

A g r i c u l t u r a l

Production in the Western
United States

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Agricultural Production in the western United States

Throughout the history of the United States, agriculture has helped shape the Nation's people, prosperity, and outlook. Self-sufficiency in agriculture served to transform a rural, agrarian society into a largely urban, industrial one. Internationally, American agriculture played a vital part in supplying food to those in need during periods of crises such as war, crop failure, and famine.

Today, agriculture continues to supply an abundance of relatively low-cost food and fiber to domestic consumers. Agricultural exports, in recent years, have been especially valuable to the domestic economy by creating a trade surplus to offset, in part, the deficit in some nonagricultural trade accounts. Agriculture also provides a livelihood to workers directly involved in agricultural production and in related industries such as food processing, farm equipment manufacture, and transportation of agricultural goods.

Arid and semiarid lands comprise about one-third of the contiguous United States and are an integral part of the Nation's productive capacity. Particular qualities of the area make it especially suited to certain types of agriculture. The climate, characterized by low humidity and many cloud-free days, is ideal for some irrigated and nonirrigated crops such as wheat, sorghum, cotton, potatoes, barley, and specialty crops such as fruits, nuts, grapes, and table vegetables. In some areas where the growing season is long, farmers can produce crops throughout the year. Seed and nursery stock production are also well-suited to the arid and semiarid region because the area's dry climate discourages growth of plant pathogens.

The arid and semiarid region is well adapted to animal production as well. Large acreages of land not suitable for intensive cultivation provide low-cost forage for animals that are used for meat, hides, or wool.

In addition, Western agriculture extends the diversity of agricultural production in the Nation and further ensures that domestic consumers have a reliable and varied food supply. Moreover, it is an important component of many local economies and contributes to the perception of a Western lifestyle. Many production technologies originated in U.S. arid and semiarid regions and were then transferred to more humid areas or to other countries. Finally, in an age of increasing urbanization, the wide expanse of open land, characteristic of the region, offers visual amenities and numerous recreational opportunities and supports a diverse and unique population of native plants and animals.

Many forces threaten continued success of this country's agriculture, but one factor that particularly threatens Western agriculture is limited water. Water is essential for food and fiber production, yet in much of this region, low precipitation limits both plant survival and growth. On land where precipitation is supplemented by water application, increasing competition from municipal and industrial users, diminishing ground water supplies, higher pumping costs, and declining water quality cloud the future of agriculture.

This chapter describes the character of Western agriculture and discusses its present features and future outlook. Other chapters address the water issue explicitly as it relates to agriculture.

CHARACTERISTICS OF ARID/SEMIARID LANDS

No universal definition of arid and semiarid lands exists for agricultural purposes. Definitions based solely on total annual precipitation fail to provide adequate information on its distribution throughout the year and on other climatic elements—e. g., temperature, humidity, wind, and intensity and duration of sunlight—that characterize the arid and semiarid environment. Definitions based on vegetation types, soils, animal distribution, or land use are similarly limited in application. Arid and semiarid lands, as used in this assessment, are those lands where crop-water requirements exceed the plant-available water (growing season precipitation plus soil water stored in the root zone) by a significant amount,

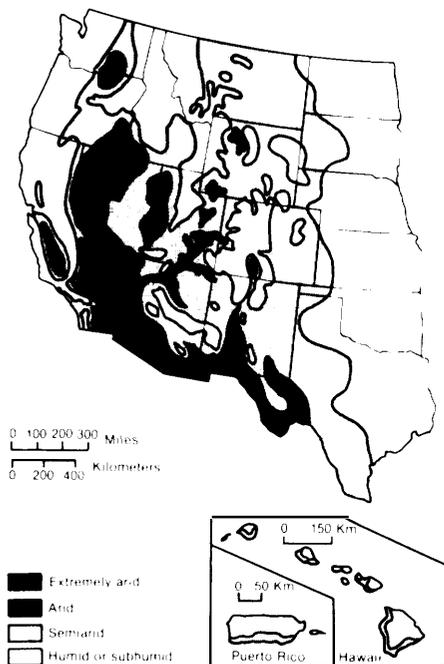
Arid and semiarid lands characteristically have predominantly clear skies, high average wind speed, and low relative humidity. The average annual precipitation is generally 20 inches or less. In the continental United States, the arid and semiarid area includes parts of the

17 Western States that lie between the 100th meridian and the Sierra Nevada and Cascade Mountain ranges (fig. 4). Offshore are scattered arid and semiarid areas on the Hawaiian Islands, the Virgin Islands, and Puerto Rico. In this assessment, the arid/semiarid lands of principal focus will be those located in the 17 Western States. *

Table 2 presents the land area by State for the 17 Western States. Because information on agricultural production is tabulated and classified by State boundaries, production figures for some areas (particularly in the Pacific and Great Plains regions) include crops and livestock produced under humid and subhumid conditions.

*Although some resource management and technology aspects of this assessment apply generally to any arid or semiarid situation, islands have unique natural resource characteristics and agricultural capacity that vary by location and geology. A separate study of arid and semiarid islands is suggested.

Figure 4.—Arid and Semiarid Regions of the United States



SOURCE: Carle Hodge (ed.), *Aridity and Man* (Washington, D.C.: American Association for the Advancement of Science, publication No. 74, 1963).

Table 2.—Agricultural Land in the Western States, by State, 1978

State	Total land area (rounded to million acres)	Agricultural land (percent of total)
<i>Great Plains:</i>		
Nebraska	49	93
North Dakota	44	91
South Dakota	49	89
Kansas	52	89
Texas	168	80
Oklahoma	44	74
<i>Mountain region:</i>		
Wyoming	62	78
Montana	93	70
New Mexico	78	69
Nevada	70	67
Colorado	66	60
Arizona	73	59
Idaho	53	52
Utah	53	49
<i>Pacific region:</i>		
Oregon	62	46
California	100	35
Washington	43	35
17 Western States	1,158	67
31 Eastern States	739	38
Total	1,897	56

Note: Agricultural land includes cropland, grassland, pasture, and range.

