

# U.S. CENSUS OF AGRICULTURE : 1959

*Final Report—Vol. III*

## ORGANIZATIONS

### FARMS AND ACREAGE IRRIGATED

### INVESTMENT • WATER USED • COST

# The United States

## IRRIGATION OF AGRICULTURAL LANDS

*Prepared under the supervision of*  
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U.S. DEPARTMENT OF COMMERCE

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## PREFACE

Volume III: Irrigation of Agricultural Lands presents all available data for the 1959 Census of Irrigation.

The 1959 Census of Irrigation covered irrigation only in the 17 conterminous Western States, Louisiana, and Hawaii. This report presents some summary data on irrigated land for the same area, obtained in the 1959 Census of Agriculture.

The 1959 Census of Irrigation was taken in conformity with the Act of Congress of August 31, 1954 (amended August 1957), which was codified Title 13, United States Code.

Most of the data presented in the report were collected by mail. Reports for irrigation enterprises with operations limited to a drainage basin area for which reports could not be obtained by mail were secured by census enumerators.

The planning of the census was performed by Hugh H. Hansen and Henry L. DeGraff, Irrigation Economists, under the supervision of Ray Hurley, Chief, Agriculture Division. Census enumerators worked under the supervision of Robert B. Voight, then Chief of the Field Division. Reports of irrigation enterprises with operations in more than one drainage basin were obtained by John Zimmer, Raymond Anderson, and Wayne Ehlers of the Agricultural Research Service of the U.S. Department of Agriculture, working as special agents of the Bureau of the Census. The compilation of the statistics was under the supervision of Henry L. DeGraff. George Coffman reviewed most of the tabulations and the statistical tables. Maps accompanying this report were prepared under the supervision of William T. Fay, Chief of the Geography Division, Bureau of the Census. This report was written by Henry L. DeGraff, Irrigation Economist, Warder B. Jenkins, Assistant Chief, Agriculture Division, and Ray Hurley, Chief of the Agriculture Division.

October 1962.

III

# UNITED STATES CENSUS OF AGRICULTURE: 1959

## FINAL REPORTS

**Volume I—Counties**—A separate part for each State, Puerto Rico, Guam, Virgin Islands, and American Samoa. Statistics on number of farms; farm characteristics; acreage in farms; cropland and other uses of land; land-use practices; irrigation; farm facilities and equipment; farm labor; farm expenditures; use of commercial fertilizer; number and kind of livestock; acres and production of crops; value of farm products; characteristics of commercial farms, farms classified by tenure, size, type, and economic class; and comparative data from the 1954 Census.

Part	State or States	Part	State or States	Part	State or States	Part	State or States
1	New England States:	15	West North Central:	30	East South Central:	44	Mountain—Con.
2	Maine.	16	Minnesota.	31	Kentucky.	45	Utah.
3	New Hampshire.	17	Iowa.	32	Tennessee.	46	Nevada.
4	Vermont.	18	Missouri.	33	Alabama.	47	Pacific:
5	Massachusetts.	19	North Dakota.	34	Mississippi.	48	Washington.
6	Rhode Island.	20	South Dakota.	35	West South Central:	49	Oregon.
7	Connecticut.	21	Nebraska.	36	Arkansas.	50	California.
8	Middle Atlantic States:	22	Kansas.	37	Louisiana.	51	Alaska.
9	New York.	23	South Atlantic:	38	Oklahoma.	52	Hawaii.
10	New Jersey.	24	Delaware.	39	Texas.	53	Other Areas:
11	Pennsylvania.	25	Maryland.	40	Mountain:	54	American Samoa.
12	East North Central:	26	Virginia.	41	Montana.		Guam.
13	Ohio.	27	West Virginia.	42	Idaho.		Puerto Rico.
14	Indiana.	28	North Carolina.	43	Wyoming.		Virgin Islands.
	Illinois.	29	South Carolina.		Colorado.		
	Michigan.		Georgia.		New Mexico.		
	Wisconsin.		Florida.		Arizona.		

**Volume II—General Report**—In 1 volume and also as 13 separates (for the Introduction and for each chapter). Statistics by subjects for 1959 and prior censuses. Statistics are presented for the United States, geographic regions, and divisions, and for the States.

Chapter	Title	Chapter	Title
I	Introduction.	VII	Field Crops and Vegetables.
II	Farms and Land in Farms.	VIII	Fruits and Nuts, Horticultural Specialties, Forest Products.
III	Age, Residence, Years on Farm, Work Off Farm.	IX	Value of Farm Products.
IV	Farm Facilities, Farm Equipment.	X	Color, Race, and Tenure of Farm Operator.
V	Farm Labor, Use of Fertilizer, Farm Expenditures, and Cash Rent.	XI	Economic Class of Farm.
VI	Size of Farm.	XII	Type of Farm.
	Livestock and Livestock Products.		

**Volume III—Irrigation of Agricultural Lands**—Data from the Irrigation Censuses of 1959 and 1950, by drainage basins, for the conterminous United States and for each of the 17 western States and Louisiana. Separate maps are available. Report also includes data from the 1959 Census of Agriculture for land irrigated and acres and production of crops on irrigated land in the 18 conterminous States and Hawaii.

**Volume IV—Drainage of Agricultural Lands**—Statistics for States and counties and for the conterminous United States, presenting 1960 data on number, area, physical works, and costs for drainage projects of 500 or more acres by size, type, and year organized. Maps are included.

### Volume V—Special Reports

**Part 1.—Special Census of Horticultural Specialties**—Statistics for States, except Alaska and Hawaii, and for the conterminous United States, presenting 1959 data on number and kinds of operations, gross receipts and/or sales, sales of specified products, inventories, employment, and structures and equipment.

**Part 2.—Irrigation in Humid Areas**—Statistics for 30 eastern States showing 1960 data on acres irrigated, number of constructed ponds and reservoirs, source and method of applying water, type of pumping power, acreage of individual crops irrigated, and frequency of irrigation by States and counties.

**Part 3.—Ranking Agricultural Counties**—Statistics for selected items of inventory and agricultural production for the leading counties in the United States.

**Part 4.—Farm Taxes and Farm Mortgage**—A cooperative report by the Economic Research Science, U.S. Department of

Agriculture and the Bureau of the Census, U.S. Department of Commerce, presenting 1961 data by States on taxes on farms, number of mortgaged farms operated by full owners and part owners, amount of mortgage debt held by principal lending agencies, and amount of interest paid.

**Part 5.—1960 Sample Survey of Agriculture**—Statistics by economic class and type of farm, showing 1960 data on farm-operator-family income from farm and off-farm sources; inventory and use of selected types of farm equipment, tractors by year made and fuel used; number, size, and materials used for new buildings constructed 1958 to 1960; number of farmers having contracts with dealers, processors, or others for the production and marketing of 15 farm products; and real estate and non-real-estate debts of farm operators and farm landlords by lending agencies.

**Part 6.—A Graphic Summary of Agriculture, 1959**—A cooperative report by the Economic Research Service, U.S. Department of Agriculture and the Bureau of the Census, U.S. Department of Commerce, presenting graphically for 1959 and prior census years some of the significant uses of agricultural land; the extent and nature of the various kinds of tenure under which farms are held and operated; and changes and developments in the use of agricultural resources and production of agricultural products.

**Special Publication—Principal Data-Collection Forms and Procedures: United States Census of Agriculture, 1959, and Related Surveys**—Facsimiles of the enumeration forms used, showing variations for the 50 States, Puerto Rico, American Samoa, Guam, and the Virgin Islands, together with brief descriptions of the census field procedures for the census and the related surveys.

# CONTENTS

## INTRODUCTION

History of census collection of irrigation data.....	IX
Legal basis for the 1959 Censuses of Agriculture and Irrigation.....	XI

### PRESENTATION OF STATISTICS

Census of agriculture data.....	XI
Other published data.....	XII
Census of irrigation data.....	XII
Maps showing irrigated areas by drainage basins.....	XV
Identification of drainage basins.....	XVI

### ENUMERATION FORMS AND PROCEDURES

Introduction.....	XVI
Organizations included.....	XVI
Questionnaires.....	XVII
Enumerator drainage basin maps.....	XVIII
The enumeration.....	XVIII

### PROCESSING OPERATIONS

Completion of enumeration.....	XVIII
Preliminary checking.....	XVIII
Editing and coding.....	XVIII
Tabulation of data.....	XIX

### DEFINITIONS AND EXPLANATIONS

Irrigation defined.....	XIX
Irrigated land.....	XIX
Census definition of a farm.....	XIX
Land in farms according to use.....	XIX
Cropland harvested.....	XIX
Cropland used only for pasture.....	XX
Cropland not harvested and not pastured.....	XX
Cultivated summer fallow.....	XX
Cropland used only for soil-improvement crops.....	XX
Other cropland not harvested and not pastured.....	XX
Woodland pastured.....	XX
Woodland not pastured.....	XX
Other pasture.....	XX
Improved pasture.....	XX
All other land.....	XX
Irrigated farms.....	XX
Irrigation organization.....	XX
Farm area reported served by organizations.....	XXI
Area reported irrigated by organizations.....	XXI

### DEFINITIONS AND EXPLANATIONS—Continued

Water users served, total.....	XXI
Farm irrigation water users.....	XXI
Residential water users.....	XXI
Other water users.....	XXI
Source of water.....	XXI
Conveyed water from surface sources within basin.....	XXII
Water entering conveyance systems.....	XXII
Conveyed water from ground sources within basin.....	XXII
Release of water from reservoirs.....	XXII
Water from other organizations in the basin.....	XXII
Water from natural sources within basin.....	XXII
Water from another drainage basin.....	XXII
Total water leaving conveyance systems.....	XXII
Conveyance loss in basin.....	XXIII
New capital investment, 1950-1959.....	XXIII
Type of organization.....	XXIII
Mutual or cooperative organizations.....	XXIII
District organizations.....	XXIII
United States Bureau of Reclamation organizations.....	XXIV
United States Bureau of Indian Affairs organizations.....	XXIV
Water from other sources.....	XXIV
Size of organization.....	XXIV
Comparability of data for prior censuses and for the census of agriculture.....	XXIV
Quantity of water by drainage basins, 1959 and 1950.....	XXIV
Farms or farm water users supplied by irrigation organizations and the number of farms reporting water received from irrigation organizations.....	XXIV
Acres irrigated as shown by census of irrigation and census of agriculture.....	XXV
Irrigation in Hawaii.....	XXV

### SUMMARY

Irrigated land in farms.....	XXVI
Sources of irrigation water.....	XXVII
Irrigated farms.....	XXVIII
Irrigation organizations.....	XXIX
Types of irrigation organizations.....	XXIX
Interrelationships between irrigation organizations.....	XXIX
Size of organization.....	XXIX
Capital investment.....	XXIX
Farms by extent of irrigated crops.....	XXIX
Importance of crop production on irrigated land.....	XXX
Relation of water used for irrigation and other purposes.....	XXXII

### CHARTS

Acres of irrigated land for the 17 Western States and Louisiana.....	XXV
Acres of irrigated land by major drainage basins in the 17 Western States and Louisiana: 1959 and 1949.....	XXVII
Percentage distribution of total acres irrigated, by source of water, by States: 1959.....	XXVII
Irrigated acreage of specified crops and pasture in the 17 Western States and Louisiana: 1959.....	XXXI

### MAPS

Location of major drainage basins in the 17 Western States and Louisiana.....	XIII
Location of submajor drainage basins for which intrastate tables are presented.....	XIV
Location of submajor drainage basins for which interstate tables are presented.....	XV
Irrigated land in farms.....	XXVI
Farms with irrigation.....	XXVIII
Irrigated land as a percent of all land in farms, 1959.....	XXX

## CONTENTS

## SUMMARY TABLES

## Summary table—

	Page
1.—Irrigated farms—number and acreage irrigated by divisions and States: Censuses of 1959, 1954, and 1950.....	2
2.—Irrigated farms—all land and irrigated land classified according to use: Censuses of 1959 and 1954.....	3
3.—Farms reporting and acres of land and selected crops—irrigation for 18 States: 1959.....	7
4.—Irrigation crop summary—farms reporting, acreage, production, and value of production for 18 specified States: 1959 and 1954.....	8
5.—Specified crops irrigated—farms reporting, acreage, and production, 1959, 1954, and 1949; and quantity sold, 1959; for 19 specified States.....	10
6.—Number of farms, irrigated farms, land irrigated, number of irrigation organizations, and land irrigated by irrigation organizations: 1890 to 1959.....	28
7.—Number of irrigation organizations and acreage irrigated by type of organization: 1920 to 1959.....	30
8.—Number and characteristics of irrigation organizations, by drainage basins: Censuses of 1959 and 1950.....	35
9.—Land irrigated by source of water, by drainage basins: Census of 1959.....	40
10.—Number and characteristics of irrigation organizations, by type of organization, type of service, quantity of water delivered per acre, and size of organization, by drainage basins: Censuses of 1959 and 1950.....	46
11.—Number and characteristics of irrigation organizations, by States: Censuses of 1959 and 1950.....	64
12.—Land irrigated by source of water, by States: Census of 1959.....	66
13.—Organizations reporting, quantities of irrigation water obtained from specified sources, and water lost in conveyance: 1959 and 1949.....	68
14.—Capital investment in irrigation organizations, 1959, 1950, and 1940; and new capital investment, 1940 to 1959.....	69
15.—Organizations reporting by type of service to water users and acre-feet delivered: 1959.....	70
16.—Number of organizations classified by number of farms provided with water: 1959 and 1949.....	70
17.—Number and characteristics of irrigation organizations, by type of organization, type of service, quantity of water delivered per acre, and size of organization, by States: Censuses of 1959 and 1950.....	71
18.—Number and characteristics of irrigation organizations, by type of organization, by size of organization, and new capital investment: Censuses of 1959 and 1950.....	77
19.—Number of irrigation organizations, type of service, new capital investment, and water conveyed, by size of organization: Census of 1959.....	79
20.—Organizations reporting quantities of irrigation water delivered direct to farms and to other organizations, 1959 and 1949; for uses other than irrigation, 1959; and average quantity of water delivered to farms per acre of irrigated land, 1959, 1949, and 1939.....	80

## STATE TABLES

## State table—

- 1.—Number and characteristics of irrigation organizations, by drainage basins: Censuses of 1959 and 1950
- 2.—Number and characteristics of irrigation organizations, by type of organization, type of service, quantity of water delivered per acre, and size of organization, by drainage basins: Censuses of 1959 and 1950
- 3.—Land irrigated by source of water, by drainage basins: Census of 1959
- 4.—Number and characteristics of irrigation organizations, by type of organization, by size of organization, and new capital investment, by drainage basins: Censuses of 1959 and 1950
- 5.—Number of irrigation organizations, type of service, new capital investment, and water conveyed, by size of organization, by drainage basins: Census of 1959

State	State tables					State	State tables				
	1	2	3	4	5		1	2	3	4	5
	Page	Page	Page	Page	Page		Page	Page	Page	Page	Page
Arizona.....	82	85	87	88	92	New Mexico.....	248	252	255	256	266
California.....	94	102	105	106	118	North Dakota.....	270	271	273	274	276
Colorado.....	122	130	133	134	152	Oregon.....	278	283	286	287	297
Idaho.....	158	163	166	167	179	South Dakota.....	300	301	303	304	306
Kansas-Oklahoma.....	184	185	187	188	190	Texas.....	308	311	314	315	321
Louisiana.....	192	194	196	197	199	Utah.....	324	329	332	333	345
Montana.....	202	208	211	212	222	Washington.....	350	353	356	357	365
Nebraska.....	226	228	230	231	233	Wyoming.....	368	374	377	378	390
Nevada.....	236	239	241	242	246						

## APPENDIX

Questionnaires.....	394
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# INTRODUCTION

(VII)





# INTRODUCTION

## 1959 CENSUS OF IRRIGATION

Data regarding irrigation were collected from two sources for the 1959 Censuses of Agriculture and Irrigation.

In the 1959 Census of Agriculture, information about irrigation was collected directly from farm operators regarding acres irrigated, and for 19 States regarding crops irrigated and source of water. The inquiries for the census of agriculture for the 17 conterminous Western States, Louisiana, and Hawaii were as follows:

213. Of the total land in this place (reported in question 203), how many acres were irrigated *this year*? . . . . . None ☐ Acres \_\_\_\_\_  
(If "None," mark X and skip to question [218].)

214. How many acres in this place were irrigated by sprinklers *this year*? . . . . . None ☐ Acres \_\_\_\_\_

215. From how many acres of irrigated land were crops harvested *this year*? . . . . . None ☐ Acres \_\_\_\_\_  
(Be sure to include all irrigated land from which hay was cut and all irrigated land in both bearing and nonbearing fruit and nut crops and irrigated land from which volunteer crops were harvested.)  
(If "None," mark X and skip to question [217].)

216. What part of the land from which crops were harvested *this year* was irrigated? . . . . . All ☐ Part ☐  
(If "All," mark X and skip to question [217].)  
(If "Part," give below name and acres irrigated for each crop. If all orchard was irrigated, list "Orchard," and if all vegetables for sale, list "Vegetables.")

Name of crop irrigated?	Acres irrigated?	Name of crop irrigated?	Acres irrigated?
(1)		(3)	
(2)		(4)	

[217] What percent of the irrigation water used on this place *this year* was obtained—

- (a) From a well (pumped or flowing) or spring directly by this farm or from another farm? . . . . . %
  - (b) From a stream, lake, drainage ditch, or reservoir directly by this farm or from another farm? . . . . . %
  - (c) From a mutual or cooperative water or ditch company, irrigation district, or other irrigation organization? (Give name below.) . . . . . %
- (The total for questions (a), (b), and (c) must=100%.)

Name \_\_\_\_\_ Name \_\_\_\_\_

The inquiries for the 30 remaining States (except Alaska) were as follows:

213. Of the total land in this place (reported in question 203), how many acres were irrigated *this year*? . . . . . None ☐ Acres \_\_\_\_\_

A special survey was made in 1960 for farms for which land irrigated was reported in the 1959 Census of Agriculture for these 30 States. This survey obtained information regarding source of water, method of irrigation, type of power used for pumping, crops irrigated, constructed reservoirs, and year irrigation was started. The results of this survey appear in Volume V, Part 2: "Irrigation in Humid Areas" of the reports for the 1959 Census of Agriculture.

Data regarding the irrigation operations were obtained from irrigation organizations. With few exceptions, the 1959 Census of Irrigation included only organizations which supplied water to two or more farms. This enumeration included the 17 conterminous Western States, Louisiana, and Hawaii. Three questionnaires were used in 1959 to enumerate irrigation organizations. These three forms requested the same basic information but differed according to the type of organization each was designed to enumerate. Facsimile copies of these questionnaires are shown in the appendix of this report. A more complete discussion of each questionnaire including its purpose, is given on page XVII.

