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AUTHOR Day, John C.; Horner, Gerald L.
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ABSTRACT

Data for the years 1974, 1978, 1982, and 1984 are used to identify the principal features of irrigated farming in the United States and to assess the importance of irrigation to the farm economy. Irrigation of U.S. acreage declined 5.6 million acres between 1978 and 1984 to 44.7 million acres. In 1982 irrigated acreage represented 6 percent of the 820 million acres of cropland and pastureland harvested in the contiguous United States. These irrigated lands accounted for about 13 percent of all cropland harvested in 1982, however, and thus contributed 32 percent of the total value of the crops produced that year. Irrigation was used on the entire rice crop; 60 to 70 percent of vegetable, potato, and orchard crops; 53 percent of the sugar beet crop; and 35 percent of the cotton crop. Other crops were irrigated in proportions ranging from 4 to 17 percent. The four western regions (Northern Plains, Southern Plains, the Rocky Mountain, and Pacific areas) accounted for almost 85 percent of all irrigated land. The most rapid increase in the use of irrigation occurred in the Lake States and Corn Belt, where irrigated acreage nearly doubled between 1974 and 1982. Other areas in which the use of irrigation was increasing at a rapid rate included Appalachia (67 percent), the Southeast (73 percent), the Delta States (78 percent), and the Northern Great Plains (52 percent). Irrigation declined 14 percent in the Southern Plains. As of 1984, about 60 percent of all irrigation systems were gravity flow systems, with the remainder being either sprinkler or drip systems. (MN)

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U.S. IRRIGATION: EXTENT AND ECONOMIC IMPORTANCE. By John C. Day and Gerald L. Horner. Resources and Technology Division, Economic Research Service, U.S. Department of Agriculture. Agriculture Information Bulletin No. 523.

ABSTRACT

About 13 percent of U.S. cropland was irrigated in 1982, contributing almost 32 percent of the total value of crops produced. This study describes some of the principal features of the irrigated sector in U.S. agriculture, using data for 1974, 1978, 1982, and 1984. The predominant irrigation States continue to be those in the Pacific and Mountain regions and the Great Plains areas. Irrigation is growing very rapidly in other regions, particularly the Lake States and Corn Belt regions. In the Southern Plains, irrigation since 1974 has declined by about 14 percent. As of 1984, about 60 percent of all irrigation systems were gravity flow, with the balance either sprinkler or drip systems.

Keywords: Irrigation growth, groundwater use, sprinkler systems, regional distribution

1301 New York Avenue, NW.
Washington, DC 20005-4788

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PREFACE

This report describes the principal features of irrigated farming in the United States and presents information on its importance in the farm economy. We do this by briefly sketching the development and growth of U.S. irrigation; summarizing the extent and location of irrigated land, the crops grown with irrigation, current irrigation systems, and the amount of water used; and by comparing gross economic returns per acre for irrigated and dryland crops.

Information about the extent of irrigation is available only periodically through special data collections, such as the census of agriculture and the water use reports of the U.S. Geological Survey, both conducted every 5 years. The 1982 Census of Agriculture is now the most current set of data available consistent with a long time series of census reporting. A special farm and ranch irrigation survey, conducted by the U.S. Bureau of the Census in 1984, helps update information reported in the 1982 Census. As data from the next Census of Agriculture will not be published until 1990, data used here make it possible to present an account of U.S. irrigation using the most current and consistent information available.

IRRIGATION TERMINOLOGY

Acre-foot. One foot of water covering 1 acre of land.

Consumptive use. The quantity of water used and transpired by vegetation plus that evaporated.

Conveyance losses. Loss of water from delivery system during conveyance, including operational losses and losses due to seepage, evaporation, and transpiration by plants growing in or near the channel.

Deep percolation. Water that percolates below the root zone and cannot be used by plants.

Evapotranspiration. The combined loss of water from a given area and during a specific period of time by evaporation from the soil surface and by transpiration from plants.

Ground water. Water in aquifers, commonly referred to as ground water, which is pumped from wells for irrigation.

Ground water aquifer. A geologic formation that transmits water in sufficient quantity to supply the needs for a water development.

Return flow. That portion of the water diverted from a stream that finds its way back to the stream channel either as surface or underground flow.

Surface water. Water of which the surface is exposed to the atmosphere.

CONTENTS

SUMMARY

U.S. irrigated acreage declined 5.6 million acres between 1978 and 1984 to 44.7 million acres. This study describes some of the principal features of the irrigated sector in U.S. agriculture using data for 1974, 1978, 1982, and 1984. In 1982, irrigated acreage represented 6 percent of the 820 million acres of cropland and pastureland harvested in the contiguous United States. About half of U.S. irrigation water comes from ground water sources. In 1980-84, ground water levels declined 1-5 feet per year under 14 million acres of irrigated land. About 60 percent of all irrigation systems were gravity flow by 1984, with the balance either sprinkler or drip systems.

Irrigated cropland made up over 13 percent of total cropland harvested in 1982. All the rice crop, 60-70 percent of the vegetable, potato, and orchard crops, 53 percent of the sugar beet crop, and 35 percent of the cotton crop were then irrigated. Other crops were irrigated in proportions ranging from 4 to 17 percent. The predominant acreage of irrigated crops was in feed and forage crops (corn, hay, pasture) and wheat. The four western regions (Northern Plains, Southern Plains, Mountain, and Pacific) accounted for almost 85 percent of all irrigated land. Most rapid growth in irrigation is occurring in the Lake States and the Corn Belt where irrigated acreage almost doubled between 1974 and 1982. Other areas with rapid growth are Appalachia (67 percent), the Southeast (73 percent), the Delta States (78 percent), and the Northern Great Plains (52 percent). Irrigated acreage grew 12 percent in the Mountain region and 14 percent in the Pacific region during that period, but declined 14 percent in the Southern Plains.