SOURCE: H Thomas Frey, *Major Uses of Land in the United States 1978*, U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No 487, 1982, appendix table 1

FEATURES OF WESTERN AGRICULTURE

Natural features, including climate and weather patterns, soils, topography, and vegetation, differ markedly across the West. These natural features, in turn, influence the types of agriculture that are practiced and the crops that are grown. *

Western Agriculture in the National Context

Agriculture (farming and ranching) is the dominant land use in the Western United States. On average, the 17 Western States use about 67 percent of the land for agriculture compared with 38 percent in the East. This percentage changes across the region and ranges from about 90 percent of the land area in some States of the Great Plains to less than 40 percent in California and Washington (see table 2).

Unlike the Eastern States, a substantial amount of land in the West is federally owned (table 3). This percentage varies widely. In

Nevada, for example, over 85 percent of the land is federally owned. In contrast, approximately 1 percent of the land in Kansas and Nebraska is federally owned. Much of the public land is used primarily for livestock grazing; a smaller portion is used primarily for timber production, recreation, mining, or national security installations.

Products of Western agriculture constitute a large share of the total income derived from farming in the United States. In 1980, cash receipts from marketing livestock and their products and crops in the 17 Western States accounted for approximately \$59.3 billion, or about 43 percent of the income derived from farming in the United States (table 4).

The types of agricultural goods that produce this income vary across the region and include livestock products (e.g., meat, wool, hides, milk, eggs, genetic material) and crops such as wheat, barley, sorghum, cotton, hay, vegetables, field seed crops, fruits, and nuts. Within the arid and semiarid area, there are regions of crop specialization. In eastern Washington

* Appendix A presents more information on natural features, and agricultural production in the arid and semiarid region.

Table 3.—Ownership of Land in the 17 Western States

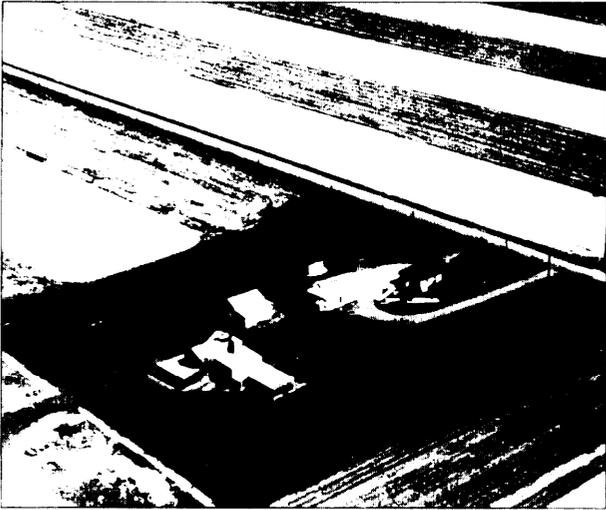
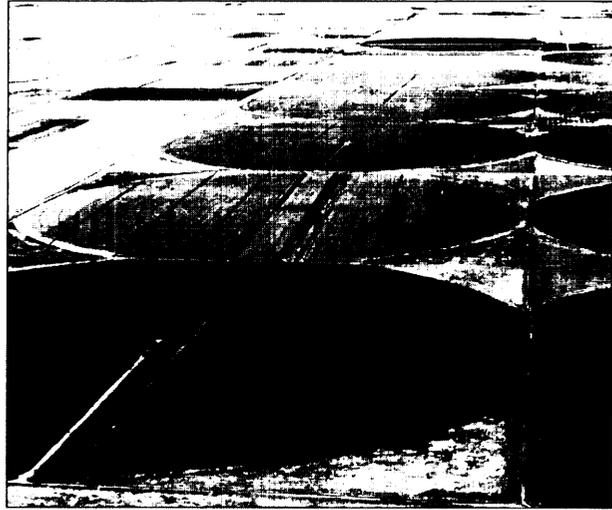
	Ownership		Percent Federal
	Federal (000 acres)	Non-Federal (000 acres)	
17 Western States	368,108	789,503	32
31 Eastern States	33,759	704,693	5

SOURCE U S Department of Agriculture, Soil Conservation Service, 1977 National Resources Inventory, *Basin Statistics*, revised February 1980, table 1

**Table 4.—Cash Receipts From Farm Marketing, 17 Western States, 1980^a
(million dollars)**

State	Agricultural product		
	Livestock and products	Crops	Total
Total, 17 Western States	\$30,281	\$29,058	\$ 59,339
Total, United States	\$69,209	\$68,806	\$138,015

^aOther income derived from farming (e.g. Government payments and nonmoney income) are not included in totals
SOURCE U S Department of Agriculture Economics and Statistics Service *Agricultural Outlook*, March 1981 AO-63 p 25



Western agriculture

Photo credit: USDA-Soil Conservation Service

Box B.—Numbers, Numbers, Numbers

Congress, executive agencies, States, farm organizations, and the public rely on agricultural statistics compiled by numerous Federal agencies. One of the most well-known and widely used sources of a variety of agricultural data is the Census of Agriculture, conducted every 5 years by the U.S. Department of Commerce, Bureau of the Census. Among the statistics that the census collects are: land use, number of farms, crops harvested, average size of farms, characteristics of farmers, and farm production expenses.

The U.S. Department of Agriculture (USDA) also has a major responsibility for collecting and tabulating information on soil and water resources, land use, world agricultural production and trade, farm income and expenses, crop supplies, market prices, and crop use. Much of this information is gathered independently by various agencies within the Department, but some data are supplemented and coordinated with the Census of Agriculture and statistics from other executive departments.