**History of census collection of irrigation data.**—Inquiries relating to irrigation of farm and ranch lands in the United States have been included in each decennial census of agriculture beginning with 1890 and for each mid-decennial census of agriculture beginning with 1935. The 1890 general questionnaire for the census of agriculture, used in all States and territories, contained one inquiry to obtain the total acreage irrigated on each farm and another to obtain the number of artesian wells flowing. Other facts were obtained by direct correspondence and special schedules addressed to each irrigator. The 1890 report (Volume V of the Eleventh Census of the United States) presented a limited amount of irrigation data for 16 States or territories in the western part of the United States, listed, for discussion purposes, under two groupings, viz, arid region and subhumid region. The arid region embraced a part or the whole of 8 States—California, Colorado, Idaho, Montana, Nevada, Oregon, Washington, and Wyoming—and the whole of 3 territories—Arizona, New Mexico, and Utah. The subhumid region embraced parts of 5 States, viz, North Dakota, South Dakota, Nebraska, Kansas, and Texas. The statistics presented in the 1890 report showed 3,631,381 acres had been irrigated in 1889 on 54,136 farms. Irrigation of Indian reservation lands was not included.

In the 1900 Census of Agriculture, two inquiries relating to irrigation of farm and ranch lands were carried, for all States and territories. These two inquiries classified the number of acres irrigated in 1899 according to whether the irrigation water came from natural streams or from pumped or artesian wells. Statistics were presented separately, first, for three groupings of States and territories, viz, arid States which corresponded to the similarly designated grouping in 1890; semiarid States which, with the addition of Oklahoma, comprised the 1890 grouping under subhumid States; and the humid States. (See Volume VI, Part II, of the Twelfth Census of the United States.) The latter grouping, for the 1900 report, was made up of four New England States, the three Middle Atlantic States, and Florida. Irrigation carried out on Indian reservations was excluded. The 1900 report acknowledged that watering of market gardens, even those of considerable size, often was not reported as irrigation.

Recognition was taken of the fact that many acres of irrigated rice, except for Texas, had not been included in the totals for the three main groupings of States. (Rice irrigation in Texas really began about 1897, the industry receiving great impetus from the success of the planters in southwestern Louisiana.) Therefore, some separate data were presented in the 1900 report for irrigated rice farms in Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina as well as for Texas. A few figures were presented for irrigated sugarcane, rice, and other crops produced in the Hawaiian Islands. The report for that year contained these observations in respect to rice. "The collection of statistics of irrigation in the Southern States, especially of those relating to the irrigation of rice, has been attended with many difficulties. In the coast counties rice is reported as grown with and without irrigation, and in many instances the yield per acre is nearly the same. To determine the extent of irrigation, correspondence with the planters was necessary, but . . . results are not satisfactory. The data concerning the large plantations

were quite fully reported, and upon these the census figures are based, no account having been taken of many small plantations growing rice from which no special reports were received."

A joint resolution of Congress, approved June 30, 1902, provided for the collection of data on irrigation for the crop year 1902. Questionnaires were mailed to irrigators reported in the 1900 Census of Agriculture and to officials of important canal companies. The statistics received by mail were supplemented by field work in a few States and by a limited amount of information from other sources. The data obtained were tabulated by drainage basins in order, so it was reported, that a better knowledge may be had of the extent of use of these waters. (See Census Bulletin 16, "Irrigation in the United States: 1902," published in 1904.) The 1902 Special Census included the same 11 arid States and territories, 6 semiarid States, 8 humid States, and 6 rice-growing States for which data were presented in the 1900 report. Irrigators in the Hawaiian Islands were not canvassed for the 1902 Special Survey of Irrigation.

Beginning with 1910, a special census of irrigation has been taken, decennially, in the United States. The law relating to the first of these special irrigation censuses provided that the inquiry should cover "the arid region of the United States." The "arid region" was held to include all sections of the United States where irrigation is commonly practiced in the growing of farm crops. The 1910 Special Census of Irrigation included the western part of the tier of States formed by the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, and all States and territories between these States and the Pacific Ocean. Hawaii and the other insular possessions were not covered. Under a broad interpretation, the 1910 Special Census of Irrigation was extended to the rice-growing districts of Louisiana, Texas, and Arkansas. A special questionnaire pertaining to irrigation enterprises was prepared and the data were collected by special agents. This irrigation questionnaire was designed to secure more detailed information than was called for by the general questionnaire for the census of agriculture carried by the enumerators who were charged with collecting data in respect to individual farms and the population. The latter enumerators, in areas using water for irrigation, made use of a supplemental irrigation schedule. (See Volumes V, VI, and VII of the reports of the Thirteenth Census for irrigation data for 1910, from both the special irrigation census and from the general census.)

For 1920, the basic plan for gathering irrigation statistics provided that the census of agriculture enumerators, in all States, would obtain a few facts in regard to land to which water had been supplied, for agricultural purposes, by artificial means or by seepage from canals, reservoirs, or other irrigated lands. A cross (X) was required to be placed before the name of each crop irrigated. In the 17 most westerly States—Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming—and also in Arkansas and Louisiana, this same general class of enumerators were instructed to obtain an irrigation schedule for each enterprise supplying water to fewer than 5 farms. Special agents were employed to obtain, in the 19 listed States, irrigation schedules for the larger enterprises and, after the regular enumeration had been completed, for any small ones missed by the general census enumerators. After 1910, rice growing became quite important in California. Since the area devoted to that crop, in that State, is not geographically separated from other lands used for growing irrigated harvested crops or irrigated pasture, all data related to rice growing in the 19 listed States, were consolidated for the first time, in the Fourteenth Census reports with the data for other irrigated lands. (See Volume VII of the reports of the Fourteenth Census.)

The first mid-decennial census of agriculture was taken in 1925. No inquiries were made for the 1925 census to identify irrigated land or irrigated crops. In each subsequent mid-decennial census, some data in regard to irrigation have been obtained, though not necessarily published, for each State, in the general census of agriculture.

In the 1930 census, irrigation statistics were gathered in a manner closely similar to that followed ten years earlier. The census of agriculture enumerator, regardless of the State in which he was working, was required to obtain a few facts for irrigated cropland (not total irrigated land) and to identify any harvested crop wholly or partially irrigated. For each harvested crop, partially grown on dryland, provision was made to list separately the dryland acres and production. The census of agriculture enumerator, in the same 19 States covered in the 1910 and 1920 Censuses of Irrigation, was required to fill a relatively simple questionnaire for individual, partnership, and cooperative enterprises serving one to four farms. For enterprises of other types, and partnership and cooperative enterprises serving more than four farms, a more elaborate questionnaire and special enumeration procedure were used. United States Government enterprises were reported direct to the Bureau of the Census by the Commissioner of the Bureau of Reclamation and the Commissioner of the Bureau of Indian Affairs, the separate reports being prepared by local division or project engineers under the supervision of these officials. Reports for others of the group of larger enterprises were obtained by mail. The mail canvass preceded the work of the enumerators, which permitted census supervisors to detail conveniently located enumerators who had performed good work in reporting the smaller enterprises, to the enumeration of enterprises which had not already been covered by reports obtained by mail. Finally, such enterprises for which reports had been obtained neither by mail nor through the regular enumerators were canvassed by special enumerators. (See "Irrigation of Agricultural Lands," one of the 1930 Census of Agriculture reports.)

In the 1935 Census of Agriculture, only one inquiry in regard to irrigation appeared on the questionnaire for the general census of agriculture. This one question was designed to obtain the total acreage from which irrigated crops were harvested in 1934. (See Volume III of the 1935 Census of Agriculture reports for data for irrigation for all States.) The publication of irrigation data for each State, as presented in the summary report for the 1935 Census of Agriculture has been continued for each succeeding census. Sometimes all of the available data have been presented in the summary report for the census of agriculture while for other years, when a special census of irrigation was conducted, some of the data appear in the summary report for the census of agriculture and the remaining in the special report dealing with irrigation.

In the 1940 Census of Agriculture, the total acreage of land from which irrigated crops were harvested and the total acreage of irrigated land used only for pasture or grazing were secured in all States. In the 17 most westerly States and in Arkansas and Louisiana, the irrigated area was also obtained for many of the individual crops. No provision was made on the questionnaire for showing separately the total production of a crop harvested from irrigated land. However, the tabulation plan provided for a separation of the acreage and production of the farms reporting a crop wholly irrigated and of the farms reporting a crop wholly nonirrigated. A limited amount of data was also tabulated for irrigated farms in Florida. (See Volume I, Volume III, and "Irrigation of Agricultural Lands" of the 1940 Census of Agriculture reports for irrigation data obtained in the 1940 general census of agriculture; also see Volume III for some historical data beginning with those for 1890.) The special census of irrigation for 1940 was conducted in Florida in addition to the 19

States referred to above. In the 1935 Census of Agriculture, 2,751 farms in Florida had been recorded as having 65,832 acres of irrigated farm and ranch land in 1934. These were larger totals than shown for any State other than those included in the designated 18 irrigation States covered in several special censuses of irrigation. (In the 1940 report "Irrigation of Agricultural Lands," statistics were presented for 19 States as one group while those for Florida were summarized with any available data presented for the group of humid States.)

The questionnaire for the 1945 Census of Agriculture contained this inquiry: "Total land in this farm irrigated in 1944." Provision was made, in the reporting form for the 19 irrigation States, for the enumerator to identify, with a check mark, crops harvested from irrigated land. However data collected in the 1945 Census of Agriculture on irrigation were not published because of their incompleteness. (See page XXVII of Volume II of the 1945 Census of Agriculture reports.) The incompleteness seemed to be more general in areas where irrigation was not widely practiced. Later, after a review of the tabulated totals for each county and some editing to correct the most likely cases of incomplete enumeration, a six-page pamphlet was issued, presenting a comparison of 1945 and 1940 census totals. This special report gave county data for farms reporting irrigated land and acres of irrigated land. However, data for counties with less than 100 acres irrigated in 1944 were consolidated in each State under the heading "All other counties." In the 1950 summary report of the census of agriculture (see pages 11, 62, and 63 of Volume II of the 1950 Census of Agriculture reports), the State totals for 1945 were published and are compared with data for prior censuses. In the 1950 Census of Agriculture, data were obtained on total land irrigated in 1949 and on acres irrigated by sprinklers. Additional data in respect to irrigation were obtained for 20 States, the 17 Western States, Arkansas, Louisiana, and Florida. The additional information obtained included a classification of the total irrigated land into four categories according to use, viz, irrigated cropland harvested, irrigated wild grass pasture, irrigated tame grass pasture, and irrigated cropland not harvested and not pastured; and information as to the specific crops irrigated and the supplier of the irrigation water. (See Volumes I, II, and III of the 1950 Census of Agriculture reports for these data.) In the 1950 Census of Irrigation, two questionnaires were used. One was used for the enumeration of irrigation enterprises operated by farms individually and the other for irrigation companies, districts, and other enterprises not operated by individual farms. The enterprises operated by individual farms were enumerated at the same time that the other census information for farms was obtained, by census of agriculture enumerators who receive special training for the enumeration of the irrigation enterprises. Enumeration of the irrigation enterprises that supplied 10 or more farms was accomplished in advance of the enumeration of the census of agriculture through the employment of specially qualified irrigation technicians—mostly professional employees of the Soil Conservation Service of the United States Department of Agriculture. Lists of enterprises serving 10 or more farms had been compiled, in part, from the reports collected in the 1940 Census of Irrigation. Another list, made currently while the census of agriculture enumeration was being conducted, was the principal source for the names of enterprises that supplied water for two to nine farms. These latter enterprises were enumerated by special enumerators trained and supervised by the irrigation technicians. (See Volume III: "Irrigation of Agricultural Lands" of the 1950 Census of Agriculture reports for statistics and their comparability with those from prior censuses.)

For the 1954 Census of Agriculture, several inquiries were used to obtain irrigation data in the 17 conterminous Western States and in Arkansas, Florida, Louisiana, and southeastern Missouri. For all of these areas, the inquiries related to the 1954 acreage

of irrigated land from which crops were harvested and the names of the crops for which the entire acreage harvested was irrigated in 1954. The area of irrigated pasture was also obtained except in Arkansas, Louisiana, and southeastern Missouri. In the remaining 27 States and Missouri except for southeastern counties in Missouri, the questionnaire called for only the total acres irrigated in 1954. For the 17 conterminous Western States and for Arkansas, Florida, and Louisiana, the published data included the total land in farms reporting irrigation, the land in farms classified by use, and, except for Arkansas and Louisiana, the irrigated portion of land in farms classified as to whether an irrigated crop had been harvested or the land had been used for pasture only. For these 20 States, data for irrigated and non-irrigated crops were published. For the other 28 States, the published data for irrigation were limited to the farms reporting and the total acres of land irrigated. (See Volumes I and II of the 1954 Census of Agriculture reports for all published data gathered on the 1954 questionnaire.) Because of increasing interest in the subject of irrigation in the humid areas, a special survey in cooperation with the United States Department of Agriculture was made in 1955 in the 28 Eastern States. (See Part 6 of Volume III, Special Reports, 1954 Census of Agriculture, for the kind of information gathered.)

**Legal basis for the 1959 Censuses of Agriculture and Irrigation.**—The 1959 Censuses of Agriculture and Irrigation were authorized by an Act of Congress, as were all similar prior censuses. "Title 13, United States Code—Census," codified in August 1954, and amended in August 1957 and September 1960, is now the legal basis for censuses of agriculture and other censuses, and surveys conducted by the Bureau of the Census. Section 142 paragraph (a) made provision for a census of agriculture and paragraph (b) for a census of irrigation. These sections read as follows:

"142. Agriculture, Irrigation, and Drainage.

- (a) The Secretary shall, beginning in the month of October 1959, and in the same month of every fifth year thereafter, take a census of agriculture, provided that the censuses directed to be taken in October 1959 and each tenth year thereafter, may, when and where deemed advisable by the Secretary, be taken instead in conjunction with the censuses provided in Section 141 of this title. (Section 141 relates to the decennial censuses of population, unemployment, and housing to be taken as of the first day of April of each decennial year.)
- (b) The Secretary shall, in conjunction with the census of agriculture directed to be taken in October 1959 and each tenth year thereafter, take a census of irrigation and drainage."

## PRESENTATION OF STATISTICS

The principal purpose of this report is to present all of the available data obtained in the 1959 Census of Irrigation. However, many of the data obtained in the 1959 Census of Agriculture are included so as to furnish more complete data not only for the Western States but also to bring together in one volume most of the data for all States and for the United States. This report also presents data obtained in previous censuses, both those for the census of irrigation and for the census of agriculture. Generally, the data from only one of these censuses are presented in a table. However, in a few cases, data from both censuses are in the same table.

**Census of agriculture data.**—Data from the census of agriculture are provided to indicate the extent of irrigation and to provide measures of the use of irrigation water for the production of various farm products. Summary table 1 shows, for each of the 50 States, exclusive of Alaska, the number of irrigated farms and the total area irrigated for the censuses of 1959, 1954, and 1950. Summary table 2 shows, for each of the 17 conterminous Western States and Louisiana, a classification of the land in farms according to use, as obtained in both the 1959 and 1954 censuses. Additional data are given for those farms, in each State, which reported all harvested crops as having been grown under irriga-

tion. Figures are given in summary table 2 for the two groups of irrigated farms (1) those which used any irrigation water and (2) a smaller but significant total for farms on which all crops were harvested from irrigated land.

A full analysis of census-collected irrigation data must take into account the kinds of individual crops to which water was applied; the proportion of the total acreage of each crop which was irrigated; the proportion of the total production which was grown under irrigation; and the average yields obtained with and without irrigation. Such data are given in summary tables 4 and 5. The first of these, summary table 4, provides a summarization by the kind of crops harvested in 1959 for 18 irrigation States, with available comparable totals for crops harvested in 1954. Figures are given, for many of the principal crops harvested, showing the number of farms which irrigated the entire acreage of a crop, with its acres, production, and value of production. These figures represent totals for farms on which all the crop harvested was irrigated.

The data for irrigated crops presented in summary table 4 do not represent the total acreage of the various crops irrigated. The data relate only to the acreage and production of crops on those farms on which the entire acreage of the crop harvested was irrigated. For example, if the total acreage of corn harvested on a farm were 40 and all 40 acres were irrigated, then the entire 40 acres of corn was included in the total for irrigated. However, if only 10 out of the 40 acres of corn harvested were irrigated, then the totals given in summary tables 4 and 5 do not include the 10 acres of corn irrigated. In such cases, the entire 40 acres of corn was included in the total for nonirrigated. However, data are given in summary table 3 showing the total acreage of each crop irrigated on farms where only part of the acreage in a crop was irrigated.

Census of agriculture data, as to total acres irrigated and acres irrigated from ground and surface sources, are included in summary tables 11 and 12 and in summary table 9.

Data for the census of irrigation are presented by States and by drainage basins. In some tables, data are presented by drainage basins within States. In the presentation of data when only a few organizations were serving within a State, State totals only are given. If only a few irrigation organizations operated in a given drainage basin, totals for the area are not shown separately but are combined with those for another basin. Somewhat similar procedures are followed in the presentation of data by type of organization or size of organization measured by total acre-feet of water conveyed.

The tables for individual States present data, on an intrastate basis, for each separately delineated drainage basin within a State. These basins may be minor basins, or submajor basins depending on the extent to which drainage basins within a State have been delineated for the purpose of presenting data. Totals are given for each grouping of basins into the next larger drainage basin unit and for the State. The tables containing totals for the

18-State area present data for larger drainage basin units on an interstate basis. Submajor drainage basins are the smallest unit for which data are shown. In both intrastate and interstate tables, if there were less than 3 organizations in one or more of the basins, combinations of the data were made so that the two basins together made a fairly homogeneous unit. In the intrastate tables for Colorado, data are given separately for the north and south parts of submajor basin IV-D.

**Other published data.**—Volume I of the reports for the 1959 Census of Agriculture contains for each State and for each county, detailed data on irrigation as follows:

**County Table 1a.**—Number, acreage, land in farms classified by use, acreage irrigated by sprinklers, irrigated farms classified by acres irrigated, and land irrigated by source of water.