The 13 percent of the U.S. cropland that was irrigated in 1982 contributed almost 32 percent of the total value of crops produced. The irrigated share of total value of crops produced ranged from a low of 0.5 percent for barley and oats to a high of 6.2 percent for orchard crops. The share of total value for other irrigated crops is: corn, 4.5 percent; cotton, 2.5; hay, 3.0; vegetables and melons, 4.5; specialty crops (peanuts, tobacco, beans), 3.1. The individual share of total value in 1982 was less than 2 percent for other irrigated crops, such as sorghum, wheat, rice, soybeans, Irish potatoes, and sugar beets.

U.S. Irrigation

Extent and Economic Importance

John C. Day*
Gerald L. Horner

INTRODUCTION

In 1889, 3.6 million acres, or 0.6 percent, of the 623 million acres of U.S. farmland were irrigated. All irrigated land was located in the arid and semi-arid West, principally California (1 million acres) and Colorado (900,000 acres). About 44.7 million acres of land in farms and ranches are now irrigated (table 1).

In 1889, 54,000 farms irrigated an average of 67 acres, each producing $11.50 per acre in crop value. Over the last century, the average amount of U.S. irrigated land has grown to 210 acres per irrigated farm, and the value of irrigated crop production has increased to about $530 per acre.

Irrigated land area has grown continuously, except for several years during the Great Depression and during 1978-84. The growth rate, however, has been declining for the last 30 years, except for a brief expansionary period in 1969-78. The proportion of irrigated farmland reached its record high of 5 percent in 1978 with approximately 50 million acres. From 1978 to 1984, irrigation acreage declined by about 11 percent with over 85 percent, or 4.3 million acres, of that decline occurring between 1982 and 1984.

A major factor behind the rapid expansion of western irrigation during 1880-1900 was the need for winter feed to sustain the growing cattle industry (2, 8). 1/ The construction of simple low-head dams and stream diversion facilities provided the means for meadow flooding and irrigating hay and other feed crops used as winter feed for both cattle and farmstead livestock. Without winter feed, it is likely that millions of acres of rangeland would have been underused and the feed grain-livestock economy of the Great Plains might never have developed. Thus, irrigation of permanent pasture and production of feed and forage characterized many early farms and ranches. More than half of all irrigated acreage is still used to produce roughage and feed grain crops (fig. 1).

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*Day is an economist with the Resources and Technology Division, Economic Research Service, U.S. Department of Agriculture. Horner is a private consultant, formerly with the Economic Research Service, USDA.

1/ Underscored numbers in parentheses refer to items in the References.

Food grain crops slowly gained in importance as a component in irrigation, rising from a 10-percent share of irrigated acreage in 1889 to a 17-percent share by 1982. As agricultural technology and transportation systems improved and as consumer demand for a wide variety of crops increased, irrigated land increasingly was devoted to specialty crops (tobacco, nuts, fruits, and vegetables). Specialty crops currently occupy 20 percent of all irrigated acreage. But, despite the growing sophistication of irrigated agriculture, over 60 percent of irrigated U.S. land continues to be devoted to the production of roughage and coarse grains for livestock consumption.

THE RECENT PICTURE

The following section summarizes the current extent of irrigation, the types of irrigation technology used, and the estimated amount of water used in agriculture.

Table 1--U.S. farmland growth, selected years 1/

Year	Farmland 2/	Irrigated farmland 3/	Share of farmland irrigated	Acreage irrigated per farm irrigated	Change in irrigated acreage	Average annual growth in irrigated acreage
	----Million acres----		Percent	Acres	Million acres	Percent
1889	623	3.6	0.6	67	NA	NA
1900	839	7.5	.9	70	3.9	10.8
1910	879	14.4	1.6	89	6.9	9.2
1920	956	19.2	2.0	83	4.8	3.3
1930	987	19.5	2.0	74	.3	1.6
1939	1,065	18.0	1.7	60	-1.5	-.8
1949	1,161	25.8	2.2	84	7.8	4.3
1959	1,123	33.0	3.0	108	7.2	2.8
1969	1,063	39.0	3.7	152	6.0	1.8
1978	1,014	50.3	5.0	168	11.7	3.0
1982	987	49.0	4.9	176	-1.3	-.5
1984	na	44.7	na	210	-4.3	-2.1

NA = Not applicable.
na = Not available.

1/ Various estimates of irrigated U.S. land acreage are available. These estimates often differ because of differences in definition, time periods, and statistical bases. For a discussion on irrigated acreage data, see (1).

2/ Farmland includes agricultural land used for crops, pasture, or grazing. It also includes woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it is part of the farm operator's total operation.

3/ Does not include double-cropped land.

Source: (8, 10).