The large amount of agricultural data and the number of organizations that collect information have led to some problems for data users. First, coordination of data between organizations that collect similar information is sometimes difficult. Second, there is often a delay between the time the survey is taken and when it is compiled, summarized, and published. Another problem is the accessibility of information. Agricultural data are dispersed throughout various USDA agencies and other departments. USDA makes an effort to compile these statistics, and each year the Department publishes *Agricultural Statistics*. Information, however, focuses on agricultural commodities. Data on cropland and rangeland use, conditions of soil and water resources, and other natural resources must be obtained from other sources, both within USDA and outside the Department.

Finally, there are problems related to the nature of agricultural surveys. Data are collected and tabulated along political boundaries, and it is very difficult to evaluate agricultural production under arid/semiarid conditions v. humid/subhumid conditions in States where both climatic types exist. Both the census and USDA have been criticized also because of the scope of their surveys. For example, neither collects information on the extent of some agricultural practices such as organic farming, "new crops," and livestock operations on public lands.

and Oregon, Idaho, and the Great Plains, for example, large acreages of wheat, sorghum, and barley exist. In California and other irrigated areas, farmers grow a wider mix of products, including specialty crops such as table vegetables, citrus fruits, wine grapes, and melons, and row crops such as corn and cotton. Wyoming, Colorado, Nevada, and Utah derive a major portion of their agricultural income from cattle and other livestock and their associated products.

Certain crops grown in the West constitute a significant share of the total acreage and value of that crop for the entire Nation (tables 5 and 6). For example, nearly 85 percent of all

Table 5.—Selected Major Crops Harvested in the 17 Western States, by Acreage, 1978

Crop	Acreage (000 acres)	Percent of national production
Wheat for grain ... ,	46,811	86
Hay crops	29,116	47
Corn for grain or seed	13,870	20
Sorghum for grain or seed	11,620	90
Cotton	9,260	73
Barley for grain .,	7,512	84
Oats for grain	4,487	44
Land in orchards	2,635	58
All vegetables harvested for sale .,	1,647	46
Field seed crops .,	905	65
Irish potatoes ... ,	867	62
Strawberries	21	46

SOURCE U S Department of Commerce Bureau of the Census, 1978 Census of Agriculture vol 1, c h 2, tables 29-34, 1981

Table 6.—Market Value of Major Agricultural Products Sold, 17 Western States, 1978

Crop	Value (million \$)	Percent of national market
Livestock, poultry, and other animal products ..	\$27,461	46
Wheat for grain	3,947	83
Hay crops	2,981	46
Fruits, nuts, and berries	2,834	61
Corn for grain or seed	2,689	19
Cotton	2,657	78
Vegetables, sweet corn, and melons	1,973	60
Field seeds, hay, forage, and silage	1,343	58
Sorghums for grain or seed ..	1,123	87
Irish potatoes	840	68

SOURCE U.S. Department of Commerce, 'Bureau of the Census, 1978 *Census of Agriculture*, vol 1, ch 3, compiled from individual State tables, 1981

land used for wheat, barley, and sorghum production in the United States is located in the 17 Western States. Most of the agricultural land used for the production of cotton, orchard crops, and field seed crops is also located in the region,

Export markets, particularly those in Japan and other countries in the Far East, provide a significant source of income for Western producers and represented about 30 percent of cash receipts from farm marketing and about 40 percent of the total U.S. agricultural exports in 1980 (table 7). The leading Western States in terms of income derived from agricultural exports are: California, Texas, Kansas, Nebraska, and North Dakota. California, Texas, Kansas, and Nebraska are also among the top 10 exporting States, by value, in the Nation. Texas, for example, ranked first by value in exports of cotton, grains, tallow, cattle hides, beef, and live animals in 1980,

Western agriculture also generates employment in processing operations such as canning, packing, and ginning, and in support services such as equipment sales, transportation, and farm and ranch supply businesses (table 8). Many of these enterprises are rural-based and are an important element of rural life (see discussion of rural economies and agriculture in ch. V].

Table 7.—Agricultural Exports in the 17 Western States, by Value, October-September, 1979-80 and 1980-81 (million dollars)

Region	1980	1981
17 Western States	\$16,662	\$17,656
Total United States	\$40,481	\$43,789
17 Western States, percent of United States	41 00	40%

SOURCE U.S. Department of Agriculture, Economic Research Service, *Foreign Agricultural Trade of the United States*, March/April 1982, table 17.

Types of Agriculture in the Arid and Semiarid Region

Agriculture is shaped by the natural environment—landscape, climate, and soils. Production technologies, landownership patterns, distance to livestock and crop markets, economic conditions, individual choice, and social custom also influence agricultural production.

Agricultural production in the arid and semi-arid region includes three broad types of agricultural practices: rangeland agriculture, dryland farming, and irrigation agriculture. Each has a different level of resource use and output (fig. 5). *Rangeland agriculture* occurs in areas where the native vegetation—predominantly grasses, grasslike plants, forbs, * and shrubs—are used commonly for grazing domestic livestock. Such areas are generally unsuitable for cultivation because they are too cool, too hot, too arid, or have soils too shallow or infertile to raise crops. *Dryland farming* is crop production through cultivation of the land. It relies on precipitation to supply plant-water needs. *Irrigation agriculture* supplements precipitation with additional water, primarily providing water for plant growth that is not normally supplied during the growing season,

The proportion of land used for each practice varies greatly across the Western States. Rangeland agriculture is the most land-extensive practice, followed by dryland farming and irrigation agriculture.

* Herbaceous plants other than grasses.