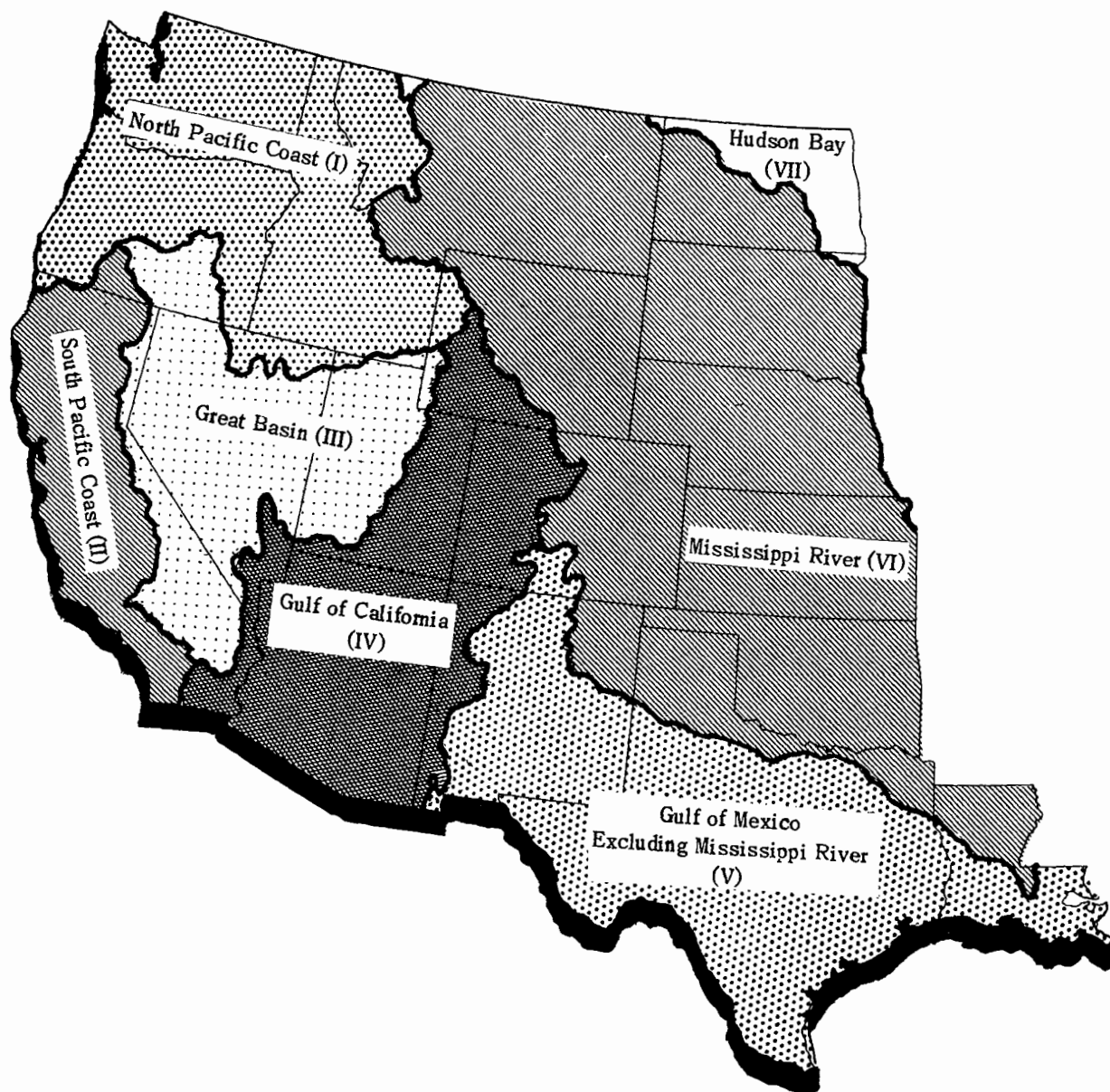
**County Table 11a.**—Farms reporting, acreage, and quantity of crops harvested from irrigated land. Figures are given for acres and quantity harvested for farms for which the entire harvested acreage of the crop was irrigated. For farms on which only part of the harvested acreage of the crop was irrigated, figures are given for farms reporting and acres, but not for quantity harvested.

**Census of irrigation data.**—Census of irrigation data are presented for the States covered by the 1959 Census of Irrigation, i.e., for the 17 conterminous Western States, and Louisiana. Data are not given separately for Oklahoma, as only two irrigation organizations were recorded in that State. To avoid disclosure of individual operations, Oklahoma figures have been combined with those for Kansas.

Drainage basin data provide the basis for a comprehensive analysis of irrigation organizations and their characteristics and development as well as measures of the relative importance of the principal streams as sources of water supply. Therefore, the statistics were assembled by drainage basins, and such geographic areas are extensively utilized herein for data presentation. Since drainage basin boundaries do not usually coincide with State lines, figures may be presented either on an intrastate or an interstate basis. Some tables contain data compiled on both bases. Since the irrigated area in a drainage basin may have received water from another drainage basin, data are shown in three of the tables regarding the interbasin transfers of water.

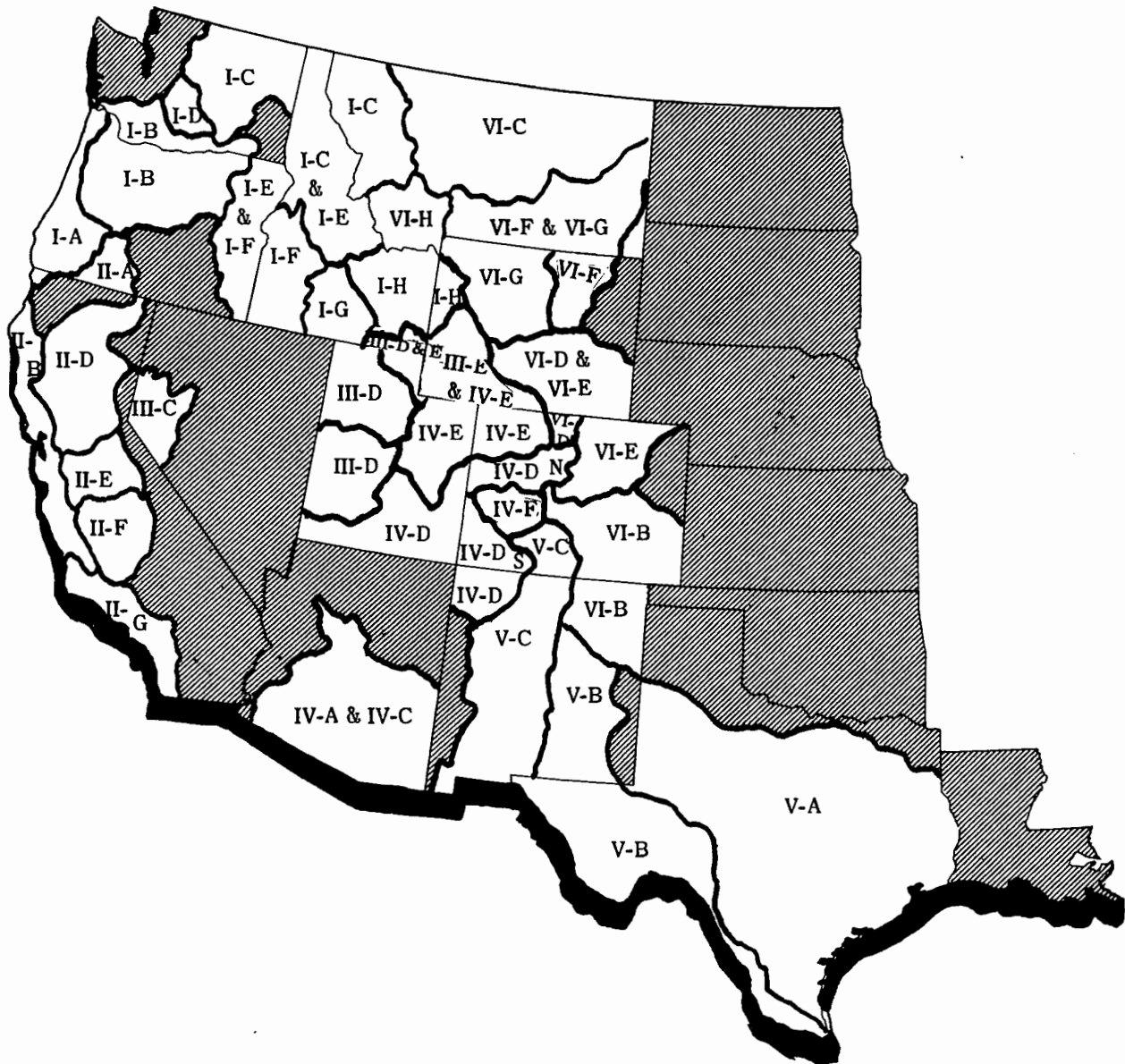
For convenience of reference, the drainage basins by which the data are presented have been identified in the tables and on the maps by a uniform system of symbols. Major drainage basins are designated by Roman numerals, submajor basins (subdivisions of the major drainage basins) by capital letters, parts or tributaries of the submajor basins by Arabic numerals, and further subdivisions by small letters. Thus, the number II-D 5c represents the drainage basin of the Yuba River (subminor basin c) which is part of the drainage area of the Feather River (minor basin 5) which is a tributary of the Sacramento River (submajor basin D) which is part of the South Pacific Coast drainage basin (major basin II). Parts of basins designated as the basin "direct" include tributaries not shown separately.

## LOCATION OF MAJOR DRAINAGE BASINS IN THE 17 WESTERN STATES AND LOUISIANA





**LOCATION OF SUBMAJOR DRAINAGE BASINS FOR WHICH INTRASTATE  
TABLES ARE PRESENTED**



# LOCATION OF SUBMAJOR DRAINAGE BASINS FOR WHICH INTERSTATE TABLES ARE PRESENTED



Maps showing irrigated areas by drainage basins.—There is a series of maps available for each of the 17 Western States and Louisiana. These maps are approximately 3 feet by 4 feet in size and were prepared on a scale of about 16 miles on the ground to 1 inch on the map. These show the location of irrigated land by counties and by drainage basins and the acres irrigated by source of water, either ground or surface. One overall map, showing similar data for all of the 18 States, is also available. The acreage shown as irrigated within a drainage basin may not have received all of its water from sources within that basin as water from one basin may have been diverted and used in another basin.

The data used in the preparation of the maps for 1959 were obtained from both the census of irrigation and the census of agriculture. All figures for acreage are from the census of agriculture. The allocation of the acreage irrigated from organization sources between surface- and ground-water sources was made on the basis of the percentage of the water received in the

drainage basin, by all organizations, which came from ground and surface sources.

The number of dots for the State maps were calculated for each minor civil division or other county subdivision. The dots were plotted within the subdivision after an examination of United States Geological Survey topographic maps, maps of the Bureau of Reclamation projects, enumerator maps, and any other available information indicating the location of the irrigated land. After plotting, the dots were counted by drainage basins to determine the irrigated acreage from each water source for each drainage basin.

The acreage irrigated for counties having less than 500 acres irrigated is not shown on the maps. However, the table printed on the map does provide totals for the irrigated acreage in each drainage basin even though the data are not shown on the map for all counties.

In order that the figures presented for drainage basins may be more easily understood, three maps are given to show the general plan of both data and map presentation. One map shows the location of the major drainage basins in the 17 conterminous Western States and Louisiana. The second map shows the submajor drainage basins for which intrastate tables are presented and the third map shows the submajor drainage basins for which interstate tables are presented.

**Identification of drainage basins.**—The major and submajor basins and map symbols are as follows:

<i>Basin</i>	<i>Map symbol</i>
<b>NORTH PACIFIC COAST:</b>	
Excluding Columbia River.....	I-A
Columbia River:	
Below Snake River.....	I-B
Above Snake River excluding Yakima River.....	I-C
Yakima River.....	I-D
Snake River:	
Below Weiser, Idaho.....	I-E
Weiser to King Hill, Idaho.....	I-F
King Hill to American Falls, Idaho.....	I-G
Above American Falls.....	I-H
<b>SOUTH PACIFIC COAST:</b>	
Klamath River.....	II-A
Klamath River to Santa Maria River excluding Central Valley.....	II-B
Central Valley:	
Sacramento-San Joaquin Delta area.....	II-C
Sacramento River.....	II-D
San Joaquin River.....	II-E
San Joaquin Valley above San Joaquin River.....	II-F
Santa Maria River and South.....	II-G
<b>GREAT BASIN:</b>	
Northwest Great Basin.....	III-A
Humboldt River.....	III-B
South Central Great Basin.....	III-C
Bonneville Basin excluding Bear River.....	III-D
Bear River.....	III-E
<b>GULF OF CALIFORNIA:</b>	
Excluding Colorado River.....	IV-A
Colorado River:	
Colorado River below Lees Ferry, Arizona:	
Excluding Gila River.....	IV-B
Gila River.....	IV-C
Colorado River above Lees Ferry:	
Excluding Green and Gunnison Rivers.....	IV-D
Green River.....	IV-E
Gunnison River.....	IV-F
<b>GULF OF MEXICO EXCLUDING MISSISSIPPI RIVER:</b>	
Excluding Rio Grande and Mermentau River.....	V-A
Rio Grande:	
Rio Grande below Fort Quitman, Texas.....	V-B
Rio Grande above Fort Quitman.....	V-C
Mermentau River.....	V-D
<b>MISSISSIPPI RIVER:</b>	
Excluding Arkansas and Missouri Rivers.....	VI-A
Arkansas River.....	VI-B
Missouri River: Below Three Forks, Mont., excluding Platte and Yellowstone Rivers.....	VI-C
Platte River:	
Excluding South Platte River.....	VI-D
South Platte River.....	VI-E
Yellowstone River:	
Excluding Bighorn River.....	VI-F
Bighorn River.....	VI-G
Missouri River headwaters above Three Forks, Montana.....	VI-H
<b>HUDSON BAY (Red River of the North).....</b>	<b>VII</b>

## ENUMERATION FORMS AND PROCEDURES

**Introduction.**—The primary purpose for the formation of an irrigation enterprise, organization, or system is to obtain water from natural sources and deliver it to water users. Under a broad interpretation, a system could include a formal or informal cooperative undertaking or a single enterprise. Water may come from ground sources or from surface sources. In many areas it is necessary to store water from melting snow or winter rain in order to have a more adequate supply during the growing season.

Most commonly, the water is stored in a reservoir behind a dam built across the stream which furnishes the water. Occasionally, a more economical location for water storage is off the stream which supplies the water and an off-stream reservoir has been constructed.

Medium and large-size irrigation systems will necessarily have one or more main canals or pipe lines to convey water to the area to be served, commonly using gravity flow. Main canals may deliver water to smaller canals, usually called laterals, which carry the water to a group of water users located along the lateral.

Many enterprises which deliver water for the irrigation of farm and ranch land perform other functions. These may include the generation of electric power, flood control, artificial drainage of lands, and the delivery of water for other uses. These other uses may be divided into two groups. The first group includes: Domestic and residential users, including lawn and garden watering; municipal water supply; water for industrial purposes; livestock watering; and water spreading for the recharge of ground-water supplies. The water involved in these uses and for the irrigation of farm and ranch lands must be taken from streams or other natural sources. These are the uses for which information was obtained in a census of irrigation, on water delivered by irrigation enterprises.

The other group of water uses for which water is delivered includes power generation, streamflow regulation for navigation, waste dilution, and for fish and wildlife. The water involved in this group either is not taken out of streams or, after diversion, is returned without any substantial loss in quantity. The census of irrigation has not been concerned directly with this second group of water uses.

The 1959 Census of Irrigation was concerned with finding out the amount of water taken from natural sources by irrigation organizations; accounting for the transfers between the organizations which had a part in water conveyance or delivery; and determining how much was delivered to farms, how much was lost along the way, and how much was delivered for uses other than irrigation of farm and ranch lands. The 1959 Census of Irrigation did not ascertain data in respect to the conveyance loss and use of water by an individual farmowner or operator.

The various organizations which depend on one another for the receipt or delivery of water are referred to as "related organizations." They may be quite independent in ownership and management, but they are related in the sense that water is transferred from one organization to another as it moves from its source to the individual user. These related organizations present special problems in their enumeration. An organization which operates facilities in more than one drainage basin also presents problems for enumeration.

In the period since the first census of irrigation there have been changes in the techniques and organization of irrigation water supply, in the kind of information needed, and in the type of data which can be reliably and economically obtained by census procedures. In recognition of such changes, each census has incorporated some modifications from its predecessor. The 1959 forms and procedures and the major changes made for the 1959 Census of Irrigation as compared with that of 1950, are outlined in this section. The effect of these changes will be indicated in more detail in the section on "Definitions and Explanations."

**Organizations included.**—For 1959 Census of Irrigation, an irrigation organization was defined as a group of two or more water users, a company, or a governmental district or agency that operated facilities to supply water for irrigation of farm and ranch lands. It may have been either a formal, legal organization or an informal or cooperative arrangement. The facilities of an organization were not required to supply water directly to farms but the water stored or conveyed had eventually to serve 2



or more farms. The organizations enumerated in 1959 correspond closely to the "multiple-farm enterprises" for the 1950 census.

In the 1950 and earlier censuses of irrigation, special questionnaires were also obtained for those farms which operated their own supply works to bring water to the farm, either from natural sources or from a canal or pipeline of an irrigation organization (if located more than a mile from the farm boundary, or if a pump were required to lift the water from an irrigation canal to the farm). The 1950 questionnaire did not, however, cover the process of conveying and distributing the water on the individual farm. Thus, a farm which operated a pump to lift water from an irrigational canal was regarded as an irrigation enterprise for the supply of water to two or more farms, and a special questionnaire was obtained. But a farm which received water by gravity from a canal was not regarded as an irrigation enterprise, even though it may have operated expensive works for the distribution of water on the farm.

Elaborate facilities for distributing and applying irrigation water on the farm are now more common than when the first census of irrigation was taken, and thus there has been an increasing investment by farmers in land leveling, distribution systems, sprinklers, etc. From the point of view of the farm economist or the equipment supplier, the facilities for the conveyance and application of water on the farm may be as important as those operated to bring water to the farm. This fact has influenced the kind of information collected in the census of irrigation. It has become more difficult for farmers and census enumerators to report cost and other information for works operated to bring water to the farm, separately from that for facilities for distribution and application on the farm. This is especially true when the same pump is used to obtain water from a well or canal and also to provide pressure to pipelines or sprinklers on the farm. However, the inclusion of on-the-farm-irrigation operations in the census of irrigation would greatly increase the cost of data collection. In 1950 the collection of 298,000 questionnaires would have been required for coverage of irrigation facilities on all irrigated farms in the 20 States. Because of costs, data on irrigation facilities on individual farms were not collected in connection with the 1959 Census of Irrigation.

As a result of the exclusion of irrigation enterprises providing water to only one farm from the 1959 census, the definition of water delivery by multiple-farm irrigation enterprises directly to farms was altered for application in 1959. In the 1950 census, if a farm operated more than a mile of canal, or if it used a pump to bring water to the farm from a canal or pipe operated by a multiple-farm irrigation enterprise, then the farm-operated supply works were considered to be an irrigation enterprise apart from the farm itself. In such a case the multiple-farm enterprise was not considered to deliver water directly to a farm but rather to another irrigation enterprise (a single-farm enterprise) which in turn delivered water to the farm. In 1959, however, any delivery by a multiple-farm enterprise to works operated by a single farm was considered to be water delivered directly to a farm.

Because the 1959 Census of Irrigation was confined to irrigation organizations, omitting individual farm water supply systems, Arkansas and Florida, which have few irrigation organizations, were not included in the census. These two States were included in the 1960 Survey of Irrigation in Humid Areas.

**Questionnaires.**—Three questionnaires, designated I-1, I-2, and I-3, were used to enumerate irrigation organizations in the 1959 Census of Irrigation. Each of these asked for essentially the same kind of information. They differed only in their adaptation to the peculiarities of the type of organization each was designed to enumerate. The I-1 form was used to enumerate organizations which operated facilities within one drainage basin and neither received any water from another organization nor

delivered water to another organization. The I-2 questionnaire was used to cover the operations of those organizations which operated facilities entirely within one drainage basin but which obtained part or all of their water from another organization and/or delivered part or all of their water to another organization. The I-3 reporting form was utilized to enumerate organizations which operated facilities in more than one drainage basin and also to enumerate some organizations which operated large off-stream reservoirs. (Facsimile copies of these three questionnaires are included in the appendix.) Whenever irrigation water was transferred in canals, pipes, or tunnels from one drainage basin to another, the organization in whose facilities it crossed the boundary was considered as an interbasin organization.