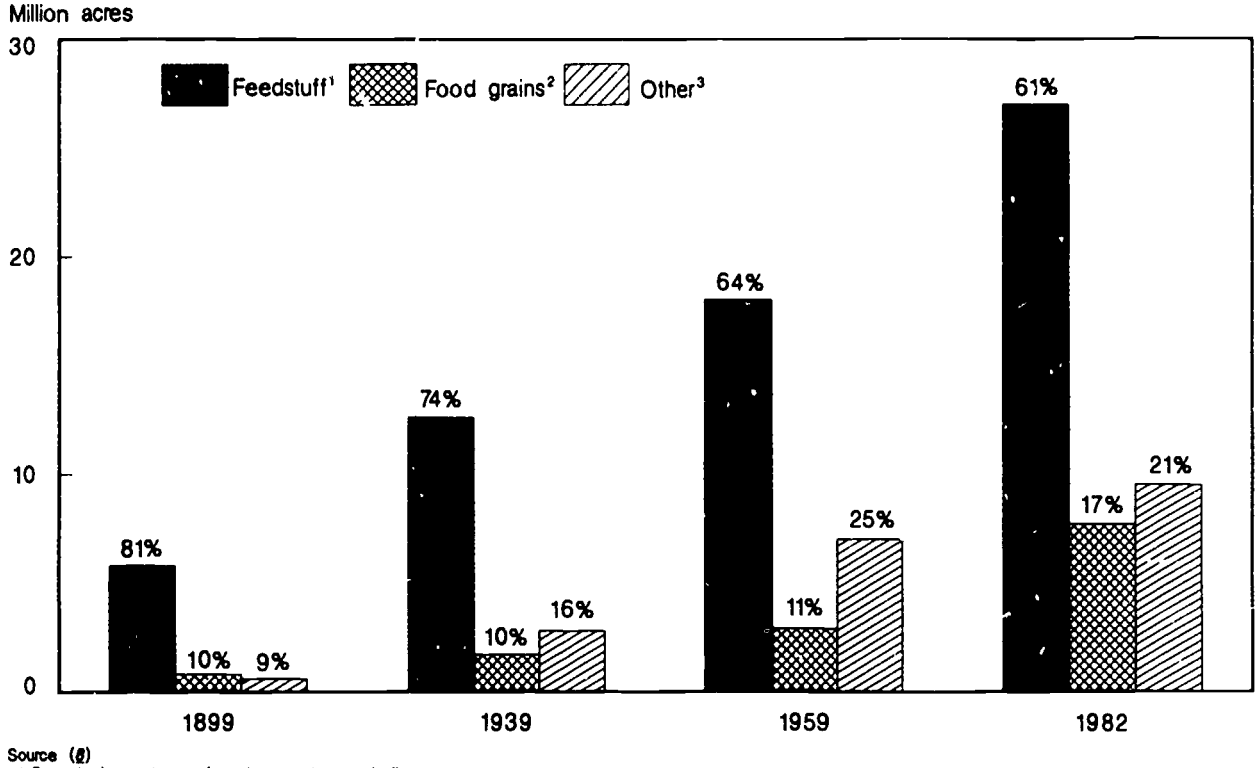
Irrigated Cropland and Pastureland

In 1984, about 44.7 million acres of land harvested in crops and pasture in the contiguous United States were irrigated, down from the 1982 totals presented in table 2. 2/ Most U.S. crops receive at least some irrigation in some locations; however, irrigation is practiced much more extensively for some crops than for others. All the rice crop, 60-70 percent of the vegetable, potato, and orchard crops, 53 percent of the sugar beet crop, and 35 percent of the cotton crop were irrigated in 1982, the latest year for which comparisons and nonirrigated acreage can be made. Irrigated cropland made up over 13 percent of total cropland in 1982.

Corn and hay were the most extensively irrigated crops, making up 19 percent and 17 percent of irrigated crop acreage in 1982 (table 2). Wheat and pasture were also widely irrigated. The share of total irrigated acreage for all other crops ranged from about 1 percent to 9 percent, with most falling at 5 percent or less. Thus, even in 1982, the predominant irrigated crops in terms of acreage were feed and forage crops (corn, hay, pasture) and wheat.

2/ Alaska and Hawaii combined had less than one-tenth of 1 percent of irrigated U.S. acreage in 1982. These two areas are excluded from the analysis.

Figure 1
Irrigated acreage by crop group



Source (8)
1/ Corn, barley, oats, sorghum, hay, pasture, and silage
2/ Wheat and rice.
3/ Cotton, sugar, peanuts, tobacco, soybeans, vegetables, and orchards

Regional Distribution of Irrigated Cropland

The 10 crop-producing regions displayed in figure 2, combining States with similar growing conditions, are convenient units of analysis for describing the distribution of irrigated U.S. crops.

Six regions accounted for almost 96 percent of irrigated cropland in the 48 States in 1982: Mountain, Pacific, Northern Plains, Southern Plains, Delta States, and the Southeast (table 3). 3/ The four western regions

3/ Irrigated pasture, as opposed to irrigated cropland, is a relatively minor component in land use, making up less than 1 percent of all farmland in 1982.

Table 2--Harvested irrigated cropland and pastureland, 1982 1/

Item	Irrigated acreage	Share of crop irrigated	Share of total irrigated
	1,000 acres	Percent	
Cropland: 2/			
Corn	9,604	12.3	19.3
Sorghum	2,295	17.0	4.6
Wheat	4,650	6.6	9.3
Barley and oats	2,098	11.8	4.2
Rice	3,233	100.0	6.5
Cotton	3,424	35.0	6.9
Soybeans	2,321	3.6	4.7
Irish potatoes	812	64.0	1.6
Hay	8,507	15.0	17.1
Vegetables and melons	2,024	60.7	4.1
Orchard crops	3,343	70.4	6.7
Sugar beets	550	53.2	1.1
Other 3/	2,428	17.9	4.9
Subtotal 4/	45,289	13.4	91.0
Pastureland	4,499	.9	9.0
Total 4/	49,788	6.1	100.0

1/ Contiguous United States.
2/ Cropland is land in farms used for crops.
3/ Includes peanuts, dry tobacco, edible beans, and the minor acreage crops of rye, flax, sunflower, sugarcane, and dry edible peas.
4/ Figures may not add due to rounding. Irrigated cropland total includes 932,000 acres of double-cropped land.