Table 8.—Agricultural Services:^a Number of Establishments,^b Gross Receipts and Payroll, by State, 1978

State	Number of establishments	Gross receipts (in \$000)	Annual payroll (in \$000)
<i>Great Plains:</i>			
Texas	2,436	\$ 281,493	\$ 96,476
Nebraska	554	48,494	14,385
Oklahoma	562	36,447	8,821
Kansas	754	41,937	8,599
South Dakota	313	16,516	3,921
North Dakota	243	15,571	3,213
<i>Mountain region:</i>			
Arizona	441	104,250	41,705
Idaho	352	45,853	10,503
Colorado	355	31,981	8,477
Montana	238	13,528	2,971
New Mexico	118	8,741	2,686
Wyoming	79	4,197	1,394
Utah	98	5,905	1,120
Nevada,	40	2,544	490
<i>Pacific region:</i>			
California	3,043	1,034,223	452,186
Washington,	387	78,732	24,904
Oregon	331	31,197	8,943
17 Western States	10,344	1,801,609	690,794
United States	20,595	2,936,208	2,134,248

^aAgricultural services consist of soil preparation services; crop services; veterinary services for cattle, hogs, sheep, goats, and poultry, animal services (except veterinary) for cattle, hogs, sheep, goats, and poultry; farm labor; and management services

^bEstablishments having a dollar volume of business less than \$2,500 are omitted.

SOURCE U S Department of Commerce, Bureau of the Census, 1978 Census of Agriculture, vol 3, table 23, 1981

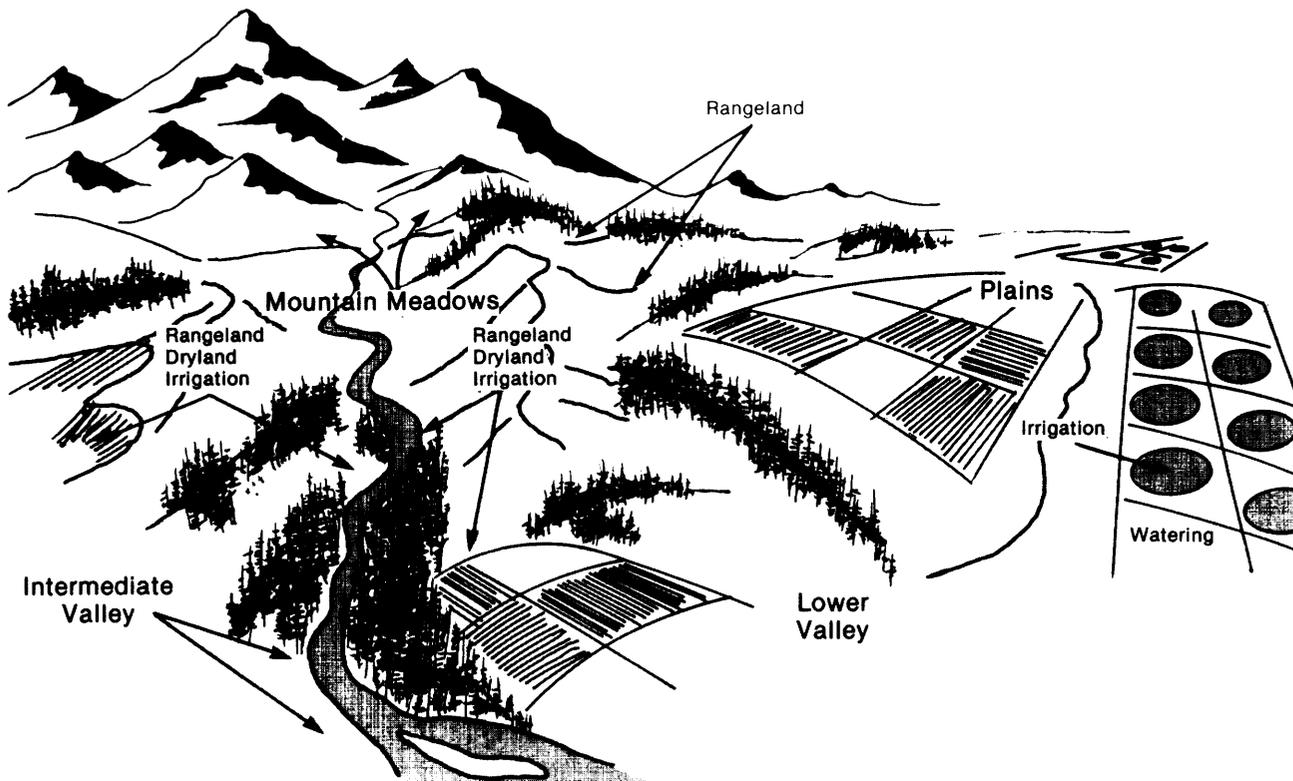
Agricultural practices are dynamic. For example, an area can shift over a period of years from rangeland to dryland farming to irrigation. If irrigation water becomes limited and dryland agriculture is possible, a producer may choose to switch to crops that require less irrigation water, supply less than full water requirements to a crop, revert to dryland farming, or reseed an area and use it for grazing purposes. At the same time, a single farm or ranch can combine different types of agricultural practices. An individual can graze livestock on land not suited for cultivation but farm other areas where the soils are more fertile and where precipitation or irrigation water is sufficient for crop production.

The way agricultural practices change over time is evident in some of the Great Plains States. In 1944, about 2 million acres of land in Kansas, Oklahoma, Nebraska, and Texas were irrigated; by 1974 this total had grown to about 13 million acres (fig. 6). The shifts among

agricultural practices continue. Irrigated acreage in the southern Great Plains (primarily Texas) decreased by over a half-million acres between 1974 and 1979 because of depletion of the Ogalalla aquifer and because of high-energy costs (11). As a second example, in the past 3 years, nearly 450,000 acres of grasslands in Colorado (approximately 700 square miles) that were previously used as range have been plowed in preparation for dryland farming (1). Another 700,000 acres of grasslands in South Dakota (approximately 100 square miles) have been plowed in the last 9 years (9). This trend has alarmed Federal and State officials who fear that this land is too fragile for intensive cultivation* and that the "Dust Bowl" days of the 1930's will return if irrigation water is in short supply or if a lengthy period of dry weather occurs.