The questionnaires contained inquiries to ascertain the legal type of organization; the number of water users served—farm, residential, and others; the number of acres served and the number of acres actually irrigated; the amount of water obtained by source; the amount of water disposed of by type of disposition; whether or not the land served by the organization received water from other sources; and the amount of new capital investment since 1950. Other questions were included, some of which enabled the enumerators to determine whether or not the organization reporting met the definition of an irrigation organization, and some of which gave information useful in the checking of other data reported on the questionnaires.

The I-1 questionnaire did not include inquiries for reporting deliveries of water to other organizations, although it did include questions to determine whether or not such deliveries should have been reported. The I-1 questionnaire also made provision for the respondent to report water quantities in units other than acre-feet. The respondent could report either in volume units or flow units in accordance with the way he kept his records or was accustomed to measuring water.

The I-2 questionnaire did provide inquiries to ascertain inter-organization transfers. A separate worksheet was furnished the enumerator for use in making entries on the I-2 questionnaire in converting water quantities reported in volume units other than acre-feet, or in flow units, to acre-feet.

The I-3 questionnaire used for the enumeration of all interbasin organizations, provided for the accounting of all water obtained and disposed of by drainage basins. Transfers between basins were reported. The I-3 questionnaire was also used to enumerate organizations which reported the use of off-stream storage.

The questionnaires for the 1959 Census of Irrigation were prepared by the Bureau of the Census. Two special committees provided advice and counsel. A Special Federal Agency Committee, for the 1959 Censuses of Irrigation and Drainage, comprised representatives of the following United States agencies: Agricultural Conservation Service, Agricultural Research Service, Rural Electrification Administration, and Soil Conservation Service of the United States Department of Agriculture; and the Bureau of Indian Affairs and the Bureau of Reclamation of the United States Department of the Interior.

A second committee, the Special Advisory Committee for the 1959 Census of Agriculture, reviewed the later stages of the planning. This committee consisted of one representative from each of the following: Agricultural Publishers Association; American Association of Land Grant Colleges and State Universities; American Farm Bureau Federation; American Farm Economic Association; American Statistical Association; Farm Equipment Institute; National Association of Commissioners, Secretaries, and Directors of Agriculture; National Council of Farmer Cooperatives; National Farmers' Union; National Grange; Rural Sociological Society; and the U.S. Department of Agriculture. A representative of the Bureau of the Budget was in attendance at all meetings of this committee.

**Enumerator drainage basin maps.**—Inasmuch as census data were to be published by drainage basins, it was important that the drainage basin location of each irrigation organization be determined. Each enumerator was supplied with a set of county highway maps for his enumeration area, on which the boundaries of the drainage basins had been traced. Each drainage basin was given a code number. The 1950 drainage basin location of each organization was provided to the enumerator on his control list of organizations. As each organization was enumerated the drainage basin location was checked on the maps. Steps, which will be described later, were taken during the processing operations to provide the drainage basin location of organizations submitting reports by mail.

**The enumeration.**—The enumeration of the irrigation organizations, for the 1959 Census of Irrigation, was accomplished during December 1959, and January, February, and March 1960. The reports covered water supply activities during the 1959 calendar year. In case water was delivered in the winter months, and the organization's records were kept on a fiscal year basis, the fiscal year figures were accepted if the fiscal year ended within three months of the end of the 1959 calendar year. Data pertaining to the expenditures for works and equipment were reported for the ten-year period, January 1, 1950, through December 31, 1959.

Prior to the beginning of the enumeration, lists of irrigation organizations were compiled from the records of the 1950 census and from information supplied by the Bureau of Reclamation, Bureau of Indian Affairs, and various State agencies. The organizations were classified, on the basis of available information, into interbasin organizations, interrelated organizations, and nonrelated organizations. Interbasin organizations included those with operations in more than one basin, interrelated organizations comprised those that received or delivered water to another organization, and unrelated organizations included all other organizations. The classification of individual organizations was made usually on the basis of information obtained from the 1950 questionnaires.

Questionnaires were mailed to the nonrelated organizations with a letter requesting that they be filled out and returned to the Agriculture Operations Office of the Bureau of the Census in Parsons, Kansas. Questionnaires were also mailed to interrelated and interbasin organizations to give these organizations advance notice of the enumeration and allow them sufficient time to prepare the information for their reports before an enumerator called.

The area of the 18 States in which the irrigation census was conducted, was divided into 80 enumeration districts in accordance with the number of organizations to be enumerated, the distribution of the organizations, and travel conditions in the area. Approximately 80 enumerators were selected from among the crew leaders, who had worked on the 1959 Census of Agriculture. These enumerators were given a two-day training course in irrigation enumeration procedures and in the use of the irrigation questionnaires.

Each enumerator was given a "field control card" for each organization to be enumerated in his area. These control cards included those for all the interrelated organizations and also those nonrelated organizations which had not submitted a report by mail.

The enumerators were instructed to enumerate all the interrelated organizations in their area, including any unlisted organizations which might be related to organizations they enumerated, except interbasin organizations. Each enumerator was notified of the receipt, by mail, of completed questionnaires from the nonrelated organizations in his area. He was instructed to enumerate all organizations for which he had not received such a notice.

Three special enumerators were recruited for the enumeration of all interbasin organizations. These enumerators were agriculture economists from the Land and Water Branch of the Farm Economics Research Division, Agriculture Research Service, U.S. Department of Agriculture. They were trained by the irrigation economist in charge of the census of irrigation.

Reports for projects operated by the Bureau of Reclamation and the Bureau of Indian Affairs of the Department of the Interior were prepared by the respective bureaus.

Special provision was made to insure the enumeration of irrigation organizations not on any control list. Each farm operator who received irrigation water from an irrigation organization was asked, on the 1959 Census of Agriculture questionnaire, to report the name of the organization or organizations from which water was received. During the processing of the census of agriculture questionnaires, a transcription card was prepared the first time each organization's name appeared. These cards were checked against the listing of the organizations supplied to the enumerators. Reports for unlisted organizations were obtained either by mail or by the enumerators.

## PROCESSING OPERATIONS

**Completion of enumeration.**—As irrigation questionnaires were received by mail from the irrigation organization in the Agriculture Operations Office in Parsons, Kansas, the date of receipt was posted on the control list for irrigation organizations. Likewise, as an enumerator completed his assignment in a county, he forwarded the completed questionnaires to the same processing center. A check was then made of the control list for the county to ascertain the degree of completion of the enumeration in the county.

**Preliminary checking.**—All irrigation questionnaires, whether received directly from irrigation organizations or from enumerators, were subjected to a preliminary checking to determine whether or not they were satisfactorily filled. To be considered satisfactory, dependance was placed primarily on the extent to which "quantity of water" information was furnished in relation to the number of acres served by the organization. If the organization served less than 500 acres, its report was considered satisfactory when the number of acres irrigated and the number of farm water users was reported and the source of water indicated. If the organization served 500 or more acres, its report was considered satisfactory only if the actual quantity of water obtained was reported or if the report contained information which would make possible a reasonably accurate estimate of the quantity of water. The questionnaires of interrelated organizations were checked to make sure the interorganization transfer quantities were in reasonable agreement.

Questionnaires which were considered unsatisfactory were returned to the enumerator with a memorandum containing instructions for obtaining the additional information needed.

**Editing and coding.**—Each questionnaire was edited and coded before the information was transferred to punchcards and tabulated. The questionnaires were arranged for editing into 3 groups—nonrelated, interrelated, and interbasin.

Questionnaires which did not represent an irrigation organization in accordance with the census definition were eliminated. Questionnaires eliminated included those reporting organizations providing water to less than 2 farms, reports for organizations serving only residential water users, and reports for organizations which did not operate water supply facilities in 1959.

In the editing process, all questionnaires were examined for errors, omissions, and inconsistencies. Among the specific items subjected to checking were the following:

a. Farm water users served: The relationship between number of farm water users, the acres served, the area irrigated, and the quantity of water delivered were checked to be sure they were reasonable.

b. Residential or other water users served: The number of residential or other water users was checked with the quantity of water delivered to see that the relationship was reasonable.

c. Water obtained and disposed of: Checks were made to insure that the quantity of water received was equal to the quantity of water disposed of.

d. Conveyance loss: A report regarding conveyance loss was necessary unless a satisfactory explanation was given as to why there was no conveyance loss.

Obvious errors in calculations and in units of measure and misplaced entries were corrected as found. Entries not clearly legible were rewritten. Questionnaires containing major inconsistencies and omissions were referred to irrigation technician for review. The technician corrected the questionnaires, either on the basis of information reported for other organizations in the area or on the basis of additional information received in response to letters directed to the organization.

A water quantity reported in a unit, other than acre-feet, was converted to acre-feet. Estimates for quantity of water were made when required for organizations which reported less than 500 acres of land irrigated. These estimates were made on the basis of information reported for other organizations of similar type in the area. In the case of the interrelated organizations, interorganization transfers of water were compared and discrepancies corrected. Discrepancies of less than 300 acre-feet between reports of two interrelated organizations were corrected by the clerks, in accordance with the following rules:

1. If only one organization reported the transfer of water, the transfer was cancelled and the other figures in the questionnaire were adjusted to make water obtained equal to water disposed of.

2. If both organizations reported the transfer but the amounts differed by a quantity of less than 300 acre-feet and one of the organizations reported measuring its water while the other did not, the report of the organization making measurements was accepted. If neither organization measured the water, each report was adjusted by an amount equal to one-half the difference.

Discrepancies between the reports of two interrelated organizations of 300 or more acre-feet, for water transferred, were referred to an irrigation technician. Discrepancies of 300 to 999 acre-feet were corrected by the technician on the basis of other information on the questionnaires. In all cases of discrepancies of 1,000 acre-feet or more, letters were sent to the respondents of both organizations pointing out that a discrepancy did exist although not revealing the quantity and asking that the reported figures be reviewed, and any necessary corrections be made. In nearly all cases the replies to these letters contained information which made possible the correction of the two reports.

The drainage basin location of organizations which reported by mail was supplied on the basis of information from the 1950 irrigation questionnaires. For organizations which were not enumerated in 1950, or for which there was any question about the drainage basin in which located, the information given on the questionnaire as to the location of the sources of water, or the land irrigated, was checked against the drainage basin maps to determine the drainage basin in which the organization was located.

The questionnaires of all interbasin organizations were edited and coded by irrigation technicians, in accordance with the same rules used for questionnaires for interrelated organizations. To facilitate tabulations, a questionnaire was prepared for each basin. Thus, if an organization operated in three drainage basins, three questionnaires were prepared, one for each basin in which it operated.

During the coding operation each irrigation organization was assigned a code to indicate (1) drainage basin in which located, (2) the legal type of organization, (3) whether or not water from other sources was used on the same land served by the irrigation organization, and (4) the amount of water delivered to farm users per acre irrigated by the organization.

**Tabulation of data.**—After the questionnaires were edited and coded, the information was punched into tabulating cards. One card only was required for each questionnaire. A tabulation was made for each individual drainage basin. Totals were obtained for the additive information on the cards for each drainage basin. This tabulation was examined by the irrigation technician for reasonableness and consistency. After the review and correction of this tabulation another tabulation was made, by type of organization for submajor drainage basins and States. This tabulation was reviewed for reasonableness and consistency, before the remaining tabulations were made.

## DEFINITIONS AND EXPLANATIONS

The definitions and explanations which follow relate mostly to those 1959 items considered to be inadequately described in the tables.

**Irrigation defined.**—The term "irrigation," as herein used, refers to the application of water, by artificial means, to land being used for agricultural purposes. These artificial means include subirrigation as well as application of water to the ground surface either by general flooding, by basins, and by furrows, or less directly through the use of sprinklers.

**Irrigated land.**—Irrigated land includes any land in farms (and ranches) to which water was applied in the year covered by the enumeration. Irrigation may have been used for producing a harvested crop, for pasture or grazing lands, for cultivated summer fallow, or for land planted to a crop intended for future harvest. Land flooded for rice cultivation was considered as irrigated. Land flooded during high water periods was to be included as irrigated only if water was diverted to agricultural lands by dams, canals, or other works. The definition of irrigated land specifically excluded land where the water table or the natural level of the ground water was controlled by drainage works with no additional water brought in by canals or pipes.

**Census definition of a farm.**—For the 1959 Census of Agriculture, the definition of a farm was based primarily on a combination of "acres in the place" and the estimated value of agricultural products sold.

The word "place" was defined to include all land under the control or supervision of one person or partnership at the time of enumeration and on which agricultural operations were conducted at any time in 1959. (For definition of "agricultural operations," see p. ix of the Introduction to volume II of the reports for the 1959 Census of Agriculture.) Control may have been exercised through ownership or management; or through a lease, rental, or cropping arrangement.

Places of 10 or more acres in 1959 were counted as farms if the estimated sales of agricultural products for the year amounted to at least \$50. Places of less than 10 acres in 1959 were counted as farms if the estimated sales of agricultural products for the year amounted to at least \$250. Places not meeting the minimum estimated level of sales in 1959 were nevertheless counted as farms if they could normally be expected to produce agricultural products in sufficient quantity to meet the requirements of the definition. This additional qualification resulted in the inclusion as farms of some places that were engaged in farming operations for the first time in 1959, as well as places affected by crop failure or other unusual conditions.

**Land in farms according to use.**—Land in farms was classified according to the use made of it in 1959. The acreage in each farm was allocated among the various land-use categories only once, and any acreage that had two or more uses during the year was classified according to its most important use.

**Cropland harvested.**—This includes land from which crops were harvested; land from which hay (including wild hay) was cut; and land in small fruits, orchards, vineyards, nurseries, and greenhouses. Land from which two or more crops were harvested was to be counted only once. The entry for cropland

harvested was obtained directly from the farm operator and then verified by the census enumerator by adding the acreages of each crop reported and subtracting from this total the acres of land from which two or more crops were harvested. This checking was repeated during the office processing for farms with 100 or more acres of cropland harvested. The enumerator was directed to list only under "Cropland harvested" any acreage that had additional uses during the year. For instance, any land from which hay was cut was classified as cropland harvested, regardless of the use of land for grazing later in the year.

**Cropland used only for pasture.**—The enumerator was instructed to include all land used only for pasture or grazing that could have been used for crops without additional improvement, and all land planted to crops that were hogged off, pastured, or grazed before reaching maturity. In the census of 1954 the enumerators were instructed to report rotation pasture and all other cropland used only for pasture as cropland used only for pasture.

**Cropland not harvested and not pastured.**—This class includes cultivated summer fallow, cropland used only for soil-improvement crops, land on which crops failed, land planted to crops for harvest after the year covered by the census, and idle cropland. The data for this class for 1959 were obtained through the use of two inquiries in some States and three in other States as follows:

**Cultivated summer fallow.**—This land use was obtained for the 17 Western States in the conterminous United States. The acreage of cultivated summer fallow is negligible in those States where the inquiry was not included on the questionnaire. For the censuses of 1959, 1954, and 1950, cultivated summer fallow was defined as cropland that was plowed and cultivated but left unseeded to control weeds and conserve moisture. Separate data are not available for 1945 and earlier censuses.

**Cropland used only for soil-improvement crops.**—Only land used for cover crops, to control erosion or to be plowed under for green manure and planted to another crop, fell into this category. A large proportion of this land was covered by contracts of the Soil Bank. The enumerator was cautioned not to include land from which crops were harvested in the census year or land that was pastured or grazed. There was no separate inquiry for Alaska and Hawaii. In these two States cropland used only for soil-improvement purposes was included under other cropland not harvested and not pastured.

**Other cropland not harvested and not pastured.**—All cropland except cropland harvested, cropland in cultivated summer fallow, cropland pastured, and land used only for soil-improvement crops was included in this land-use class. This total included all acreage on which crops failed because of drought, floods, insects, etc.; acreage not harvested because of low prices or labor shortage; acreage not harvested but occupied by growing crops intended for harvest in later years; acreage which had been plowed, and could be plowed again without first clearing away brush, but which had been idle for one or more years.

**Woodland pastured.**—This includes all woodland that was used for pasture or grazing during the census year. According to instructions, woodland refers to woodlots and timber tracts, natural or planted.

**Woodland not pastured.**—The enumerator was instructed to include in this category land in the Soil Bank planted to trees.

**Other pasture.**—All land, other than woodland and cropland, used for pasture or grazing was designated other pasture.

**Improved pasture.**—A pasture that had been limed, fertilized, seeded, irrigated, drained, or cleared of weeds or brush was to be considered improved pasture.

**All other land.**—This item refers to all land not included in any of the preceding land-use items and includes land occupied by a house or other buildings; lanes, roads, and ditches; and land area of ponds and wasteland. Unusually large tracts of other land held primarily for purposes other than agriculture were excluded from the tabulations.

In summary tables 6 and 11, the "total acres irrigated in census year" is shown for 1959 and 1949. The 1959 data were obtained in the general census of agriculture while those for 1949 were obtained in the 1950 Census of Irrigation. The most useful comparison of drainage basin totals was made possible only by using data from the two sources. Data in respect to the number of irrigated farms and acreage of irrigated land collected in the census of agriculture are more accurate than those collected in the census of irrigation. The 1950 Census of Agriculture data were not apportioned to drainage basins. However, the 1950 Census of Irrigation acreages, through a process of reconciliation,

were brought into reasonable agreement with the 1950 Census of Agriculture irrigated acreage. (See page XXIV for a discussion of the method used in 1950 to reconcile census of irrigation data with similar data gathered in the census of agriculture. See also "Area reported irrigated by organizations" on page XXI.) The State totals for 1959 correspond with those reported in volume I of the reports for the 1959 Census of Agriculture.

**Irrigated farms.**—All farms with any land irrigated in 1959 are counted as irrigated farms. The extent of irrigation on any particular farm could have ranged from an adequate and timely supply of water for all crops and pasture to an inadequate supply of water with the result that the crop irrigated was not worth harvesting or it was harvested for a purpose different than the purpose for which it was planted.

If, from the total number of irrigated farms, as shown in summary table 1, the number of farms reporting irrigated cropland harvested is subtracted, the resulting difference represents those irrigated farms which had no irrigated harvested crops. These farms could have had irrigated pasture (any kind of pasture land which was not used for crop production in the census year), land planted to an irrigated crop intended for future harvest, land in cultivated summer fallow, land which was irrigated in the census year and was being prepared for seeding a crop for harvest in a later year, and land in a crop which was irrigated in the census year but which was a complete failure.

**Irrigation organization.**—An irrigation organization is a business comprising a group of two or more water users, a company, a corporation, or a governmental district or agency that operates facilities to supply water for the irrigation of farm and ranch lands. It may be either a formal, legal organization or an informal or cooperative arrangement. To be included in the census of irrigation two or more farm water users had to be served by the water which was stored or conveyed by the facilities of an organization but these water users did not have to be served directly. Thus, if a storage reservoir released water into a stream channel which was picked up downstream by another organization which served two or more farms, the organization which owned the reservoir qualified as an irrigation organization. Likewise, if all the water of one organization was received into facilities of another organization, both were included as irrigation organizations provided two or more farm water users were served. In the first example, the reservoir would be included as an organization which did not convey water.