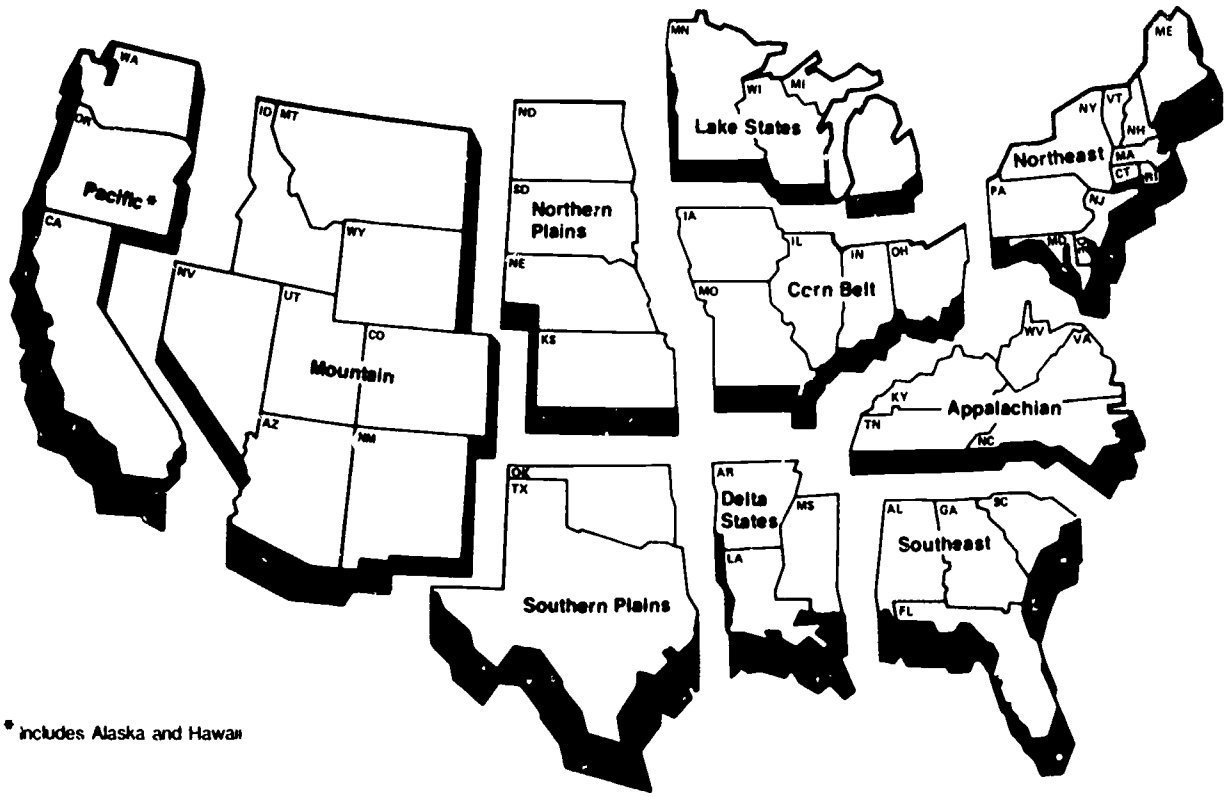
Source: (8).

(Northern Plains, Southern Plains, Mountain, and Pacific) account for almost 85 percent of irrigated U.S. cropland. Irrigation is much less prevalent in humid areas, but supplemental irrigation is expanding rapidly, particularly in the Lake States and the Corn Belt, as farmers are learning to augment rainfall to improve planting schedules and reduce weather risks (table 3). Rapid growth of irrigation in the Southeast is largely due to expansion in Georgia. Recent growth in the Delta area is due to increases in irrigated acreage in Mississippi and Arkansas.

The proportion of irrigated cropland differs markedly among regions due primarily to differences in weather, rainfall, the availability and cost of irrigation water, and the resulting comparative advantage of irrigated versus dryland production practices. Low rainfall alone is not the primary reason for irrigation. For example, the Southeastern and Delta States generally receive much more rainfall during the growing season than do the Northern Plains, yet a higher proportion of cropland in those areas is irrigated. On the other hand, in the dry Mountain and Pacific regions, the situation is closer to what one would expect: 44 percent of all cropland within the Mountain region is irrigated, while the figure is 60 percent in the Pacific region. California dominates irrigation in the Pacific region and accounted for 72 percent of the region's irrigated cropland in 1982. (See app. table 1 for State-level data on irrigated cropland.) Irrigated

Figure 2

Farm Production Regions



* Includes Alaska and Hawaii

acreage increased during 1974-82 in most regions. The greatest recent growth rate has been in the East. The only area where irrigation declined was the Southern Plains, where ground water supplies, the primary source of irrigation water, are being depleted.

Public Versus Private Irrigation Programs

Principal Federal involvement in irrigation has been through the U.S. Bureau of Reclamation (BuRec). BuRec was established to facilitate western settlement by developing water supplies for irrigation as specified in the Reclamation Act of 1902. It has carried out an extensive effort since that time to construct and maintain the necessary dams, reservoirs, and water distribution systems. The BuRec program is limited to the 17 Western States (see app. table 2).

In 1982, 10.9 million acres of land received irrigation water from BuRec projects and produced about $7.3 billion in gross value of output (table 4).

Table 3--Irrigated cropland by region, 1982 1/

Region	Irrigated cropland	Acreage change, 1974-82	Share of irrigated cropland	Share of total regional cropland
	1,000 acres		Percent	
Northeast	280	16.5	0.6	2.1
Lake States	859	186.3	1.9	2.2
Corn Belt	841	186.1	1.9	1.0
Appalachia	167	67.0	.4	.9
Southeast	2,119	73.1	4.7	15.7
Delta States	3,224	78.4	7.1	17.4
Northern Plains	9,322	52.4	20.6	12.5
Southern Plains	5,777	-14.1	12.8	18.8
Mountain	11,872	11.7	26.2	44.0
Pacific	10,827	13.8	23.9	59.5
United States 2/	45,289	22.6	100.0	13.4

1/ Contiguous United States.
2/ Figures may not add due to rounding.

Source: (8).

These figures represented about one-fifth of all irrigated land in the 48 States and about one-third of the value of all irrigated output.

The BuRec irrigation program significantly contributes to the gross crop value of irrigated production, even though the private sector dominates irrigated agriculture. Federal (BuRec and Bureau of Indian Affairs), State, and local organizations provided water to about 10.3 million acres, or 20 percent of irrigated cropland in 1978, the latest year for which national data exist on irrigation organizations (8, 11). Private organizations and individuals served the rest.