*Legislation has been introduced in Congress and in some States with the intent of curbing this practice. See also ch. XII.

Figure 5.—Schematic of Western Agriculture



SOURCE: U.S. Departments of the Interior and Agriculture, Environmental Protection Agency, Irrigation Water Use and Management, Interagency Task Force Report (Washington, D.C.: U.S. Government Printing Office, 1979), p. 34.

Rangeland Agriculture

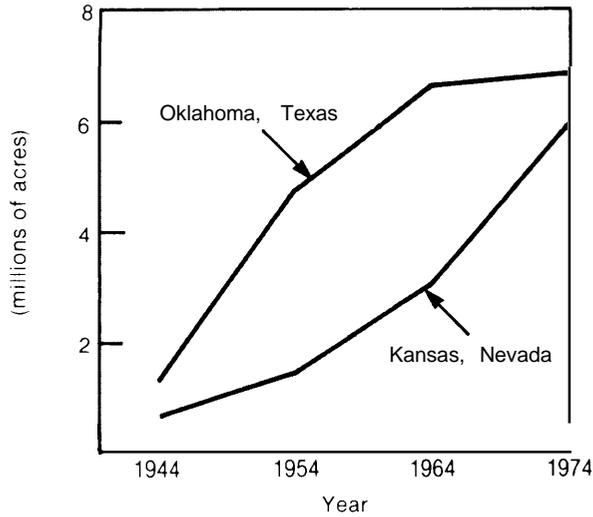
After the Western territories were acquired by the Federal Government in the 1800's, much of the land was in the public domain. One value that became apparent to early inhabitants was its use for breeding and feeding domestic livestock, mainly sheep and cattle. Gradually, the livestock industry advanced throughout the Western region to supply settlers' needs and to fulfill the demand from Eastern States.

Rangeland is often classified by vegetation type: grassland or prairie types, desert shrub, chaparral, and understory herbage in both co-

niferous and hardwood forests (fig. 7). The natural productivity of a particular site varies greatly throughout the region and depends on precipitation, soils, and management.

In general, rangeland agricultural areas produce forage for livestock. In addition, many of these areas are located in mountainous regions where surface runoff provides water to streams and rivers. Rangelands serve, too, along with forests, as the most productive and largest habitat for wildlife in the United States because they are managed less intensively than are other types of ecosystems. Federally owned rangelands are mandated to be managed for

Figure 6.—Irrigation Development in the Central and Southern Great Plains, 1944–74



SOURCE: Marvin E. Jensen, "Overview: Irrigation in U.S. Arid and Semiarid Lands," Office of Technology Assessment, unpublished draft report, 1982.

multiple products—grazing, timber, mining, water, and recreation.

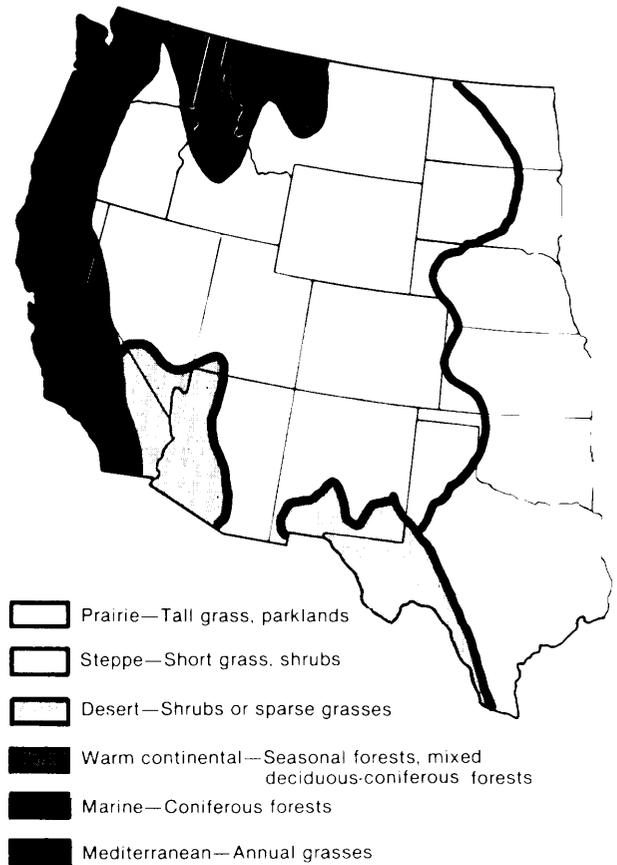
Dryland Farming

The United States contains an estimated 350 million acres (546,000 square miles) of semiarid land [2]. This area encompasses the Great plains, eastern Oregon, eastern Washington, northern and southern Idaho, parts of western Colorado, Utah, and parts of the California Valley. Some of this land is suitable for crop production, especially using dryland methods.

In dryland farming, crops must be able to grow and produce under conditions of low precipitation. The number of crops currently adapted is limited. Wheat and barley, sorghum, millets, seed legumes (e. g., dry beans, dry peas, and lentils), safflowers, and sunflowers are produced commonly. The choice of a crop is further limited because some crops are adapted narrowly to certain climatic conditions (e. g., seasonal distribution of precipitation, winter and summer temperatures, and length of growing season).

The most extensive dryland crop area in the semiarid region of the United States is planted

Figure 7.—Vegetation Types in the Arid and Semiarid Regions of the United States



SOURCE: R. G. Bailey, *Description of the Ecoregions of the United States* USDA, miscellaneous publication no. 1391, 1980.

in wheat, which provides the highest cash income of all dryland crops. The major producing areas include the Great Plains, eastern Oregon, eastern Washington, and Idaho. Depending on climatic characteristics, different classes of wheat (i.e., hard red winter, hard red spring, durum, or soft white wheat) are grown in certain areas.