An organization was included in the census, if any of the water stored or conveyed in its facilities was used for farm irrigation even though irrigation was not the main purpose of the organization. Organizations which did not operate water supply works, in 1959, because of water shortage or other reasons were not included.

An irrigation system operated by a single farm primarily to supply water for that farm was not counted as an irrigation organization, though it may have supplied water to one or more other farms. (In 1950, a total of 105,254 single-farm irrigation enterprises were reported in the 18 irrigation States, and they supplied water to 7,125 other farms.) However, if a ditch, pump, or other works which supplied water to two or more farms (or water users) was operated as a cooperative undertaking of two or more farmers or water users, it was included as an irrigation organization. The determination as to whether a small irrigation system serving two water users is operated by one of them or by both jointly is difficult in some cases, particularly if the two water users have such relationships as landlord and tenant, or father and son. The determination of whether the persons providing water to two or more water users qualified as an irrigation organization may not always be made in a uniform basis from census to census; and thus, part of the change in the number of irrigation organizations may be the result of differences in determination of whether the organization meets the criteria



for inclusion in the census of irrigation. Changes in the number of organizations from census to census may arise from changes in the number of farm operators for the same land irrigated without any change in water supply facilities. For example, an irrigated tract of land may comprise three farms for one census and only one farm at another census because of the consolidation of farms.

Only organizations which divert, pump, store, or convey water used, at least in part, for irrigation are included. Water-user organizations which provide information or technical assistance and which represent the interest of water users, promote water development, etc., but do not operate any water supply facilities are excluded.

Many of the larger irrigation organizations deliver water by main supply canals to lateral ditches which are maintained by the water users served. The water users on each lateral may be more or less formally organized to perform any maintenance work required, or to hire such work performed. In some areas, it is the custom for each water user, individually, to maintain the portion of the ditch adjoining his property, without any joint action by the water users as a group. In most cases payments to the main supply organization are made by the water users individually, while in others a lateral organization makes the payment. The instructions to enumerators in 1959 provided that a group of water users operating a lateral ditch were to be counted as a separate organization if either (a) water was obtained from more than one source—that is, from another organization, or directly from a natural source as well as from another organization—or (b) the group collected payments from water users. If all water was obtained from another organization, and no cash payments were collected by the lateral, then the lateral was not to be considered as a separate organization and the water users and land were considered to be served directly by the organization from which the water was obtained.

The procedure for counting laterals did not affect the total acreage reported as irrigated by irrigation organizations although, in some areas, it may have affected significantly the number of mutual unincorporated organizations counted and the acreage served directly by each type of organization. If an irrigation district supplied water to laterals operated as unincorporated mutual organizations, the water users and land were tabulated as served directly by mutuals. If the laterals did not qualify as separate irrigation organizations, however, the water users and land were considered to be served directly by the irrigation organization delivering the water. These same criteria for the enumeration of laterals were generally followed for the 1950 census.

The definition of "irrigation organization" used for the 1959 census is essentially the same as that of "multiple-farm enterprise" used in the 1950 census.

**Farm area reported served by organizations.**—Farm area served is defined as the area for which farm water users were entitled to receive water in 1959. Land which may have been irrigated in some year previous to 1959, but was not irrigated in 1959, was to be included.

**Area reported irrigated by organizations.**—Each irrigation organization was asked to report the number of acres actually irrigated in 1959 with water from the organization. Acres irrigated were counted only for the organizations delivering water directly to farm distribution systems. Land eligible to receive water directly (i.e., delivered to farm distribution systems from two organizations) was reported by each, however, and hence is counted twice. The total acres irrigated, as reported by irrigation organizations, often provides an overstatement of the acres actually irrigated. Although defined the same as acres irrigated by multiple-farm enterprises in 1950, the figures reported in the 1959 Census of Irrigation are not strictly comparable with

those shown for the 1950 Census of Irrigation because the checking of reports for the 1950 Censuses of Irrigation and Agriculture resulted in the elimination of most of the overstatement of the acres irrigated by irrigation organizations for 1950.

**Water users served, total.**—A water user is defined as any person or organization, which received water for use on a farm, in a business, or in or around a home. Organizations reporting by mail were not provided with a definition; therefore, the number of water users reported depends on the interpretation of "water user" by the organization.

**Farm irrigation water users.**—A farm irrigation water user is one who received water for irrigation and who had ten or more acres of land from which in 1959 at least \$50 worth of agricultural products were sold, or if he had less than 10 acres at least \$250 worth of agricultural products were sold in that year. Users having smaller acreages of land or smaller sales were counted as residential or other water users. This definition was provided only to irrigation enumerators, and was not given to irrigation organizations submitting reports by mail. Although the definition corresponds to that of a census farm, it was recognized that irrigation organizations would be unable to determine which of the water users met the criteria, especially if the service area included many small tracts. Moreover, in some cases, a water user as shown by the records of the irrigation organization, may rent or lease all the acreage he controls to another person and hence not qualify as a census farm for the census of agriculture. The number of farm water users, as obtained in the census of irrigation, often exceeds the number of farms receiving water from irrigation organizations, as reported in the 1959 Census of Agriculture.

**Residential water users.**—A residential or domestic water user is one who received water for household use and/or to water lawns, flowers, shrubs, and vegetable gardens, but who did not sell enough products to qualify as a farm.

**Other water users.**—Other water users include industrial plants; recreational activities, such as golf courses; public institutions; etc.

**Source of water.**—The basic data in regard to irrigation water supplies—from either ground or surface sources—was obtained in the 1959 Census of Agriculture. The agriculture questionnaire contained an inquiry regarding the proportion of the irrigation water used on each farm from ground-water, surface-water, and irrigation-organization sources. Ground-water sources include wells (pumped or flowing) and springs; surface-water sources include streams, lakes, reservoirs, and sewage and drainage ditches. The percentages reported for each source were multiplied by the total area irrigated on each farm, during the office processing of the agricultural questionnaires. An allocation, between ground- and surface-water sources, was made of the water received by farms directly from irrigation organizations. This was accomplished as follows:

1. The irrigated acreage computed for ground, surface, and irrigation-organization sources as shown by the census of agriculture was totaled for each county.
2. The quantity of water received from ground and surface sources as reported by irrigation organizations was tabulated for each drainage basin.
3. The calculated acres of land irrigated by irrigation organizations as shown by data from the census of agriculture was placed on a map with county and drainage basin boundaries. If the county were entirely within a drainage basin, then the acres irrigated from ground and surface sources by irrigation organizations were allocated by multiplying the acres irrigated by the percentage of water irrigation organizations obtained from ground and surface sources in the drainage basin. If only a part of a county were in a drainage basin, then the acres irrigated by water from irrigation organizations as shown for the census of agriculture were allocated to each drainage basin on the basis of total acres irrigated by water from irrigation organizations for the minor civil divisions or other county subdivisions comprising the part of

the county within the drainage basin to the acres irrigated by water from irrigation organizations. The acreage irrigated by water from ground and surface sources was calculated for each drainage basin part of the county in the same way as for counties entirely within a drainage basin.

4. The total acreage irrigated by water from ground and surface sources was obtained by adding the calculated acreage for the counties and parts of counties comprising the drainage basin.

5. Totals for the acres irrigated by water from farm sources, by ground and surface sources were also obtained for each drainage basin by adding the data for the census of agriculture for the counties and parts of counties comprising the drainage basin. When only part of a county was within a drainage basin, the acres irrigated by water from farm sources, was obtained by totaling the acres irrigated for the minor civil division or other county subdivisions in the drainage basin.

6. To obtain totals for acres irrigated by water from ground and from surface sources, totals for water obtained from farm sources were added to the corresponding totals for water obtained from irrigation organization sources.

**A conveyance system** comprises the canals, pipes, and tunnels of an organization constructed to carry water from one place to another. It does not include drainage ditches not operated as water supply canals, nor reservoirs, nor stream channels.

**Water delivered** by an irrigation organization, to a water user or to another irrigation organization, means water which flowed from a canal, pipe, or reservoir operated by one organization directly into a canal, pipe, or reservoir operated by a water user or another organization. Water released to a natural stream channel for diversion by a water user or another organization downstream was not considered a delivery by the organization releasing the water; it was considered as spillback.

**Quantity of water** is given in the tables in acre-feet. An acre-foot of water is the quantity sufficient to cover 1 acre to a depth of 1 foot, or a total of 43,560 cubic feet. Quantities of water reported on the questionnaires in units other than acre-feet were converted to acre-feet.

**Drainage basin** is the area of land from which water flows into a given stream, lake, or other body of water or into a natural depression. Drainage basins from which water does not flow into streams that lead to the ocean are termed "independent basins."

The drainage basins for which data from the 1959 census have been tabulated are essentially the same as those used in 1950. Before enumeration, these maps were reviewed by field offices of the United States Geological Survey or United States Army Corps of Engineers. Some changes were made for 1959 in the drainage basin boundaries used in 1950 in order to conform more closely with the drainage basin boundaries used by other government agencies and with stream-gaging stations.

**Water conveyed** represents the net quantity of water entering the conveyance systems operated by irrigation organizations in each of the designated drainage basins. The quantities reported are "net" in that (1) water transferred from one irrigation organization to another is counted only once; and (2) water released from conveyance systems of irrigation organizations to reservoirs, streams, or drainage ditches or for ground-water recharge is not included. The figures include water conveyed only for withdrawal uses. They, therefore, do not include water used or released for navigation, fish and wildlife, pollution control, or hydroelectric power generation in the same drainage basin. (These uses were included in the 1950 Census of Irrigation and account for most of the water then reported for uses other than irrigation in 1950.)

**Conveyed water from surface sources within basin.**—Surface sources of water include streams, lakes, reservoirs, and sewage and drainage ditches. Surface water, obtained from natural sources by organizations, represents the amount by which irrigation organizations reduced the supplies of surface water in a particular drainage basin. Water obtained from another basin

released for any reason to surface sources from the conveyance system of an irrigation organization (considered to be a negative withdrawal) was subtracted from the amount withdrawn from surface sources in the drainage basin where the water is released. When the figures for all organizations in a basin were combined, the amount of such surface water diversions usually exceeded the amount of interbasin water transfers released to streams. However, in some basins the quantity of water transferred from other basins and released to streams was greater than the total surface diversions in the basin by the irrigation organizations in the basin, and in such cases, the quantity of water appears in the table as a negative number.

**Water entering conveyance systems.**—The total water entering conveyance systems in a drainage basin includes the quantity obtained from natural sources in the basin plus water received from other basins. The total water conveyed is shown in acre-feet.

**Conveyed water from ground sources within basin.**—Ground-water sources relate to wells (pumped or flowing) and water taken directly from springs. The amount of ground water represents the quantity taken from ground-water sources in each basin by irrigation organizations. In 1950, ground-water sources were defined to include only pumped wells.

**Release of water from reservoirs.**—Releases of water from reservoirs were reported as surface water only if water were diverted into a canal or piped directly from the reservoir itself. Releases from a reservoir to a stream channel for any purpose were not included. If water released by a reservoir were diverted from the stream below the reservoir the quantity reported as received was the amount diverted from the stream, not the amount released from the reservoir. The point of diversion was taken as the location at which the water entered the conveyance system and this could have been in a drainage basin other than the drainage basin in which the reservoir was located. The quantities of water delivered, conveyance loss, etc., in the tables, therefore, do not include reservoir inflows, releases, evaporation from reservoirs, nor changes during the year in the amount of water held in storage.

The quantity of water received for an organization operating a reservoir for storage purposes represented the amount of water entering the conveyance system plus the conveyance losses from the canal or conveyance system that conveyed the water into the reservoir. Thus water received does not include any allowance for changes in the amount of water in the reservoir nor for losses in the reservoir.

**Water from other organizations in the basin.**—The amount of water received from other irrigation organizations in the basin represents the quantity of water received into the conveyance systems of irrigation organizations from the conveyance system of other irrigation organizations in the same drainage basin.

**Water from natural sources within basin.**—This is the sum of the water withdrawn within the basin from surface- and ground-water sources.

**Water from another drainage basin.**—This represents the quantity of water conveyed into the drainage basin from an adjoining basin in a canal, pipeline, or tunnel operated by an irrigation organization. It includes the quantity of water which flowed across the basin boundary in irrigation conveyance systems, regardless of the use of that water. It does not include water flowing from one drainage basin to another in streams or drainage ditches.

**Total water leaving conveyance systems.**—The total water leaving conveyance systems of organizations is equal to the total water entering the conveyance systems of the organizations in a drainage basin.

**Water delivered to farm irrigation water users** represents the quantity of water which was delivered at the turnouts to individual irrigated farms. Any water delivered to farm irrigators and used for livestock or other nonirrigation purposes is also included, but the quantity of water used for these purposes represents a very small part of the total water delivered.

**Water delivered to residential water users** is the amount of water delivered by irrigation organizations to individual water users for household use and for watering lawns, flower gardens, vegetable gardens, etc. It does not include water delivered to urban water-supply systems.

**Water delivered for other uses** includes any water delivered by an irrigation organization other than water delivered (a) to farm irrigation water users, (b) to individual residential water users, and (c) to other irrigation organizations. It includes water delivered to municipal and suburban water systems not delivering any water for farm irrigation; water delivered for industrial uses; water delivered to farms which used water for livestock or other nonirrigation uses only; and water conveyed for ground-water recharge. Water for other uses does not include water used for hydroelectric power generation only, or to maintain stream flow, for navigation, fish and wildlife protection, or for pollution control.

**Water delivered to other irrigation organizations** represents the amount of water conveyed from a pipe, canal, or reservoir operated by one irrigation organization into a pipe, canal, or reservoir operated by another irrigation organization, at points within the drainage basin. The amounts are the same as the quantities reported as received from other irrigation organizations in the same basin.

**Water delivered for use in the basin** is the sum of deliveries at points within the basin to farm irrigation water users, residential water users, and for other uses.

**Water conveyed to another drainage basin** is the amount of water conveyed from the drainage basin into an adjoining basin or basins, in the conveyance systems of irrigation organizations. The amount flowing across a drainage basin boundary in the conveyance system of irrigation organizations is counted regardless of its use. The disposition of such water is accounted for in the basin to which it was conveyed.

The figures are identical to those given under "Water conveyed from another drainage basin" but tabulated under the basin from which the water was conveyed. The lines in State table 1, entitled "From drainage basin number" and "To drainage basin number," together with the footnotes referring to those lines show the drainage basins involved in the interbasin transfers.

**Conveyance loss in basin.**—Conveyance loss is the amount of water lost from evaporation, seepage, and wastage not returned in canals or pipes to streams associated with the conveyance of water during the year in the canals and conveyance systems operated by irrigation organizations between natural sources and points of delivery to water users. Conveyance loss does not include losses from reservoirs, or in natural stream channels, or water released for any reason to streams or reservoirs. Losses in the distribution systems of the water users are not included.

**The average delivery per acre** is given separately for organizations, which did not report water from other sources used on the same land, and for those which did report water from other sources used on the same land. The organizations which did not report water from other sources used on the same land were classified according to the acre-feet of water delivered per acre irrigated, in order to provide more accurate data on the quantity of water used per acre. The classification of organizations operating in more than one basin was made on the basis of acre-feet of water delivered per acre irrigated for the entire organization rather than just the part within the drainage basin.

**New capital investment, 1950-1959.**—New capital investment represents the amount spent by irrigation organizations for additional new works and equipment for irrigation and drainage from January 1, 1950, to December 31, 1959. It includes expenditures for new construction, enlargement or improvement of works, or for purchase of additional new equipment. It includes only that portion of the cost of multiple-purpose works chargeable to the irrigation and drainage of farm and ranch lands, and the portion financed by the irrigation organization or the cost of works built jointly with another organization. It does not include expenditures for repairs and replacements, operation and maintenance, payment for works constructed before 1950, purchase of water rights, land, or stock or shares in another organization, or contracts or repayment for the purchase of works constructed by the U.S. Bureau of Reclamation or by any other irrigation organization. For new irrigation organizations with irrigation works under construction, the amount spent on both the completed and uncompleted parts of the works from January 1, 1950, to December 31, 1959, were included. However, new capital investments for any organizations that did not deliver water in 1959 were not included.

Each organization was asked to report only its expenditures for works and equipment by itself and not to include expenditures made by any other organization on works which the organization operated in 1959. In the case of works built by the Bureau of Reclamation but now operated by water users organizations, the amount of the expenditures made by the Bureau of Reclamation on the project from January 1, 1950, to December 31, 1959, was obtained from the bureau and included with the expenditures of the water users organizations. In summary table 18, expenditures made by the Bureau of Reclamation are shown separately from those made by other organizations.

For interbasin organizations the new capital investment was tabulated for the drainage basin in which the investment was made.

**Type of organization.**—The types of organization under which the data are classified are as follows:

**Mutual or cooperative organizations.**—Mutual or cooperative organizations are private (nongovernmental) organizations controlled or operated by two or more water users primarily to supply water to their own farms. They do not include district enterprises organized under special State laws. They do not have the power to levy taxes and they are operated for the benefit of water users rather than for the profit of owners. If 50 percent or more of the acreage irrigated was not in the farms of the water users who controlled and operated the enterprise, the organization was classified as "commercial." Mutual or cooperative organizations include partnerships of two or more farms which operate irrigation supply works or equipment; groups of water users informally associated under verbal or written agreements; mutual irrigation or water companies; water users associations; "lateral" companies; community ditches or "acequias" organized originally in accordance with old Spanish, Mexican, or Indian customs. Mutual or cooperative organizations may be either unincorporated or incorporated.

**District organizations.**—District organizations are public corporations established under special State laws to serve particular purposes. A district organization may serve purposes other than irrigation of farm lands and may be known under a variety of names other than "irrigation district," such as conservancy district, water improvement district, water storage district, and State reclamation district. Reclamation districts organized under State laws should not be confused with the United States Bureau of Reclamation projects.

**United States Bureau of Reclamation organizations.**—As the name implies, United States Bureau of Reclamation organizations include the projects operated by the United States Bureau of Reclamation. If the operation of works constructed by the Bureau of Reclamation had been transferred entirely to a water-users organization, the organization was classified according to the successor type of water-users organization such as district or mutual. If part of the works of the irrigation project were operated by the Bureau of Reclamation and part by a water-users organization, the parts operated by each were reported as separate organizations. In summary tables 10 and 17, data for United States Bureau of Reclamation constructed projects transferred to water users for operation are shown separately. The data for these projects are also included with the type of organization in which the water-user organization was classified in 1959. The purpose for presenting these data separately is to give, as nearly as possible, complete information for all irrigation organizations built by the Bureau of Reclamation.

**United States Bureau of Indian Affairs organizations.**—These are organizations which were operated by the United States Bureau of Indian Affairs of the United States Department of the Interior.

