture

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