Barley can be grown in many areas where wheat is produced but tends to be less tolerant of cold weather. Much of the dryland region in California produces barley, and the crop is used for animal feed or malt.

Where wheat and barley production is limited by low precipitation or hot temperatures, farmers can grow sorghum, millets, and seed legumes. Grain sorghum is especially suited to parts of the southern and central Great Plains, where growing seasons are long. It can be used for animal feed or grazed by livestock. Other crops such as pinto beans, dry peas, lentils, safflowers, and sunflowers are locally important. For example, dry peas are grown in the Pacific Northwest and sunflowers are produced in North Dakota and western Nebraska.

Irrigation Agriculture

Irrigation agriculture accounts for roughly 50 million acres of agricultural land in the 17 Western States, or about 6 percent of the total agricultural land in the region (table 9). California is the leading State in number of acres irrigated, followed by Texas, Nebraska, Idaho, and Colorado. In 1978 more than 80 percent of the harvested cropland in Nevada, Arizona, and California was irrigated; from 50 to 80 percent of the harvested cropland in Idaho, Wyoming, and Utah was irrigated.

Irrigation can have several purposes. Its primary aim is to supply water to plants so that yields are not limited by insufficient water. Other purposes include:

- flushing soluble salts out of the soil, thereby preventing their harmful effects on plants;
- preventing severe freeze or frost damage to orchards, citrus nurseries, strawberries, ferns, and subtropical fruits;
- seed-bed preparation;
- waste treatment of effluents from food processing industries and municipal sewage facilities;
- reducing heat stress in plants by wetting the foliage; and
- facilitating harvest of root crops (e.g., sugar beets, potatoes) (6).

Irrigation is an economically important practice in the arid and semiarid region because it allows crop production where it might not otherwise be possible. Furthermore, with its value in controlling soil water and in reducing the risk associated with crop production,

Table 9.—Nonirrigated and Irrigated Cropland,^a 17 Western States, 1977

State	Non irrigated (000 acres)	All cropland irrigated (000 acres)	Percent of total cropland irrigated
<i>Great Plains:</i>			
North Dakota	26,835	78	<1
Kansas	25,631	3,175	11
Texas	22,510	7,929	26
South Dakota	17,684	472	3
Nebraska	13,794	6,905	33
Oklahoma	11,073	710	6
<i>Mountain region:</i>			
Montana	13,294	2,061	13
Colorado	7,699	3,394	31
Idaho	2,743	3,547	56
Wyoming	1,320	1,650	56
New Mexico	1,203	1,079	47
Utah	655	1,160	64
Arizona	145	1,167	89
Nevada	4	1,103	100
<i>Pacific region:</i>			
Washington	6,179	1,772	22
Oregon	3,139	2,009	39
California	1,920	8,153	81
Total, 17 Western States	155,828	46,364	23
Total 48 States	357,027	55,594	13

^aCropland includes cultivated cropland, pasture, hay land, orchards, and vineyards.

SOURCE U S Department of Agriculture, Soil Conservation Service, 1977 *National Resources Inventory*. Basic Statistics, revised February 1980. table 3

Box C.—Rainfall and the Western Settler

One element that strongly shaped agriculture in the Western States was the environment, particularly limited precipitation. Explorers to the region in the early 1800's noted that the West was unsuited for farming operations and called it "A Great American Desert." Some individuals who later attempted to farm without irrigation affirmed this notion—the weather was unpredictable; precipitation was often erratic, scant, and poorly distributed; and temperatures were extreme.

Despite the crop failures sustained by many farmers and the powerful presence of the cattle industry, hopes for a more intensive type of agriculture than ranching remained alive. Some colorful myths developed that promised rain to the farmers:

- rain would follow the plow because evaporation would increase from worked soil,
- rain would follow the train because raindrops would form around smoke particles,
- rain would follow the telegraph because of electricity in the air,
- rain would follow a military battle (experiments were even conducted in Texas with explosives and cannons—without success), and
- rain would follow settlement because the people were good and worthy with a destiny to fulfill.

Farming practices in the West strongly reflect this past experience. Dryland farming techniques eventually evolved that conserved precipitation during the winter months for use during the growing season. Crops were selected that did well despite the low amounts of water. Water supplies were developed (by reservoir and canal construction) to enable crop production in areas that would have little potential for farming otherwise.

farmers who irrigate generally have higher and more stable yields than do dryland farmers. * Moreover, such producers have a wider choice of crops. ** These crops include corn, cotton, wheat, sorghum, high-value specialty crops such as fruits, nuts, berries, vegetables, sweet corn, and melons, and field seed crops (table 10).

Structure of Western Agriculture

Farm Size and Ownership

Many factors influence farm/ranch size and ownership patterns including natural resources, availability of capital, export demand for crops, availability of nonfarm employment, commodity programs, credit availability, and tax rules. *** In the Western States, farms and

* Frederick and Hanson (5) compared yields among western dryland and irrigated crops of corn, sorghum, wheat, and cotton to the East. Irrigated crops had significantly higher yields per acre than either dryland crops or crops grown in the East. For example, with irrigation, average yields for corn increased from 48 to 115 bushels per acre. In the East, average yields were 89 bushels per acre.

** The wide selection of crops available to irrigators is reflected in the fact that in California, over 200 commercial crops are grown.

*** This discussion is largely from Schertz, et al. (10).

ranches tend to be larger than in the rest of the United States; dryland farms and ranches tend to be larger than irrigated areas.

For purposes of this discussion, the farming regions are as follows:

1. the Great Plains include North and South Dakota, Nebraska, Kansas, Oklahoma, Texas, Colorado, Wyoming, and Montana;
2. the Southwest includes California, Nevada, Utah, Arizona, and New Mexico; and
3. the Northwest includes Washington, Idaho, and Oregon.