**Commercial organizations** are privately operated organizations (by individuals, partnerships, or corporations) with 50 percent or more of the acreage irrigated in farms of water users who do not share in the control and operation of the organization. In some cases, commercial organizations are public utilities regulated by a State commission or by the governing board of a county.

**State organizations** are those operated by a State agency of any kind.

**City or town organizations** are those operated by municipalities usually in combination with a domestic water-supply system. If a city or town water-supply organization supplied water for the irrigation of 100 or more acres of agricultural land, it was enumerated as an irrigation organization.

**Irrigation organizations by type of service** provides a classification of organization by the extent to which water was conveyed by more than one organization between its diversion from a natural source and its delivery to individual water users. The irrigation organizations are classified according to the origin of water conveyed by the organization—that is, (1) all water from ground and surface sources only, (2) all water from irrigation organizations, (3) all water from ground and surface sources, and (4) organizations which conveyed no water in 1959. Organizations which conveyed no water in 1959 are those which operated reservoirs but not conveyance facilities.

**Total water conveyed** was obtained by adding together the amount of water obtained from surface- and ground-water sources and the amount received from other organizations. This procedure, therefore, caused a double counting of the water obtained from the other organizations if the water were included in the total conveyed by the receiving organization.

Because of the method of handling interorganization transfers released to streams, and organizations receiving water from other organizations and releasing part or all of the water to natural stream channels, negative quantities appear for the quantity of water "From surface and ground water sources," when the amount of water released to streams exceeds the quantity of water taken from sources within the basin or State.

**Water from other sources.**—The purpose of the question "Was any water from other sources or other organizations also used in 1959 to irrigate the same farm and ranch lands to which water was delivered by this organization?" was to provide a basis for selecting organizations which furnished all the water for irrigating farm and ranch lands in order to make tabulations of acres irrigated and water use for such organizations. The

classification of organizations by acre-feet of water used per acre was made only for those organizations reporting that they provided all the water used by the farms they served.

**Size or organization.**—Data are presented for three measures of the size of irrigation organizations. These measures are number of farm irrigation water users served directly, number of acre-feet of water delivered directly to farms, and number of acre-feet of water conveyed.

In the case of organizations operating in more than one drainage basin, all measures of size relate to operations of the irrigation organization in all basins rather than to the operations within one drainage basin.

**Comparability of data for prior censuses and for the census of agriculture.**—The comparability of data for the various censuses of irrigation have been affected by changes in definitions and procedures. The data for the census of irrigation and the census of agriculture are not fully comparable, because of differences in definition and the extent of reconciliation made in reports for the two censuses. The following discussion relates to most of the important differences in comparability.

**Quantity of water by drainage basins, 1959 and 1950.**—In 1959, a report was obtained for each irrigation organization for the quantity of water delivered to farm water users for each drainage basin. For 1950, data were not obtained from each irrigation organization for each drainage basin for the quantity of water delivered to farms. In 1950, irrigation organizations operating in more than one county or drainage basin reported 47 percent of all water delivered to farms and other irrigation organizations. For these organizations the quantity of water delivered to farms was allocated to drainage basins in proportion to the acreage irrigated by such organizations in each drainage basin. In 1950, no allocation was made by drainage basins of the quantity of water obtained from ground and surface sources, the quantity of water lost in conveyance, and the quantity delivered to other irrigation organizations. In the drainage basins, where a substantial part of the water is obtained from sources outside the drainage basin, the data for 1959 and 1950 are not fully comparable.

**Farms or farm water users supplied by irrigation organizations and the number of farms reporting water received from irrigation organizations.**—An examination of data for the number of water users or farms provided with irrigation water as reported by irrigation organizations and the number of farms receiving water from irrigation organizations for the census of agriculture indicates that the data from the two sources are not comparable. For example, for 1959, the number of farm water users as reported by irrigation organizations for the 18 States was 383,654. The number of farms reporting water received from irrigation organizations as shown by the census of agriculture for the 18 States was 153,704. In many cases, irrigation organizations count as the number of farm users, the number of stockholders, the number of ownership units, the number of persons paying bills, or the number of tracts eligible to receive water as the number of farm water users. When two or more irrigation organizations furnish water to the same water user, the water user is counted by each organization supplying the water. Undoubtedly some of the farm water users reported by irrigation organizations were landlords not operating a farm. In the census of agriculture, one farm operator often operates several tracts and rents land from several owners, or obtains water from more than one irrigation organization. In the census of agriculture, such a farm operation is counted as one farm. On the other hand in the census of irrigation, each owner of land or tract may be counted as a separate farm water user.

For the 1950 census, the number of farms receiving water as reported by each irrigation organization was checked against the records for the farm operators reporting water received from the irrigation organization as shown by the census of agriculture.



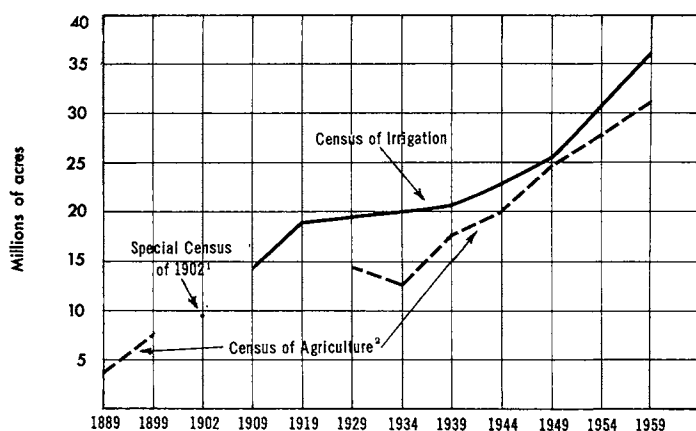
The checking resulted in the number of farms reported as receiving water from irrigation organizations being reduced from approximately 400,000 to 246,000. Because of the correction in the number of farms furnished irrigation water as shown by reports of the census of irrigation as the result of the matching of reports for the census of irrigation with the reports of the 1950 Census of Agriculture, the number of irrigated farms shown for the 1950 Census of Irrigation is not comparable with number of farm irrigation water users reported for irrigation organizations in 1959 nor with the number of farm water users or irrigated farms reported for irrigation organizations for other censuses.

**Acres irrigated as shown by census of irrigation and census of agriculture.**—For every census, the area irrigated as reported by irrigation organizations has exceeded the acres irrigated as reported by the census of agriculture. The area irrigated as reported by irrigation organizations has been overstated for every census. The overstatement arises from two sources:

1. Some irrigation organizations report the area assessed for water, the area eligible to receive water, or the total area in farms receiving water. Usually these areas are considerably greater than the area irrigated during a year.

2. In some cases, two or more irrigation organizations provide water used to irrigate the same area. In such cases, the same area is counted by each of the organizations supplying the water.

ACREAGE OF IRRIGATED LAND FOR THE 17 WESTERN STATES AND LOUISIANA



<sup>1</sup>Total irrigated land, all States.

<sup>2</sup>In 1889, 1899 and 1944 through 1959, all irrigated land in farms; 1929 and 1934, acreage of irrigated crops only; 1939, acreage of irrigated crops plus irrigated pasture. Data for 1909 and 1919 not available.

A comparison of the area reported as irrigated by each irrigation organization and the area reported as irrigated by the farm operators receiving water from the organization was made for the 1950 census. This comparison resulted in the reduction of approximately 7 percent in the acreage irrigated as reported by irrigation organizations. In 1959, approximately one-seventh of all the irrigation organizations provided water to farms that also received irrigation water from other irrigation organizations. These irrigation organizations provided water for one-fifth of the area irrigated by irrigation organizations in 1959. However, the area receiving irrigation with water from two or more irrigation organizations represented about one-fifth of the area irrigated by all irrigation organizations.

For 1950, the overstatement of the area irrigated plus the duplication in the counting of the area irrigated by water from two or more irrigation organizations was equal to 12 to 15 percent of the area irrigated as originally reported by irrigation organizations for 1949.

For 1959, irrigation organizations reported 17.7 million acres irrigated. The calculations of area irrigated by water furnished by irrigation organizations for farms included in the census of agriculture was 12.9 million acres. Part of the 4.8 million acre

difference is the result of the counting by each irrigation organization of areas to which two or more irrigation organizations provided water, and part of the difference is the result of the overstatement of areas irrigated by irrigation organizations. Also, it is very likely that the method used in the 1959 Census of Agriculture for calculating acres irrigated by water furnished farms by irrigation organizations may have resulted in an understatement of the area actually irrigated. There were 27,102 farms, representing 10.1 percent of all the farms with irrigation in the 18 States that obtained water from on-the-farm sources and also from irrigation organizations. The total acres irrigated on these farms was 5.3 million, of which 2.6 million acres were allocated as irrigated by water from irrigation organizations. On many farms, where irrigation water is obtained from irrigation organizations, the cost of water from irrigation organizations is likely to be less than the cost of water obtained from wells, etc. Because of the differences in cost and in the availability of water during the irrigating season, it is very likely that the proportion of the area irrigated with water from irrigation organizations may be considerably greater than the proportion of water obtained from such source.

Because of the correction of the area irrigated by irrigation organizations on the basis of detailed comparisons of the reports for each irrigation organization with the records for the 1950 Census of Agriculture, the figures for the area irrigated by water from irrigation organizations for 1950 are not comparable with those for 1959 nor with those for 1940 and prior censuses. The difference between the area irrigated as shown by the 1959 census and the 1950 census for irrigation organizations overstates significantly the increase in the acreage irrigated by water furnished by irrigation organizations.

**Irrigation in Hawaii.**—The first census of irrigation organizations was taken for 1959. The figures for Hawaii have not been included with those of the 18 States in continuous United States because comparative data are not available for prior censuses. There were 16 organizations qualifying for the census of irrigation in Hawaii in 1959; these 16 organizations provided water for 86,949 out of the 141,179 acres irrigated in 1959 in Hawaii. The following table presents a summary of the more significant data for Hawaii. Of the 16 irrigation organizations in Hawaii, 10 were operated by commercial organizations and 6 by the State, cities, and other agencies.

SUMMARY FOR IRRIGATION ORGANIZATIONS IN HAWAII: 1959

Item (For definitions and explanations, see text)	Hawaii
Total acres irrigated in census year.....1959..	141, 179
Irrigation organizations.....organizations 1959..	16
Service area, 1959:	
Farm area reported served, by organizations.....acres 1959..	244, 888
Farm area reported irrigated, by organizations.....acres 1959..	85, 251
Water users served, total.....water users 1959..	50, 763
Farm irrigation water users.....water users 1959..	729
Residential water users.....water users 1959..	49, 342
Other water users.....water users 1959..	692
LAND IRRIGATED BY SOURCE OF WATER, 1959	
Ground water sources.....acres..	74, 000
Surface water sources.....acres..	67, 000
WATER CONVEYED BY IRRIGATION ORGANIZATIONS, 1959	
Total entering conveyance system in basin.....organizations..	16
From natural sources within basin.....organizations..	1, 007, 106
Surface water.....organizations..	1, 007, 106
Ground water.....organizations..	14
Conveyance loss in basin.....organizations..	437, 395
Surface water.....organizations..	11
Ground water.....organizations..	569, 711
Total leaving conveyance systems.....organizations..	16
Conveyance loss in basin.....organizations..	1, 007, 106
Surface water.....organizations..	10
Ground water.....organizations..	122, 596
Delivered for use in the basin.....organizations..	884, 510
To farm irrigation water users.....organizations..	16
To other water users.....organizations..	803, 333

## SUMMARY FOR IRRIGATION ORGANIZATIONS IN HAWAII: 1959—Con.

Item (For definitions and explanations, see text)	Hawaii
<b>AVERAGE DELIVERY OF IRRIGATION WATER PER ACRE, 1959</b>	
Per acre irrigated as reported by organizations.....acre-feet..	9.4
<b>NEW CAPITAL INVESTMENT, 1950-1959</b>	
Expenditures for additional new works and equipment for irrigation and drainage Jan. 1, 1950-Dec. 31, 1959.....organizations..	8
dollars.....	5,614,476
<b>ACRES IRRIGATED</b>	
Total acres irrigated.....farms reporting.....	1,251
acres.....	141,179
Acres irrigated by sprinklers.....farms reporting.....	546
acres.....	16,065
Sprinklers only.....farms reporting.....	475
acres.....	13,169
<b>LAND IRRIGATED, BY SOURCE OF WATER TO INDIVIDUAL FARMS, 1959</b>	
Ground water sources on farm.....farms reporting.....	219
acres.....	26,086
Ground water sources on farm only.....farms reporting.....	166
acres.....	9,449
Surface sources on farm.....farms reporting.....	334
acres.....	28,144
Surface sources on farm only.....farms reporting.....	289
acres.....	13,121
Irrigation organization sources.....farms reporting.....	781
acres.....	86,949
Irrigation organizations sources only.....farms reporting.....	713
acres.....	81,788
Both farm ground water sources and surface sources.....farms reporting.....	15
acres.....	14,909
Both irrigation organization and farm ground water or farm surface sources.....farms reporting.....	68
acres.....	21,912

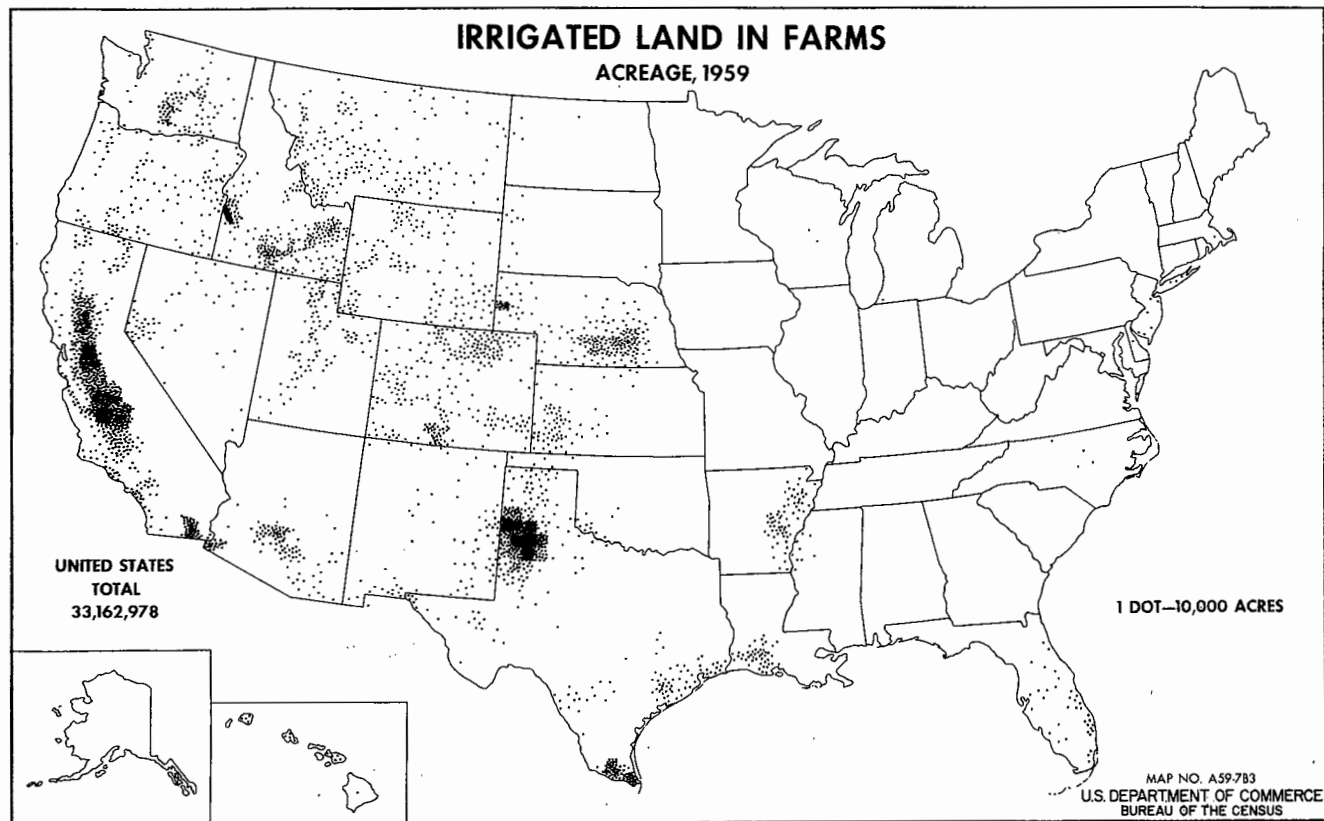
No data are available by drainage basins for Hawaii. Some irrigation works of considerable size are operated by sugarcane plantations to provide water for a single farm. Data for those irrigation operations for a single farm are not included in the data for irrigation organizations for Hawaii.

Irrigated land in sugarcane, vegetables, and pineapples accounts for more than four-fifths of the total acres irrigated in Hawaii. Detailed data regarding irrigated farms and the acreage and production of crops on irrigated land may be found in county tables 1a and 11a of part 50 of volume I of the reports for the 1959 Census of Agriculture.

## SUMMARY

This summary presents both current and historical data pertaining to irrigated farms and irrigated land in farms obtained in the 1959 and earlier censuses of agriculture; and data pertaining to irrigation organizations from the 1959 and earlier censuses of irrigation; and data pertaining to irrigation water obtained in the 1959 and earlier censuses, both agriculture and irrigation.

**Irrigated land in farms.**—The acreage irrigated in 1959 for the 48 conterminous (Alaska and Hawaii are excluded) States was 33,021,799 acres according to the 1959 Census of Agriculture. This was 11.7 percent greater than the 29,552,155 acres reported in 1954 and 28 percent greater than the 25,787,455 acres reported in 1950 for the calendar year 1949. For the 17 conterminous Western States and Louisiana, the 1959 irrigated area amounted to 31,222,967 acres, or 94.6 percent of the irrigated acreage for the 48 conterminous States. The increase in irrigated acreage for the 18 States was 12.8 percent from 1954 to 1959 and 25.7 percent from 1949 to 1959.



The change in irrigated acreage in the 18 States varied considerably by geographic areas. Of the 6.4 million acres net increase from 1949 to 1959, 42.2 percent occurred in the Plains States of Texas and Oklahoma; 29.4 percent in the Northern Plains States of Nebraska, Kansas, North and South Dakota; and 22.8 percent in three Pacific States of California, Washington, and Oregon. In the eight Mountain States, the net increase was only 452,228 acres or 7.1 percent of the total increase in the 18 States. Decreases were reported for Colorado, Nevada, and Utah, and also for Louisiana.

The largest acreage expansion in the 10-year period in any individual State was recorded in Texas with an increase of 2,524,104 acres, or 80.6 percent increase in the irrigated acreage from 1949 to 1959. Nebraska had an increase of 1,201,667 acres, or 137.1 percent, and California an increase of 957,246 acres, or 14.9 percent from 1949 to 1959.