Today's Irrigation Technology

The main types of irrigation systems used today are the traditional gravity flow systems and the more modern sprinkler systems. A more accurate way to describe the newer technology is "pressurized system," but the term "sprinkler" is commonly used as a general reference covering a number of different types of pressurized pieces of equipment. Included in the sprinkler category are center pivots, side-roll units moved either mechanically or by hand, permanent sprinklers, permanently mounted "guns," and a variety of drip systems.

Table 4--Harvested acreage and gross crop values through BuRec's irrigation program, 1982 1/

Crop	Acreage		Crop value	
	Total	Share of crop irrigated	Total	Share of crop irrigated
	1,000 acres	Percent	Million dollars	Percent
Cereals 2/	3,290	6.6	930.4	3.9
Forage 3/	3,499	7.0	930.1	3.9
Miscellaneous field crops 4/	1,951	3.9	1,287.0	5.3
Vegetables	863	1.7	1,603.1	6.7
Seeds	215	.4	117.3	.5
Fruits	814	1.6	1,948.6	8.1
Nuts	222	.5	287.9	1.2
Other 5/	43	.1	183.8	.8
Total 6/	10,897	21.9	7,288.2	30.3

1/ Contiguous United States.
2/ Barley, corn, oats, rice, sorghum, and wheat.
3/ Hay, pasture, and silage.
4/ Cotton, beans, sugar beets, soybeans, hops, peppermint, and spearmint.
5/ Nursery and family gardens and orchards.
6/ Figures may not add due to rounding.

Source: (11).

The sprinkler system's principal feature, compared with gravity systems, is its more precise means of water distribution. Water can be delivered to plants exactly when, where, and in the amounts needed for optimum plant growth. Sprinklers can also be used on a much wider variety of land types. Gravity systems are restricted to certain soil types, land slopes, and irrigation system configurations.

Initial investment costs for sprinkler systems are high, but more efficient use of water on a crop-by-crop basis is possible. Thus, sprinkler systems have encouraged an expansion in farming activity in areas where water is relatively expensive and expansion might not otherwise be economically feasible. By reducing the risk of drought, sprinklers have moved cropping practices away from dryland production in some locations, such as the Southern Plains and parts of the Southeast.

Adoption of sprinkler irrigation has been rapid since World War II, growing from 640,000 acres in 1949 to 18.7 million acres in 1979. Sprinkler irrigation doubled from 3.4 to 7.2 million acres during 1959-69, compared with the average annual increase of 16 percent during 1969-78 (3, 9). Sprinkler irrigation acreage declined about 2 percent during 1979-84, according to the most recent data (table 5).

The four largest sprinkler irrigation States are Nebraska, California, Texas, and Idaho. Sprinkler acreage in these States makes up about half of U.S. sprinkler acreage (table 5). Forty percent of U.S. irrigated land receives water through some type of sprinkler system (table 6). Drip and trickle irrigation together make up about 3 percent of all irrigated agreage. Gravity systems still predominate in the West, which has 88 percent of all gravity systems. The West also claims about 82 percent of U.S. sprinkler irrigation.

Sprinkler irrigation in the East, about 18 percent of all irrigation, supplements rainfall and has led to better timing and scheduling of planting operations for traditional crops and to new double-cropping possibilities. For example, wheat acreage expansion and double-cropping wheat with soybeans in the Southeast are largely a result of the better water management practices of sprinkler technology. Because of the growth in the new technology in this region, gravity systems are no longer the predominant irrigation systems in the humid East.

Agricultural Water Use

Agriculture is the second largest water user in the Nation following the industrial sector. Irrigation uses 33 percent of all water withdrawn from U.S. surface and ground water supplies and about 80 percent of nonindustrial freshwater withdrawals (table 7).

The rate of increase in irrigation water use has declined since 1975. Of the 150 billion gallons per day (170 million acre-feet per year) used in irrigation in 1980, 55 percent, or 83 million acre-feet, was consumptive use, primarily evapotranspiration and deep percolation. Agriculture is the Nation's largest consumptive water user. Conveyance losses (16 percent) and return flows (29 percent) accounted for the remaining 45 percent of irrigation withdrawals (6). Table 8 shows estimates of water applications among the major irrigated crops.

Ground water use has increased in all agricultural regions. About 45-50 percent of all water used in irrigation comes from ground water aquifers (6, 10). The Mountain and Pacific regions together made up over 50 percent of all ground water withdrawals in 1980. The Pacific region used the most ground water (table 9).

Table 5--Sprinkler irrigation, 1984 1/

Region and State	Acreage	Share of total	Acreage change, 1979-84
	Acres	Percent	
East:			
Arkansas	172,157	0.9	93.8
Florida	860,293	4.7	30.9
Louisiana	88,352	.5	200.0
All other	2,204,601	12.0	6.5
Subtotal	3,325,403	18.1	16.8
West:			
Arizona	124,701	.6	-35.5
California	2,439,355	13.3	4.8
Colorado	1,127,574	6.5	-13.3
Idaho	1,774,447	9.7	12.2
Kansas	950,794	5.2	-.6
Montana	629,458	3.4	23.1
Nebraska	3,067,434	16.7	-8.3
Nevada	135,726	.7	-1.8
New Mexico	229,289	1.3	5.0
North Dakota	100,279	.5	43.0
Oklahoma	240,377	1.3	5.4
Oregon	896,857	4.9	-6.3
South Dakota	226,184	1.2	-20.6
Texas	1,387,216	7.6	-29.5
Utah	318,905	1.7	17.9
Washington	1,155,582	6.3	-3.6
Wyoming	208,530	1.1	-26.1
Subtotal	15,012,708	81.9	-5.3
Total	18,338,111	100.0	-1.9

1/ Contiguous United States.

Source: (9, 10).