Among the Western States, as in the rest of the United States, there has been a trend toward fewer but larger farms. In the Great Plains in 1978, the average farm size was about 900 acres (over two times the national average of 415 acres). Cash receipts per farm were about \$55,000 (the national average was about \$44,000). Most of the farms in the region were less than 500 acres in size, but about one-fifth (about 100,000 farms) were over 1,000 acres. Over one-half of the farms were owned by an individual or family; many operators also rented land.

Table 10.—Irrigated Acreage of Selected Crops, 17 Western States, 1978

Crop	Acres harvested (000 acres)	Acres irrigated (000 acres)	Percent of crop irrigated
Hay Crops	29,116	8,954	31
Corn	13,870	7,850	57
Cotton	9,260	4,555	49
Wheat	46,811	2,987	6
Orchard crops	2,635	2,306	87
Sorghum	11,620	2,019	17
Barley	7,512	1,964	26
All vegetables harvested for sale	1,647	1,445	88
Irish potatoes	867	716	83
Field seed crops	905	303	33
Oats	4,487	223	5
Strawberries	21	18	86

SOURCE US Department of Commerce, Bureau of the Census, 1978 *Census of Agriculture*, vol 4, ch 1, tables 9.13, 1981

Farm size in the Southwest, as measured by resources controlled and output per farm, far exceeds the U.S. average. In 1978, average farm size was 1,300 acres and cash receipts per farm totaled about \$130,000. Looking only at crop production, the value of crops sold per farm in the Southwest was 3 1/2 times the U.S. average. Also of interest was the distribution of farms and sales among size classes. In 1974 the Southwest had a slightly higher proportion of small farms (less than 180 acres) than did the rest of the United States (reflecting specialty-crop production); however, more than 55 percent of Southwestern farms exceeded 1,000 acres, compared with 34 percent for the United States. Three percent of all farms had more than \$500,000 in annual sales and produced 60 percent of the cash receipts from farming.

Corporate farms (both family held and non-family owned) are another important feature of the Southwest. In 1978 corporate farms controlled nearly 20 percent of Southwestern farmland. Their role varies with crop and area. For example, in the southern San Joaquin Valley of California, conglomerates operate some large producing-processing-marketing farms. These farms produce a large variety of crops, including tree fruits, nuts, and vegetables.

Characteristics of Northwestern farm production are difficult to assess because of the diverse crop-production capabilities in the region. In 1978 average farm size was slightly over 500 acres; however, farm size tended to

be much lower along the coastal areas than in the intermountain irrigated area or dryland farming region east of the Cascade Mountains. Average farm sales were approximately \$75,000. A majority of farms were owned by an individual or family.

Role of Labor

Since World War II, one of the most dramatic shifts in agriculture has been the substitution of capital goods (e. g., tractors and other farm machinery, farm chemicals, and irrigation water) for labor. On the Great Plains, for example, fewer farms and the development of larger tractors and other machinery have reduced farm labor requirements and the number of farmworkers. Over the period from 1960 to 1977, the number of farmworkers declined from 1.25 million to 785,000. About one-fourth of these workers were hired; the rest of the labor force consisted of family farm labor.

Where high-value specialty crops are grown, considerably more hired labor is used. For example, in the Southwest in 1977, the bill for hired labor totaled \$1.9 billion, 26 percent of the U.S. hired labor charge. Of the total farm work force in the region, 69 percent was hired labor, compared with 31 percent owner and family labor. Comparable national totals were reversed.

Much has been written about the hired labor force in the Southwest. In general, it is char-

acterized by its impermanence—80 to 90 percent of hired labor work less than 150 days. Furthermore, of all the occupational classes in the United States, farm laborers are the least educated. Male farm laborers between the ages

of 25 and 44 have an average of 9 years of schooling (4). Many are minorities, and these workers may find little alternative employment outside of agriculture.

TRENDS

The long-term future of Western agriculture is uncertain. The elements that have shaped its past—natural resources, people, science and technology, economics, and Government policies—will invariably affect its future. New considerations, unknown or discounted as unimportant at present, may influence the future direction of Western agriculture. Examples of these elements include climatic change, increased foreign and corporate ownership of farmland, energy shortages, increased water restrictions on agriculture, resource degradation, world food shortages or famine, widespread crop failure (domestically or internationally), international conflicts, or other crises.

Irrigation agriculture raises particular concern at present. The West supplies the Nation with important foodcrops, especially perishables, and most of these crops are irrigated.* Furthermore, mild winter temperatures and fertile soils give some areas of the region (e.g., California and Arizona) a virtual monopoly in producing numerous specialty crops (e.g., almonds, walnuts, and wine grapes). However, large tracts of land produce corn, sorghum, alfalfa, wheat, and lesser grains that are produced in abundance elsewhere.** In recent years, some of these commodities have been in surplus. Moreover, decisionmakers at all levels of government are concerned that the water-short West may not be able to sustain current levels of population growth, accom-

modate new energy and industrial development, and maintain its irrigated acreage (see discussion of competing uses in ch. V). Individuals and groups that support environmental conservation worry also about the effects of irrigation on land, surface flows, and wildlife. Depletion of ground water resources, especially in the southern Great Plains, threatens not only the well-being of agricultural producers who use this water but also rural communities that are agriculturally based. Furthermore, current use of easily tapped ground water diminishes the possibility of using this resource in the future. Added together, these factors lead many analysts to believe that irrigation in its present form will not continue to make the contributions to agricultural growth that it has in the past (5,8).

The social ramifications of irrigation are less well understood and more difficult to assess, but important questions nonetheless. Irrigation agriculture often affects farm size and ownership dramatically—changing land use patterns, increasing land values, and limiting ownership to large farmers and ranchers, outside investors, or corporations that can more easily afford the high risks and high investments irrigation often necessitates (7). Reliance on migrant farm labor, especially in fruit and vegetable crop production in the Northwest and Southwest, raises questions about income equity, housing standards for migrant workers, and immigration policies (12).