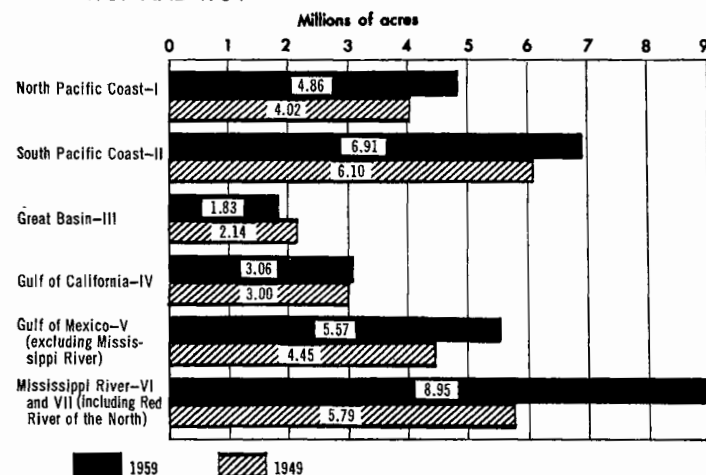
IRRIGATED LAND IN FARMS: 1959, 1954, AND 1949

Area or State	1959 (acres)	1954 (acres)	1949 (acres)
48 conterminous States, total.....	33,021,799	29,552,155	25,787,455
18 specified States, total.....	31,222,907	27,678,507	24,847,341
Northern Plains States.....	3,003,312	1,630,963	1,128,308
North Dakota.....	47,656	37,672	35,294
South Dakota.....	115,629	90,371	78,069
Nebraska.....	2,077,926	1,171,369	876,259
Kansas.....	762,101	331,551	138,686
Southern Plains States.....	5,853,270	4,815,179	3,165,605
Oklahoma.....	197,632	108,151	34,071
Texas.....	5,655,638	4,707,028	3,131,534
Louisiana.....	484,850	707,818	576,775
Mountain States.....	12,094,712	11,207,997	11,642,484
Montana.....	1,874,520	1,890,671	1,716,792
Idaho.....	2,576,580	2,324,571	2,137,237
Wyoming.....	1,469,911	1,262,632	1,431,767
Colorado.....	2,684,757	2,262,921	2,872,348
New Mexico.....	731,835	649,615	655,287
Arizona.....	1,152,450	1,177,407	963,560
Utah.....	1,061,683	1,072,682	1,137,996
Nevada.....	542,976	567,498	727,498
Pacific States (conterminous).....	9,786,823	9,316,550	8,334,169
Washington.....	1,006,969	778,135	589,035
Oregon.....	1,384,284	1,490,366	1,306,810
California.....	7,395,570	7,048,049	6,438,324

For the major drainage basins, the Mississippi River Basin, which includes all the Plains States except for the southern part of Texas, with 8.97 million acres, had the largest irrigated acreage, and its increase of 3.16 million acres over 1950 was the largest in any of the basins. The Great Basin had a small decrease in irrigated acreage from 1949 to 1959.

The different regional trends in the number of acres irrigated have been affected by a number of factors. The increase in

ACREAGE OF IRRIGATED LAND BY MAJOR DRAINAGE BASINS IN THE 17 CONTERMINOUS WESTERN STATES AND LOUISIANA: 1959 AND 1954

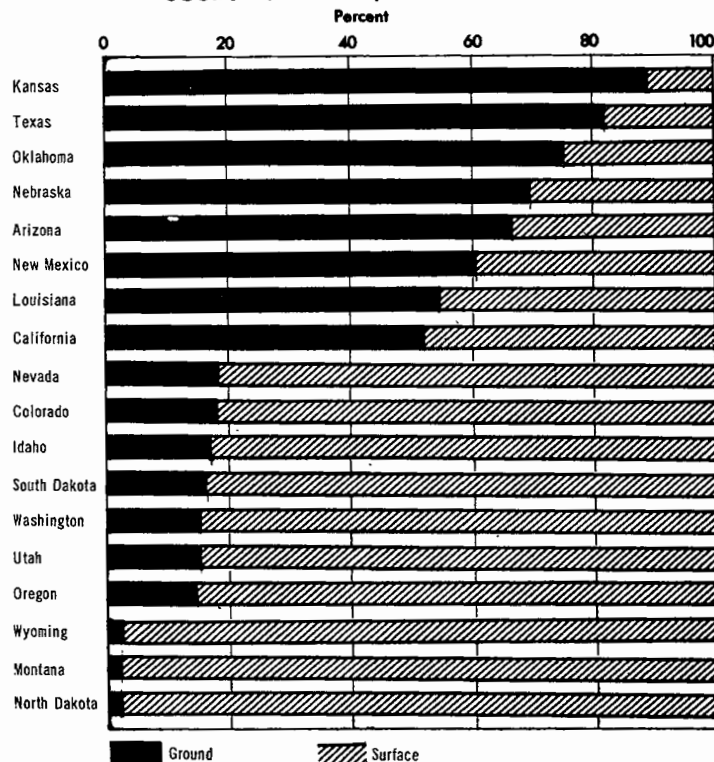


Nebraska, Kansas, Oklahoma, and Texas has been largely due to the development of ground-water supplies. In the Northern Plains States, irrigation expansion was in part the result of the development of large-scale public projects. In the Mountain States, ground-water supplies are not as plentiful as in the Plains States and surface-water supplies were more fully developed before 1950. Irrigation growth in the Pacific States has resulted from the availability of both ground- and surface-water supplies and the development of large-scale public irrigation projects. The decrease of irrigated acreage in Louisiana is largely the result of lower rice acreage, while the decrease in irrigated acreage in the Great Basin was largely the result of a water shortage in 1959.

Sources of irrigation water.—According to the 1959 Census of Agriculture, of the total of 31,222,967 acres irrigated in the 18 States, 13,243,912 acres, or 42.4 percent, were irrigated from ground-water sources on the farm; 5,081,250 acres, or 16.3 percent, were irrigated from surface-water sources on the farm; and 12,897,805 acres, or 41.3 percent, were irrigated by water received from irrigation organizations.

The irrigation organizations obtained the major portion of their water from surface-water sources. In the 18 States, the irrigation organizations reported 72,997,259 acre-feet of water were obtained from natural sources. Of this amount, 68,685,789 acre-feet, or 94 percent, was from surface sources.

PERCENTAGE DISTRIBUTION OF TOTAL ACRES IRRIGATED, BY SOURCE OF WATER, BY STATES: 1959



Arizona, Louisiana, and California are the only States in which the proportion of ground water obtained by irrigation organizations exceeded the average for the 18 States. In Arizona, irrigation organizations obtained 39 percent of the water from ground-water sources; in Louisiana, irrigation organizations obtained 16.4 percent; and in California, irrigation organizations secured 9.6 percent of the total water from ground-water sources.

To determine the total farm acreage irrigated from ground and surface sources, the acreage irrigated by organization water in each drainage basin was divided between ground and surface

sources in proportion to the amount of water obtained from each source by the irrigation organizations and these figures were added to the acreage irrigated from farm ground and surface sources. In this manner, the total farm acreage irrigated from ground-water sources was determined to be approximately 14.0 million acres or about 45 percent of the total acres irrigated. The total farm acreage irrigated from surface-water sources equaled about 17.2 million acres or about 55 percent of the total acres irrigated.

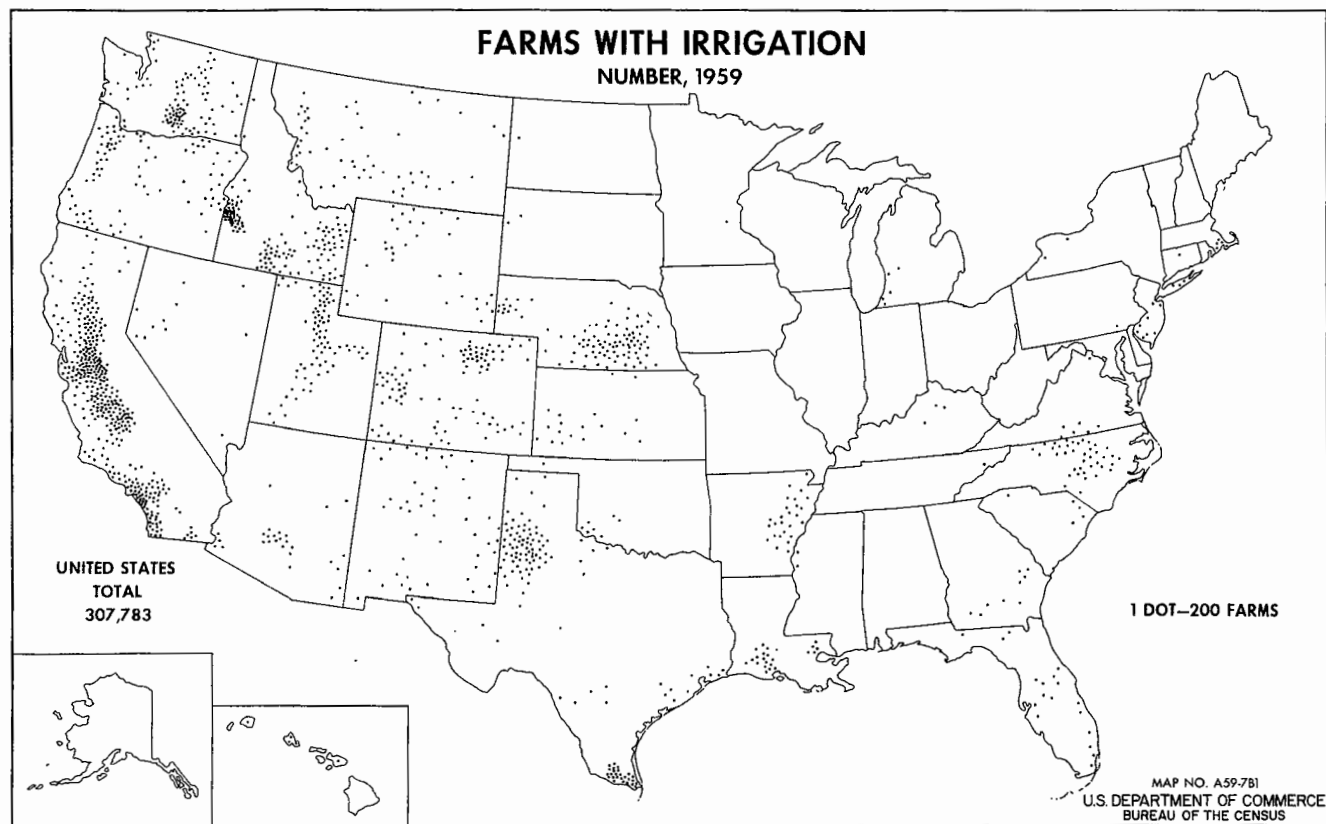
The percentage of the irrigation water which originated from ground or surface sources varied greatly among the 18 States. In Kansas 88.7 percent of the irrigation water was secured from ground sources. The corresponding percentages for North Dakota and Montana were 2 percent. The States with over 50 percent of the irrigation water received from ground sources were the Plains States of Nebraska, Kansas, Oklahoma, and Texas; and Arizona, New Mexico, and Louisiana. In each of the other 10 States, the proportion of the water from ground sources was less than 20 percent.

**Irrigated farms.**—There were 306,532 farms in the conterminous United States with irrigated land in 1959 according to the 1959 Census of Agriculture. In 1954, irrigated land was reported by 320,236 farms and in 1950 by 305,061 farms. The number of irrigated farms was almost the same in 1959 as in 1950 but the number decreased 4.3 percent between 1954 and 1959. In the 18 States the number of irrigated farms in 1959 was 7.4 percent smaller than in 1950 and 6.8 percent smaller than in 1954. The

number of irrigated farms decreased in all the Mountain States and in California and Louisiana. In each of the Plains States and Washington there was an increase in the number of irrigated farms from 1954 to 1959.

NUMBER OF IRRIGATED FARMS AND PERCENT OF ALL FARMS WITH IRRIGATION: 1959, 1954, AND 1950

Area or State	Number of irrigated farms			Percent of all farms reporting irrigation		
	1959	1954	1950	1959	1954	1950
48 conterminous States, total.....	306,532	320,236	305,061	8.3	6.7	5.7
18 States, total.....	267,431	286,793	288,914	25.6	22.2	20.2
Northern Plains States.....	25,001	16,558	11,957	8.2	4.8	3.2
North Dakota.....	471	399	304	0.9	0.6	0.5
South Dakota.....	1,002	923	807	1.8	1.5	1.2
Nebraska.....	18,936	12,500	9,680	20.9	12.4	9.0
Kansas.....	4,592	2,736	1,166	4.4	2.3	0.9
Southern Plains States.....	30,365	27,935	21,893	9.4	6.8	4.6
Oklahoma.....	2,481	1,620	466	2.6	1.4	0.3
Texas.....	27,884	26,315	21,427	12.3	9.0	6.5
Louisiana.....	4,817	6,897	7,438	6.5	6.2	6.0
Mountain States.....	96,094	112,231	122,280	64.5	62.3	62.8
Montana.....	11,935	13,114	13,457	41.2	39.7	38.4
Idaho.....	25,383	28,218	29,413	75.4	72.8	73.0
Wyoming.....	6,412	7,130	7,831	65.8	62.5	62.1
Colorado.....	20,312	23,355	27,121	60.8	57.3	59.5
New Mexico.....	8,850	11,690	12,691	55.6	55.5	53.8
Arizona.....	5,391	6,809	7,822	74.5	73.1	75.1
Utah.....	15,701	19,406	21,126	88.2	85.0	87.4
Nevada.....	2,110	2,509	2,819	89.6	87.8	90.6
Pacific States (conterminous).....	111,154	123,172	125,346	57.5	50.8	47.0
Washington.....	19,292	18,844	16,928	37.4	28.9	24.2
Oregon.....	17,724	19,826	17,663	41.6	36.4	29.5
California.....	74,138	84,502	90,755	74.7	68.7	66.2



In the areas showing a decrease in the number of irrigated farms, the decline was largely the result of the consolidation of farms into larger operating units. The States with an increase in the number of irrigated farms also showed an increase in irrigated acreage. In the States with an increase in the number of farms with irrigation, irrigation was introduced on some of

the existing farms and in some cases the introduction of irrigation resulted in the division of existing dryland farms into a larger number of smaller irrigated farms. With the exception of Arizona and Nevada, a larger proportion of the farms in each of the 18 States had irrigation in 1959 than in 1950.

**Irrigation organizations.**—A total of 8,749 irrigation organizations was included in the 1959 Census of Irrigation in the 17 conterminous Western States and Louisiana. This compares with 10,491 organizations in 1950. In Kansas, North Dakota, and South Dakota there was a larger number of irrigation organizations in 1959 than in 1950.

**Types of irrigation organizations.**—The number of mutual organizations reported in 1959 was 7,726. Of these, 4,989 were classified as unincorporated and 2,737 as incorporated. The total number of mutual organizations had declined from 9,348 in 1950 when there were 6,464 unincorporated organizations and 2,884 incorporated organizations.

The number of mutual organizations, incorporated and unincorporated combined, decreased in 16 States. The decrease in the number of mutual organizations resulted from several factors. In California, the agricultural lands of many of the smaller organizations have been converted to urban uses. In New Mexico, many of the small organizations did not have a water supply in 1959 and, therefore, were not included in the census. In all States, some of the small mutual organizations which had served two or three farms in 1950, did not qualify for inclusion in the 1959 census because of the consolidation of the farms served by them.

The combined irrigated acreage reported by both the unincorporated and the incorporated mutuals equals 8.8 million acres. This is larger than the irrigated acreage reported by any other type of organization. However, the 6.9 million acres reported irrigated by irrigation districts is greater than the acreage reported by either type of mutual organization alone.

There were 558 irrigation districts reported in the 1959 Census of Irrigation which was an increase from 483 in 1950. The number of irrigation districts increased in 10 of the 18 States. In Nevada, the number was identical for both 1950 and 1959. There were no irrigation districts in Louisiana.

The number of projects or storage systems (see page xvi "Organizations included" for definition of project) operated by the Bureau of Reclamation increased from 37 in 1950 to 54 in 1959. The 54 projects reported 710,904 acres irrigated; however, these figures do not represent the total contribution of the Bureau of Reclamation to irrigation. Usually as the Bureau of Reclamation completes a project, the project is turned over to a water-users organization for operation. These organizations were enumerated under the type of organization they represented (in most cases, irrigation districts). In the 1959 Census of Irrigation, there were 147 organizations which had been built by the Bureau of Reclamation but were then operated by water-users organizations. These 147 organizations reported 3.3 million acres irrigated. This represents the total number of organizations for which the irrigation facilities were built by the Bureau of Reclamation and turned over to water users for operation.

The number of commercial organizations in the 18 States, dropped from 401 in 1950 to 246 in 1959. There was a decrease in the number of commercial organizations in both Louisiana and California, the only States where commercial organizations are important. The decrease in the number of organizations in California was largely the result of farm lands being taken over for urban and suburban development. In Louisiana, a number of commercial irrigation organizations did not qualify for inclusion in the census because they provided water for only one farm.

According to the 1959 Census of Irrigation, there were 123 United States Bureau of Indian Affairs irrigation projects. This was a decline from the 141 reported in 1950. The decrease resulted largely from differences in counting projects as independent irrigation organizations, when some of the projects were controlled by the same part of the Bureau of Indian Affairs.

**Interrelationships between irrigation organizations.**—Many irrigation organizations do not deliver all of their water for irrigation direct to farms, but rather deliver part or all to other irriga-

tion organizations which may deliver to farms or which in turn may deliver water to still other irrigation organizations.

Out of the 8,749 total irrigation organizations, reported in the 18 States, 5.2 percent received part of their water from other organizations, and 8 percent received all of their water from other organizations. In the 18 States, irrigation organizations reported 56.1 million acre-feet of water delivered to farm and residential water users. Of this amount 18.8 percent was delivered by organizations which obtained part of their water from other organizations, and 7.5 percent was delivered by organizations which received all of their water from other organizations.

The delivery of part of the water to other organizations was reported by 379 organizations or 4.3 percent of all organizations. The delivery of all water to other organizations was reported by only 67 organizations. Organizations supplying part of their water to other organizations delivered 8.7 million acre-feet of water to those other organizations or 9.5 percent of the total water conveyed, including water delivered to other organizations. Organizations, delivering all of their water to other organizations supplied 9.9 million acre-feet of water or 10.8 percent of the total water conveyed.

**Size of organization.**—Data are presented for the three measures of size of organizations. Acre-feet of water conveyed constitutes the most accurate measure of size. Of the 8,749 irrigation organizations in the 18 States, 8,669 conveyed water (the other 80 operated reservoir facilities and released all water to natural stream channels). The 8,669 organizations which conveyed water, reported an average of 10,571 acre-feet of water conveyed. This average includes quantities delivered to other organizations. More irrigation organizations were in the size group conveying 300 to 999 acre-feet of water than in any other size group. There were 1,707 organizations which conveyed 1 to 299 acre-feet and 2,059 organizations which conveyed between 1,000 to 2,999 acre-feet. There were 132 organizations which conveyed over 100,000 acre-feet of water.