Table 6--Irrigated farmland by region and type of irrigation, 1984 1/

Item	Irrigated farmland	Share of irrigated U.S. farmland	Share of irrigated regional farmland
	1,000 acres	Percent	
East	6,697	14.6	100.0
Gravity 2/	3,372	12.3	50.4
Sprinkler 3/	3,325	18.1	49.6
West	39,098	85.4	100.0
Gravity	24,085	87.7	61.6
Sprinkler	15,013	81.9	38.4
United States	45,795	100.0	NA
Gravity	27,457	60.0	NA
Sprinkler	18,338	40.0	NA

NA = Not applicable. 1/ Contiguous United States. 2/ Includes gated pipe, ditches with siphon tubes, flooding, and subirrigation. 3/ Includes center pivot, mechanical move, hand move, solid sprinklers, and drip and trickle irrigation.

Source: (10).

Table 7--Water withdrawals by major uses 1/, 2/

Item	1975	1980	Share of 1980 total	Change 1970-75	Change 1975-80
	Billion gallons --- per day ---		Percent		
Public supply	29	34	8	8	15
		(7)	(7)		
Rural domestic and livestock	5	6	1	10	14
		(4)	(4)		
Irrigation	140	150	33	11	7
		(83)	(80)		
Self-supplied industrial	245	260	58	13	6
		(10)	(9)		
Total	420	450	100	12	8
		(104)	(100)		

1/ Contiguous United States. 2/ Figures in parenthesis refer to consumptive use.

Source: (6).

Continual pumping depletes ground water levels beneath more than 14 million acres of irrigated land at an annual rate of between 1-5 feet (5). Table 10 shows the areas of decline for the 11 major ground water irrigation States, and table 11 shows crops grown in these areas.

ECONOMIC IMPORTANCE OF IRRIGATION

Irrigation generally increases the volume and value per acre of agricultural output compared with what is possible under dryland conditions. The higher crop yields associated with irrigation largely explain these increases. Irrigation may also improve product quality and thereby increase the price received. But this price difference is a minor part of the overall contribution of irrigation to output value.

Table 8--Estimated water applications for selected irrigated crops, 1982 1/

Crop	Average application rate	Irrigated acreage	Estimated water use	Share of total water used
	Acre-feet per acre	1,000 acres	Million acre-feet	Percent
Corn	1.5	9,604	14.4	19
Sorghum	1.2	2,245	2.7	4
Wheat	1.4	4,650	6.5	9
Barley and oats	1.6	2,098	3.4	5
Rice	2.9	3,233	9.4	13
Cotton	2.1	3,424	7.2	10
Soybeans	.8	2,321	1.9	2
Irish potatoes	1.9	812	1.5	2
Hay	2.1	8,507	17.9	24
Vegetables and melons	2.2	2,024	4.5	6
Orchard crops	1.2	3,343	4.0	5
Sugar beets	2.6	550	1.4	2
Total 2/	NA	45,289	74.8	100

NA = Not applicable.
1/ Contiguous United States.
2/ Figures may not add due to rounding.

Source: (8, 10).

Table 9--Ground water withdrawals for irrigation, 1980 1/

Region	Ground water withdrawals	Share of total
	1,000 acre-feet	Percent
Northeast	119	--
Lake States	338	--
Corn Belt	517	--
Northern Plains	13,543	20
Appalachia	61	--
Southeast	2,250	3
Delta States	5,950	9
Southern Plains	8,720	13
Mountain	15,730	23
Pacific	21,250	31
Total	68,478	100

-- = Less than 1 percent.
1/ Contiguous United States.

Source: (6).

Table 10--Acreage irrigated in areas with declining ground water supplies, by major ground water irrigation States, 1980-84 1/

State	Total area irrigated with groundwater	Ground water decline area 2/:	Share of total area irrigated from declining ground water aquifers
	1,000 acres		Percent
Arizona	938	606	65
Arkansas	2,337	425	18
California	4,265	2,069	48
Colorado	1,660	590	36
Florida	1,610	250	16
Idaho	1,450	225	15
Kansas	3,504	2,180	62
Nebraska	7,025	2,039	29
New Mexico	805	560	70
Oklahoma	645	523	81
Texas	6,685	4,565	73
Total	30,924	14,032	45

1/ Contiguous United States.
2/ Areas with at least one-half foot average annual decline.

Source: (5).

Table 11--Estimated acreage of irrigated crops in areas of ground water decline, 1982 1/

State	Alfalfa	Cotton	Corn	Citrus	Grapes	Grain sorghum
			1,000 acres			
Arizona	104	211	--	--	--	57
Arkansas	--	3	--	--	--	--
California	242	613	87	--	258	--
Colorado	44	--	315	--	--	56
Florida	--	--	--	200	--	--
Idaho	52	--	--	--	--	--
Kansas	122	--	664	--	--	542
Nebraska	64	--	1,456	--	--	123
New Mexico	136	72	55	--	--	96
Oklahoma	37	17	31	--	--	181
Texas	115	1,108	568	--	--	1,019
Total	916	2,024	3,176	200	258	2,074

State	Peanuts	Rice	Small grain	Other	Total
			1,000 acres		
Arizona	--	--	180	54	606
Arkansas	--	261	--	161	425
California	--	--	295	573	2,068
Colorado	--	--	73	102	590
Florida	--	--	--	50	250
Idaho	--	--	108	65	225
Kansas	--	--	683	169	2,180
Nebraska	--	--	44	352	2,039
New Mexico	--	--	126	75	560
Oklahoma	26	--	213	18	523
Texas	25	133	1,029	568	4,565
Total	51	394	2,751	2,187	14,031

-- = No irrigated crops.
1/ Contiguous United States.

Source: (5).

Irrigated Versus Dryland Crop Yields

National average differences in dryland and irrigated yields for some crops are substantial (table 12). For others, the effect of irrigation seems small. In 1982, irrigated yields averaged 50 percent higher than dryland yields. But, for some crops (namely, wheat and cotton), irrigated yields were about twice as high as dryland yields. However, the difference between irrigated yields and dryland yields is partially due to higher levels of other inputs common to irrigated farming.