A second set of issues affects agricultural land and its competition with nonagricultural uses: urban development, recreation, and transportation. Estimates indicate that from 1967 to 1977, some 2 million to 3 million acres of agricultural land (cropland, pasture, range-

*For example, the U.S. Department of Commerce reports that from 1973 to 1977, the 17 Western States supplied 55 percent of fresh fruits and vegetables to 36 major U.S. cities (4).

**Many of these crops are fed to cattle and their increased availability has been one of the most obvious factors in the growth of the feedlot industry in Nebraska, western Kansas, eastern Colorado, and the panhandles of Texas and Oklahoma during the last 25 years.

Box D.—Reducing Agricultural Surpluses

During the 1981 and 1982 crop years, U.S. and world grain production reached record levels. Favorable weather contributed to this increase. At the same time, the demand for U.S. agricultural products slowed, and domestic grain stocks ranged to new highs mainly caused by weak economic conditions in the United States and in other parts of the world, financial instability in several countries, a strong U.S. dollar, market losses related to the Soviet embargo, continued East-West tensions, and restrictive marketing practices in some foreign markets. For farmers in this country, the high grain stocks meant reduced crop prices; in calendar 1982, average domestic prices for wheat and coarse grains dropped to their lowest levels since 1979.

Following these events, the administration launched several programs to reduce stock, lower Federal commodity payments, and bolster prices. In 1982, USDA offered farmers an acreage-reduction program in an effort to curb production. Under this program, farmers voluntarily agreed to reduce the number of acres they would plant in a particular crop (e.g., corn, wheat, cotton) by a specified percentage. In return, they became eligible for Federal price support benefits. However, good weather and the late program announcement negated its intended effects.

For 1983, the program was expanded to include paid diversion (i.e., farmers who comply with the voluntary acreage reduction may further reduce their acreage and receive cash payments), an expanded export credit program, and a payment-in-kind (PIK) program. The novel PIK program attracted much interest from the public. Under this program, farmers who removed from production additional acres over what they agreed to take out under current acreage-reduction programs received as payment a certain amount of the commodity they would have grown on these acres. The commodity then became the property of the individual and could be disposed of in any way the farmer wished. Crops of wheat, corn, grain sorghum, cotton, and rice were included in PIK.

Secretary Block, in detailing features of the program, noted, "We have a threefold objective with PIK—reduce production, reduce surplus stockholdings, and avoid increased budget outlays that would otherwise be necessary under price support programs." Furthermore, he stated, "It is unlikely our surplus will be substantially reduced any time soon by increased exports. PIK is aimed at bringing supply more in line with demand."

SOURCES: USDA Payment in Kind Fact Sheet, 1983. Remarks Secretary John R. Block, Jan. 11, 1983. Economic Research Service, *World Agriculture Outlook and Situation*, WAS-3I, March 1983.

land, and forest) were converted each year to nonagricultural uses (3). About one-third was in active use. Two points become evident. First, with current low prices of many farm commodities (particularly grains and cotton), many farmers are facing financial ruin. Some Western farmers may leave agriculture, thereby easing the way for additional land conversion, which may ultimately affect the Nation's capacity to produce food and fiber. Second, expansion of urban areas often occurs at the expense of local agricultural land. Farmers may decide to retire from agriculture or move their operations to other lands, which may be less productive and more erosive, and which may entail higher production costs.

A third but related set of issues affects agricultural practices in the region. Will the shift from rangeland agriculture to dryland farming or irrigation on privately owned lands create another "Dust Bowl"? If these areas are converted but later abandoned, how can they be rehabilitated and made productive again, and who should bear the costs of reclamation?

New technologies and Government policies (including water, food, export, and agricultural research policies) may drastically shape tomorrow's agriculture in the arid and semiarid region. Traditional agricultural practices may change. Irrigation, as it is practiced today, may become less important; producers may move

away from reliance on a single crop for their income toward multiple-use of croplands and rangelands. Some native plants and animals may be used more intensively for food, fiber, energy, and industrial feedstocks. Greenhouses

and fish enclosures may gradually become more common, capturing the incoming solar radiation and highly concentrating food production over small areas of land.

CHAPTER II REFERENCES

1. Anonymous, "Where is That Rain on the Western Plain?" *The Kansas City Times*, May 25, 1982.
2. Brengle, K. G., *Principles and Practices of Dry-land Farming* (Boulder, Colo.: Colorado Associated University Press, 1982).
3. Conservation Foundation, *State of the Environment 1982* (Washington, D. C.: Conservation Foundation, 1982).
4. Finan, Timothy J., Downing, Theodore E., and Bennett, John W., "Social Impacts of Water Technology Changes on Western Populations," OTA commissioned paper, August 1982.
5. Frederick, Kenneth D., and Hanson, James C., *Water for Western Agriculture* (Washington, D. C.: Resources for the Future, 1982).
6. Jensen, Marvin E., "Overview-Irrigation in U.S. Arid and Semiarid Lands," OTA commissioned paper, October 1982.
7. Johnson, Stanley S., and Jesse, Edward V., "The Southwest," *Another Revolution in U.S. Farming?* U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, Agricultural Economic Report No. 441, 1979, pp. 362-403.
8. Langrone, William Franklin, "The Great Plains," *Another Revolution in U.S. Farming?* U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, Agricultural Economic Report No. 441, 1979, pp. 335-361.
9. Laycock, William A., Range Ecologist, Ft. Collins, Colo., personal communication, 1983.
10. Schertz, Lyle P., et al., *Another Revolution in Farming?* U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, Agricultural Economic Report No. 441, 1979.
11. Texas Department of Water Resources, *Inventory of Irrigated Acres in Texas*, Report 263, October 1981.
12. Torres, Luis, Program Director, Northern New Mexico American Friends Service Committee, Espanola, N. Mex., personal communication, 1982.