**Capital investment.**—The data given for capital investment of irrigation organizations are not precise. In the 1940 Census of Irrigation the organizations were asked to report the total investment in their works and equipment as of December 31, 1939. In the censuses of 1950 and 1959 the organizations were asked to report only capital investments made during the 10-year period preceding the census. These figures which have been added together to obtain total capital investment and the total have not been adjusted to take into account changes on the price level. The amounts of investment reported by the smaller organizations are largely estimates. Many changes in ownership, organization, and method of computing the valuation have influenced the accuracy of the figures for capital investment.

**Farms by extent of irrigated crops.**—For tabulation purposes, farms in the 18 States were classified into four groups: (1) Farms with all crops irrigated, (2) farms with part of the crops irrigated, (3) farms with land irrigated and no crops harvested from irrigated land, and (4) farms with no irrigated land. The summary for these four groups of farms for the 18 States for 1959 follows:

Item	All farms	Farms with all crops harvested, irrigated	Farms with part of crops harvested, irrigated	Farms with irrigated land, but no crops harvested from irrigated land	Farms with no irrigated land
Number of farms.....	1,044,166	178,029	64,404	24,998	776,735
Land in farms.....acres..	714,860,571	105,108,816	92,395,396	15,826,185	501,530,174
Land irrigated.....acres..	31,222,967	22,142,351	8,133,410	947,206	-----
Cropland harvested, total.....acres..	144,414,833	18,747,587	19,089,304	644,946	105,932,996
Irrigated.....acres..	26,198,581	18,747,587	7,450,994	-----	-----
Not irrigated.....acres..	118,216,252	-----	11,638,310	644,946	105,932,996
Land other than cropland harvested irrigated.....acres..	5,024,386	3,394,764	682,416	947,206	-----

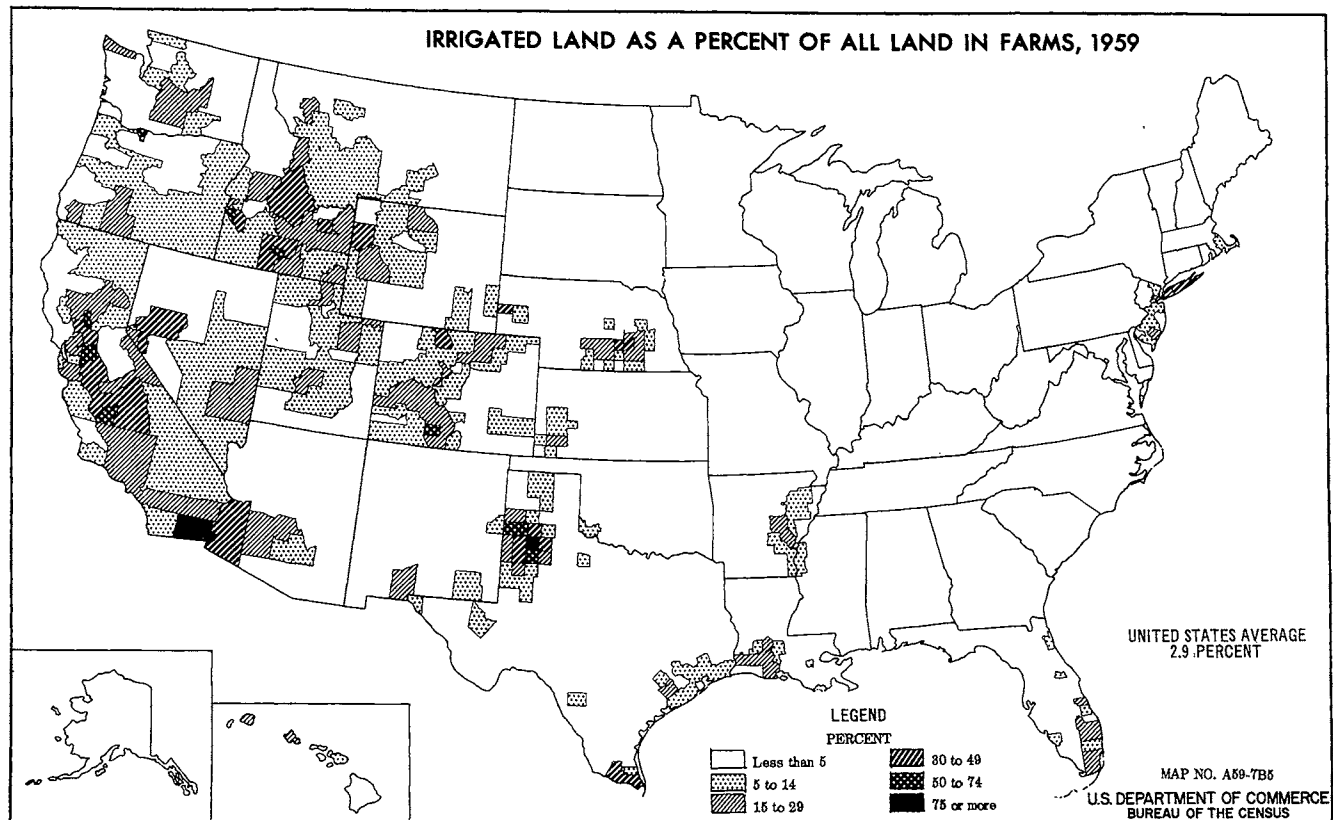


## IRRIGATION OF AGRICULTURAL LANDS

Of the 1,044,166 farms in the 18 States, only 267,431 reported land irrigated in 1959 and only 31.2 million acres were irrigated of the 715 million acres of land in farms in these States. Irrigated farms in these States contained over 213 million acres of land. In 1959, crops were harvested from 26.2 million acres of the 31.2 million acres irrigated. The 5 million acres of irrigated land from which no crops were harvested were largely irrigated pastureland, although a part of the acreage was irrigated land in cultivated summer fallow.

In the 18 States there were 144.4 million acres of land from which crops were harvested but only 26.2 million acres, or 18

percent, were irrigated in 1959. Approximately 68 percent (26.2 million acres) of the 38.5 million acres of land from which crops were harvested on farms with irrigation were irrigated in 1959. There were 178,029 farms on which all crops harvested were irrigated. Those farms had 71 percent of all irrigated land and 72 percent of the irrigated land from which crops were harvested. There were 24,998 farms with no crops harvested from irrigated land in 1959. These farms had 947,206 acres of irrigated land and nearly 645,000 acres of land from which crops were harvested. A large part of the irrigated land on these 24,998 farms was used for pasture.



In order to facilitate the tabulation of census data on crops, farm operators were asked to indicate which crops on their farms were entirely irrigated in 1959 and to report the acreage irrigated for those crops which had only a part of the harvested acreage irrigated in 1959.

There were approximately 26.2 million acres of crops harvested from irrigated land in the 18 States. Only data for the acreage harvested are available for the crops for which only part of the acreage harvested was irrigated, since farm operators were not asked to report separately the quantity harvested from the irrigated land if only a part of the acreage for a crop was irrigated.

The data in summary table 4 for crops harvested on irrigated farms relate only to the crops for which the entire area harvested was irrigated. The entire acreage harvested and the production were included in the totals for nonirrigated crops when only part of the acreage of the crop on a farm was irrigated. The figures for nonirrigated crops include about 2.9 million acres of irrigated crops for 1959 and more than 2.0 million acres of irrigated crops for 1954. This procedure should be kept in mind if the figures are to be used in making comparisons of relative yields for irrigated and nonirrigated crops. Since the acreage irrigated is not available for those crops for which only a part of the acreage

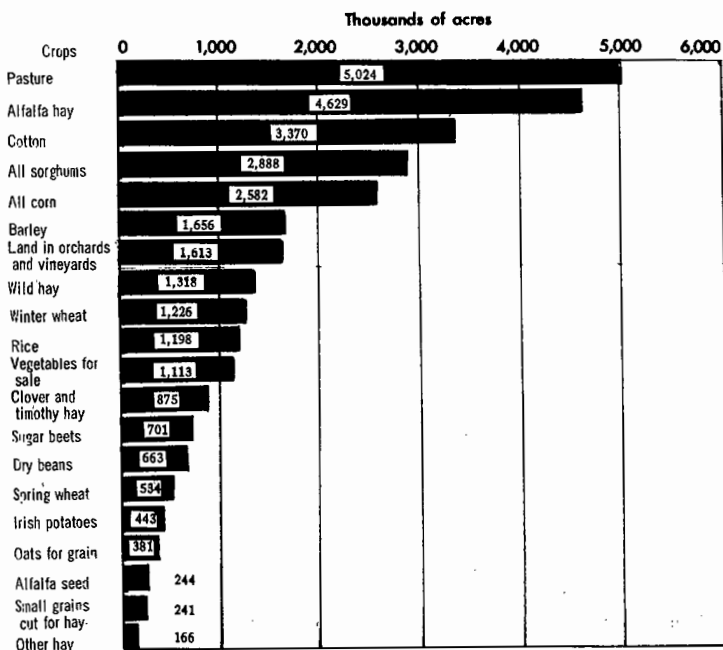
harvested was irrigated in 1954, the data in summary table 4 cannot be used to measure the change from 1954 to 1959 in the irrigated acreage of each crop harvested. Summary table 3 presents the total acres irrigated for each crop in 1959 and also the acreages irrigated for those crops for which only a part of the acreage was irrigated in 1959. Six crops—sorghums (755,000 acres), corn (725,000 acres), hay (483,000 acres), wheat (432,000 acres), cotton (446,000 acres), and barley (92,000 acres)—accounted for a total of 98 percent of the 3,000,000 acres of irrigated crops harvested on farms on which only a part of the acreage of such crops was irrigated in 1959. These were the only crops for which as much as 3 percent of the total acreage of the irrigated crop was reported on farms on which only a part of the crop was irrigated.

**Importance of crop production on irrigated land.**—In order to indicate the importance of the production of each crop harvested on irrigated land, estimates have been made for the production on the irrigated part for each crop irrigated, when only part of the acreage of the crop was irrigated. These estimates represent approximations as the estimates have been made by assuming that the yield per acre for the acreage irrigated for crops for which only part of the acreage was irrigated was the same as for the acreage for which the entire acreage was irrigated. These estimates have been made only for the 18 States as a group.

ESTIMATED PRODUCTION OF PRINCIPAL CROPS HARVESTED FROM IRRIGATED LAND  
FOR 18 SPECIFIED STATES: 1959

Crop	Estimated total production on irrigated land in 18 States			Reported production on irrigated land where all of crop was irrigated	Estimated production on irrigated land where part of crop was irrigated
	Total	Percent of total for 18 States	Percent of total for conterminous United States		
FIELD CROPS					
Corn harvested for grain..... bushels.....	150,415,229	27.9	4.1	98,228,621	52,186,608
Sorghums harvested for grain..... bushels.....	172,646,780	36.4	34.0	124,396,146	48,250,634
Small grains harvested, total..... acres.....	5,251,160	8.1	5.4	4,703,047	548,113
All wheat..... bushels.....	69,166,629	8.7	6.6	52,182,584	16,984,045
Winter wheat..... bushels.....	41,979,119	6.7	4.8	28,394,776	13,584,343
Spring wheat..... bushels.....	25,451,952	15.2	13.4	23,787,808	1,664,144
Oats..... bushels.....	18,072,472	9.2	1.8	17,264,207	808,265
Barley..... bushels.....	84,649,138	25.3	21.3	79,952,435	4,696,703
Rye..... bushels.....	354,306	2.8	1.6	333,790	20,516
Flaxseed..... bushels.....	1,392,599	9.5	7.1	1,387,544	5,055
Rice..... bushels.....	89,791,855	100.0	74.3	89,791,855	.....
Other grains..... acres.....	202,372	22.3	17.4	196,386	5,986
Soybeans harvested for beans..... bushels.....	1,407,958	6.1	0.3	1,324,568	83,390
Cowpeas harvested for peas..... bushels.....	102,825	14.6	7.0	91,132	11,693
Dry field and seed beans harvested for beans..... 100-lb. bags.....	11,631,511	95.7	60.9	11,487,993	143,518
Dry field and seed peas harvested for peas..... bushels.....	1,546,990	18.9	18.6	1,530,259	16,731
Hay:					
Alfalfa and alfalfa mixtures cut for hay..... tons.....	16,101,913	60.6	26.9	15,103,044	998,869
Clover, timothy, and mixtures of clover and grasses cut for hay..... tons.....	1,312,367	52.9	5.9	1,231,371	80,996
Lespedeza cut for hay..... tons.....	1,085	0.5	(Z)	1,085	.....
Vetch or peas cut for hay..... tons.....	7,400	13.8	13.8	6,367	1,033
Oats, wheat, and other small grains cut for hay..... tons.....	424,104	18.8	11.6	402,247	21,857
Wild hay cut..... tons.....	1,311,603	17.0	15.2	1,203,257	108,346
Other hay cut..... tons.....	257,685	10.7	4.2	229,561	28,024
Grass silage..... tons, green weight.....	373,465	29.3	46.9	331,297	42,168
Alfalfa seed harvested..... bushels.....	1,264,816	72.0	69.8	1,254,359	10,457
Red clover seed harvested..... bushels.....	218,447	66.4	14.8	218,000	447
Sweetclover seed harvested..... bushels.....	14,572	6.2	3.8	14,514	58
Cotton harvested..... bales.....	5,303,255	68.0	38.1	4,589,108	714,147
Irish potatoes harvested..... bushels.....	163,701,963	86.8	43.8	162,477,070	1,224,893
Sweetpotatoes harvested..... bushels.....	2,112,923	21.0	7.2	2,056,912	56,011
Sugar beets harvested..... tons.....	13,821,730	97.2	82.2	13,796,573	25,157
Hops harvested..... pounds.....	54,032,675	99.0	99.0	53,527,469	505,206
Popcorn harvested..... 1,000 lb. ear corn.....	9,551	29.1	3.9	8,299	1,252
BERRIES AND SMALL FRUITS					
Berries and other small fruits harvested for sale, total..... acres.....	33,618	51.4	17.5	32,213	1,405
Strawberries..... quarts.....	148,044,034	78.2	53.0	141,303,547	6,740,487
Blackberries and dewberries..... quarts.....	8,938,360	43.4	40.3	8,597,110	341,250
Boysenberries..... quarts.....	10,325,023	73.2	70.4	10,136,177	188,846
Raspberries..... quarts.....	6,368,156	30.3	19.1	6,038,888	329,268
Cranberries..... barrels.....	154,301	100.0	13.0	154,301	.....
Blueberries..... quarts.....	952,342	43.7	2.9	903,508	48,834
Other berries..... acres.....	509	18.5	13.3	474	35

Z Less than 0.05 percent.

IRRIGATED ACREAGE OF SPECIFIED CROPS AND PASTURE IN THE  
17 WESTERN STATES AND LOUISIANA: 1959

The making of estimates using the same procedure by counties or by States would provide different totals. The estimated production for the irrigated acreage where only part of the acreage was irrigated represents 6 percent or more of the total production for only seven crops, sorghums (28 percent), corn (35 percent), hay (6 percent), wheat (25 percent), cotton (13 percent), popcorn (13 percent), and cowpeas for peas (11 percent).

No data are available regarding the production of tree fruits, nuts, and grapes on irrigated land. However, the irrigated acreage of tree fruits, nuts, and grapes represents almost 80 percent of the total acreage in the 18 States and almost 40 percent of the total acreage in the 48 States. The value of the fruit, nut, and grape crops in the 18 States was \$708 million in 1959. A large part of this value was for crops harvested from irrigated land. The value of the tree fruit, nut, and grape crops in the 18 States comprised 55 percent of the value of these crops in the 48 conterminous States. Thus, at least half of the tree fruit, nut, and grape crops in the 48 conterminous States were produced in 1959 on irrigated land in the 18 States.

Data are not available for the production on irrigated land of vegetables harvested for sale. The following table summarizes the acreages of vegetables grown for sale on irrigated land in the 18 States as well as the total acreages of vegetables harvested for sale in the 18 States and in the 48 conterminous States.

Item	Total acreage 48 States	Acreage for 18 States			
		Total	Irrigated total	Irrigated acreage as a percent of total for 48 States	Irrigated acreage as a percent of total for 18 States
All vegetable crops.....	3,486,741	1,439,729	1,113,305	31.9	77.3
Asparagus.....	162,914	100,581	98,993	60.8	98.4
Green snap beans.....	243,983	36,196	29,576	12.1	81.7
Cabbage.....	111,324	38,851	32,719	29.4	84.2
Cantaloups and musk- melons.....	133,751	97,513	90,015	67.3	92.8
Sweet corn.....	617,362	93,597	78,093	12.6	83.4
Lettuce and romaine.....	200,577	181,144	179,937	89.7	99.3
Dry onions.....	101,569	71,692	58,935	58.0	82.2
Green peas.....	334,221	146,445	24,569	7.4	16.8
Tomatoes.....	445,133	218,471	210,698	47.3	96.4
All other.....	1,077,301	455,239	309,770	28.8	68.0
Value of vegetables har- vested for sale.....	Dollars 736,244,138	Dollars 370,033,730	NA	NA	NA

NA Not available.

**Relation of water used for irrigation and other purposes.**—Data on quantity of water used for irrigation purposes are available only for water delivered to farms by irrigation organizations. Irrigation organizations provided water for the irrigation of 12.9 out of the 31.2 million acres irrigated in 1959. Irrigation organizations delivered 54.5 million acre-feet of water to farm irrigation water users. However, 9.8 million acre-feet of water was delivered to farms where water from other sources was also used for irrigation purposes. The average amount of water delivered to farms per acre irrigated, for those irrigation organizations reporting the quantity of water delivered and the acres irrigated for farms receiving water for irrigation purposes from irrigation organizations only, was 3.2 acre-feet per acre irrigated for the 18

States. The acre-feet per acre irrigated reported for their irrigation organizations varied from 1.2 to 4.8 acre-feet per acre in the 18 States. If it is assumed that the average acre-feet used per acre irrigated reported by these irrigation organizations indicate the approximate use of water per acre irrigated for land irrigated for each of the 18 States, then the total quantity of water used for irrigation purposes in the 18 States would be approximately 92 million acre feet in 1959. The conveyance loss of water as reported by irrigation organizations totaled 15.8 million acre-feet. The conveyance loss does not include losses from evaporation and other causes in reservoirs. The area of the principal reservoirs and regulated lakes in the 17 States is 3,446,000 acres and the estimated annual evaporation from these reservoirs and lakes is 12,299,000 acre-feet (Evaporation from the 17 Western States. Geological Survey Professional Paper 272-D, Geological Survey, U.S. Department of the Interior). Thus, the total water withdrawn for irrigation uses in the 18 States was approximately 120 million acre-feet in 1959. The 1958 Census of Manufacturers reported the withdrawal of 2,978 billion gallons or 9 million acre-feet of water in 1959 in the 18 States. However, 92 percent of the water withdrawn by industry was discharged into the stream, etc., and therefore may have been available for reuse.

In the 18 irrigation States, water withdrawn for the use of livestock and poultry and for public use is a small percent of withdrawals for all purposes. A large part of the water withdrawn for industrial use is returned to streams and may be reused but the water delivered to farms for irrigation purposes is not available for reuse because of transpiration and evaporation. Water used for irrigation may have amounted to as much as nine-tenths of the total water consumed in the 18 States.