The Role of Irrigation in U.S. Crop Production

One way to look at the role of irrigation in crop production is to compare the irrigated share of total crop acreage and value. This can be done on a

Table 12--Average irrigated and dryland yields, 1982 1/

Item	Units	Dryland yields (1)	Irrigated yields (2)	Ratio 2/ (2)÷(1)
Corn for grain	Bushels	106.0	122.1	1.15
Sorghum for grain	do.	53.6	78.0	1.46
Wheat	do.	31.8	64.3	2.02
Barley	do.	48.2	78.0	1.62
Oats	do.	55.0	68.7	1.25
Rice	Hundredweight	NA	47.9	NA
Cotton	Bales	.9	1.7	1.89
Soybeans	Bushels	30.7	34.1	1.11
Irish potatoes	Hundredweight	83.2	310.2	1.69
Hay (alfalfa)	Tons	2.7	4.1	1.52
Sugar beets	do.	17.9	22.8	1.27
Peanuts	Pounds	2,578.1	2,821.5	1.12
Tobacco	do.	1,991.8	2,147.6	1.03
Dry edible beans	Hundredweight	12.3	17.2	1.40

NA = Not applicable.

1/ Contiguous United States.

2/ The ratios of irrigated yields to dryland yields must not be interpreted as a situation where all other things are equal. National averages may mask significant yield differences in certain locations due to differences in local climatic conditions and farming practices.

Source: (8).

crop by crop basis, or on the basis of an irrigated crop compared with its share of total U.S. crop acreage and value. For example, the share of total corn acreage and value attributed to irrigated corn gives one an indication of the role of irrigation in U.S. corn production, while the share of U.S. crop production in total attributed to irrigated corn indicates the role of irrigated corn in national crop production. One can compare the average per acre value of irrigated production with the average value per acre of rainfed production. These comparisons (table 13) give an indication of added returns associated with irrigation. However, as indicated, any differences due to increased productivity of irrigated land may also be due to greater use of other inputs in addition to water.

For many crops, the proportion irrigated was very high; for example, 70 percent for orchard crops. In all cases, the share of crop value for irrigated land equaled or exceeded the irrigated share of acreage. For example, irrigated corn made up 12.3 percent of total corn acreage but contributed 17.2 percent to the value of the total corn crop. Thus, irrigated area contributed more per acre to the gross value of crop output than did dryland acres.

Irrigated acreages' share of total crop value (for the 48 States) exceeds its share of total acreage. That is, the 13 percent of the total cropland area that was irrigated contributed almost 32 percent of the total value of output.

Although irrigation can add significantly to the per acre crop value on an individual basis, no one irrigated crop adds greatly to the total value of national crop production. For example, table 13 indicates that irrigated rice accounts for 100 percent of the total value of rice output but contributes 1.7 percent to the value of national production of all crops. Irrigated sugar beets contribute almost 80 percent to the total value of the sugar beet crop but a mere 0.6 percent to the value of all crop output. This relationship stems from the fact that either irrigated acreage of a crop is a small percentage of national cropland acreage (for example, soybeans), or relatively lower priced crops are produced (hay, barley, oats).

Table 13 also shows that the gross value of irrigated crop production is sometimes two to three times higher per acre than is rainfed production. In some cases, particularly for the fruits, vegetables, and tree crops, this difference is no doubt due to more favorable weather during the growing season as found in the Pacific and Mountain regions, where irrigation is so predominant. But, irrigation water is only one factor; irrigation farmers tend to apply greater amounts of other inputs such as fertilizer and pesticides than do rainfed farmers.

Given current water application rates (see table 8), large quantities of water apparently are applied to many crops that add little to sector returns at the national level. However, only a portion of the water applied in any given situation is "consumed;" that is, only a portion of irrigation water is lost to the local hydrologic cycle in the form of deep percolation, evaporation, and transpiration. The rest is returned to surface and ground water supplies to be reused often on other fields and other crops. Thus, the table 8 application rates may overstate the amount of water actually consumed by a particular crop.

Table 13--Irrigated cropland: Acreage and value by crop, 1982 1/

Crop	Acreage			Value				
	Irrigated	Share of crop irrigated	Share of total cropland 2/	Irrigated	Irrigated share of crop value	Irrigated share of total crop value 3/	Irrigated value per acre	Rainfed value per acre
	1,000 acres	------Percent-----		Million dollars	-----Percent-----		-----Dollars-----	
Corn	9,604	12.3	2.8	3,440	17.2	4.5	358	235
Sorghum	2,295	17.0	.7	901	53.2	1.2	393	66
Wheat	4,650	6.6	1.4	1,144	16.7	1.4	246	84
Barley and oats	2,098	11.8	.6	375	20.0	.5	179	93
Rice	3,233	100.0	1.0	1,226	100.0	1.7	379	NA
Cotton	3,424	35.0	1.0	1,883	58.4	2.5	549	200
Soybeans	2,321	3.6	.7	491	4.4	.6	211	17
Irish potatoes	812	64.0	.2	1,261	81.7	1.7	1,553	546
Hay	8,507	15.0	2.5	2,275	27.7	3.0	267	120
Vegetables and melons	2,029	60.7	.6	3,375	79.7	4.5	1,663	591
Orchard crops	3,343	70.4	1.0	4,732	85.1	6.2	1,415	502
Sugar beets	550	53.2	.2	491	77.7	.6	893	262
Other crops 4/	2,428	17.9	.7	2,424	25.4	3.1	998	638
Total 5/	45,289	NA	13.4	24,047	NA	31.8	531 6/	176 6/

NA = Not applicable.

1/ Contiguous United States.

2/ This is the share each irrigated crop represents of the total acreage of crops produced in the 48 States in 1982.

3/ This is the share each irrigated crop represents of the total value of crops produced in the 48 States in 1982.

4/ Includes peanuts, tobacco, dry edible beans, and the minor acreage crops rye, flax, sugarcane, and dry edible pears.

5/ Includes about 932,000 acres of double-cropped land. Figures might not add to due to rounding.

6/ Average weighted by acreage.

Source: (8).

Regional Crop Values

The economic value of crop output generated by irrigation is largely determined by the amount of land irrigated, the type of crop grown, and the crop prices received. The total value of irrigated output is much larger in the West than in the East. Much more land is irrigated in the West, and a greater amount of that land is used to produce higher valued fruits, vegetables, and nuts. Thus, the distribution of gross returns to irrigated crop production is not uniformly distributed among U.S. agricultural regions.

The Pacific share of total value clearly shows that region's significance as a producer of high-valued crops (table 14). Producers there accrued about 42 percent of the value of all irrigated crop production within the 48 States in 1982. The Mountain region, the next leading producing area, is far below the Pacific region with a 16-percent share, even though irrigated acreage is about 10 percent greater.

This disparity between acreage and value is due to the higher proportion of speciality crops grown in the Pacific region compared with those in the Mountain areas. A similar relationship holds for the Northern Plains where, relatively speaking, a considerable amount of land is irrigated. However, the crops grown tend to be the lower priced food and feed grains. Large quantities of land are irrigated in the Southern Plains, Delta States, and Southeast, but the regional value shares are low largely because of the small percentage of total irrigated land devoted to the higher priced commodities.

Regional shares are generally quite small in terms of the contribution of irrigated land to the value of total crop production. The Pacific region is an exception. Although the region's irrigated cropland is only 3 percent of the Nation's cropland, that area contributes more than 13 percent to the Nation's value of crop output.

We can see the regional productivity of irrigated land by comparing the percentage of irrigated land within the region with its percentage of regional crop value. In the Pacific region, for example, the 59 percent of the cropland which is irrigated produces almost 90 percent of the region's crop value. The ratio of percentage of value to percentage of acreage generally ranges from 1.5 to 3 for all regions, except for the Northeast and Appalachia. In the Northeast, the value to acreage ratio is about 11 because about 66 percent of all irrigated land is used to produce high-valued vegetable, orchard, nursery, and berry crops. The same is true in Appalachia, where about 20 percent of the irrigated land is devoted to vegetable and orchard crops (yield responsive and higher priced crops) and wheat (yield responsive), and about 40 percent to tobacco (higher priced). Irrigated land in the region contributes about six times as much to crop output value than the acreage alone would suggest.

Table 14--Irrigated crops: Harvested area production value, and irrigated crop shares by region, 1982 1/

Region	Irrigated acreage	Production value	Regional share of irrigated value	Irrigated area's share of regional-- Cropland acreage	Irrigated area's share of regional-- Crop value	Irrigated area's share of 48 States'-- Cropland acreage	Irrigated area's share of 48 States'-- Crop value
	1,000 acres	Million dollars	Percent				
Northeast	280	448	1.9	2.1	11.0	--	0.6
Lake States	859	573	2.2	2.2	7.5	0.2	.7
Corn Belt	841	378	1.6	1.0	2.0	.2	.5
Appalachia	167	333	1.4	.9	6.0	--	.4
Southeast	2,119	2,251	9.4	15.6	43.8	.6	3.0
Delta States	3,224	1,124	4.7	17.3	29.3	.9	1.5
Northern Plains	9,322	2,742	11.4	12.5	28.6	2.7	3.6
Southern Plains	5,777	2,123	8.8	18.7	48.6	1.7	2.8
Mountain	11,872	3,922	16.3	43.8	73.4	3.5	5.2
Pacific	10,827	10,152	42.2	59.2	88.6	3.2	13.4
United States 2/	45,289	24,047	100.0	NA	NA	13.4	31.8

-- = Negligible
NA = Not applicable.
1/ Contiguous United States.
2/ Figures might not add due to rounding. Total irrigated acreage includes 932,000 acres of double-cropped land.

Source: (7, 8).

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Appendix table 1--Distribution of irrigated cropland and pastureland, 1982

Region/State	Acreage	Share of total
	Million acres	Percent
Mountain	14.2	29.0
Montana	2.1	15.0
Idaho	3.5	24.0
Wyoming	1.5	11.0
Colorado	3.2	22.0
New Mexico	.8	6.0
Arizona	1.1	8.0
Utah	1.1	8.0
Nevada	.8	6.0
Pacific	11.9	24.0
Washington	1.5	13.0
Oregon	1.8	15.0
California	8.6	72.0
Northern Plains	9.3	19.0
North Dakota	.2	2.0
South Dakota	.4	4.0
Nebraska	6.0	65.0
Kansas	2.7	29.0
Southern Plains	6.1	12.0
Oklahoma	.5	1.0
Texas	5.6	11.0
Delta States	3.1	7.0
Mississippi	.4	1.0
Arkansas	2.0	4.0
Louisiana	.7	2.0
Southeast	2.4	5.0
South Carolina	.1	.2
Georgia	.6	1.2
Florida	1.6	3.3
Alabama	.1	.2
Total	47.0	96.0

Source: (8).

Appendix table 2--Distribution of BuRec-irrigated acreage, 1982

State	Irrigated acreage	Farms receiving BuRec water
	1,000 acres	Number
California	3,838	42,691
Idaho	1,514	14,506
Colorado	1,140	10,807
Washington	940	16,927
Nebraska	503	3,089
Oregon	474	12,588
Wyoming	394	11,346
Utah	360	10,401
Montana	350	3,506
Arizona	307	7,910
Texas	252	4,243
New Mexico	206	7,433
Nevada	172	4,154
South Dakota	75	322
Oklahoma	40	159
Kansas	34	648
North Dakota	32	327
Hawaii	4	164
Total	10,635	151,221

Source: (11).