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1940

UNITED STATES DEPARTMENT OF COMMERCE

JESSE H. JONES, Secretary

BUREAU OF THE CENSUS

J. C. CAPT, Director (Appointed May 22, 1941)

WILLIAM LANE AUSTIN, Director (Retired January 31, 1941)

PHILIP M. HAUSER, Assistant Director

HOWARD H. McCLURE, Assistant Director



SIXTEENTH CENSUS OF THE UNITED STATES: 1940

IRRIGATION OF AGRICULTURAL LANDS

Irrigation Enterprises, Areas, Irrigation Works,
Investment, Indebtedness, Maintenance and
Operation, Water Used, Pay Roll and Employees,
and Irrigated Crops, With Detailed Statistics for
Drainage Basins and Counties, and Summaries
for States and the United States

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Library*

Prepared under the supervision of
ZELMER R. PETTET
Chief Statistician for Agriculture

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942

BUREAU OF THE CENSUS

J. C. CAPT, *Director (Appointed May 22, 1941)*

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Vital Statistics—HALBERT L. DUNN, *Chief Statistician.*

LETTER OF TRANSMITTAL

DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
Washington, D. C., November 5, 1942

SIR:

I transmit herewith the volume on Irrigation of Agricultural Lands of the Sixteenth Decennial Census. This report contains detailed statistics for drainage basins and counties with summaries for the States and the United States. State reports, contained in this volume, were first published as separate bulletins.

Provision for the 1940 Census of Irrigation was made in the Act providing for the Fifteenth Decennial Census which was approved on June 18, 1929. Through the medium of mail and field canvasses, returns were obtained from all types of irrigation enterprises, except enterprises of the United States Government which were reported directly to the Bureau of the Census.

The collection and compilation of these statistics and the preparation of this volume were made under the supervision of Z. R. Pettet, Chief Statistician for Agriculture, with the assistance of Sherman S. Slick, Assistant Chief Statistician, and Milo B. Williams, Principal Irrigation Engineer. Much helpful aid was furnished by other members of the Division of Agriculture. The graphic material was prepared under the supervision of Clarence E. Batschelet, Geographer of the Census.

Acknowledgment is made also of the assistance and cooperation of Paul A. Ewing, Irrigation Economist, U. S. Department of Agriculture, who acted in a consultant capacity; Wells A. Hutchins, Senior Irrigation Economist, Soil Conservation Service, U. S. Department of Agriculture; G. W. Lineweaver, Chief of Research Section, Bureau of Reclamation, Department of the Interior; and of the Division of Statistical Standards, Bureau of the Budget.

Respectfully,

J. C. CAPT,
Director of the Census

Hon. JESSE H. JONES,
Secretary of Commerce

III

SIXTEENTH CENSUS OF THE UNITED STATES: 1940

REPORTS ON AGRICULTURE, IRRIGATION, AND DRAINAGE

Volume I.—Statistics by Counties for Farms, and Farm Property, with Related Information for Farms and Farm Operators; Live-stock and Livestock Products; and Crops.

Part 1.—New England, Middle Atlantic, and
East North Central States
2.—West North Central States
3.—South Atlantic States

Part 4.—East South Central States
5.—West South Central States
6.—Mountain and Pacific States

Volume II.—Statistics by Counties for Value of Farm Products, Farms Classified by Major Source of Income, and Farms Classified by Total Value of Products.

Part 1.—Northern States

Part 2.—Southern States

Part 3.—Western States

Volume III.—General Report—Statistics by Subjects for the United States, Geographic Divisions, and States.

Chapter I.—Farms and Farm Property
II.—Size of Farms
III.—Color, Tenure, and Race of
Farm Operators
IV.—Farm Mortgages and Farm
Taxes
V.—Work Off Farm, Age, and
Years on Farm

Chapter VI.—Cooperation, Labor, Expenditures,
Machinery, Facilities, and
Residence
VII.—Livestock and Livestock Products
VIII.—Field Crops and Vegetables
IX.—Fruits and Nuts and
Horticultural Specialties
X.—Value of Farm Products

United States Summary Bulletins.—Statistics for the United States, Geographic Divisions, and States in condensed form as follows:

First Series Summary—Number of Farms, Uses of Land, Values, Principal Classes of Livestock and Livestock Products; and Specified Crops Harvested.

Second Series Summary—Farm Mortgages, Taxes, Labor, Expenditures, and Miscellaneous Farm Information; Goats and Mohair; and Fruits, Vegetables, and Minor Crops.

Third Series Summary—Value of Farm Products, Farms Classified by Major Source of Income, and Farms Classified by Total Value of Products.

Special Poultry Report.—Statistics by Geographic Divisions and States for Poultry of All Kinds on Hand and Raised; by Counties for Chickens and Chicken Egg Production by Number of Chickens on Hand; and by Counties for Farms Reporting Chickens and Turkeys Raised by Numbers Raised (one volume).

Cows Milked and Dairy Products—Number of Cows Milked, Milk Produced, Disposition of Dairy Products, and Number of Cows Kept Mainly for Milk Production, Classified by Number of Cows Milked, by Counties; with Related Data for Other Classes of Livestock and Livestock Products for the States and also for the United States.

Territories and Outlying Possessions.—Farms and Farm Property, Livestock and Livestock Products, and Crops (one volume). (Separate agricultural bulletins are available for Hawaii and Puerto Rico).

Territories:
Alaska
Hawaii
Puerto Rico

Outlying Possessions:
American Samoa
Guam
Virgin Islands of the United States

Irrigation of Agricultural Lands.—Statistics by Drainage Basins and by Counties for 20 Irrigation States and a Summary for the United States (one volume).

Twenty Separate State Maps Showing Irrigation by Drainage Basins.
A Separate Composite Map Showing Irrigation by Drainage Basins.

Drainage of Agricultural Lands.—Statistics for 38 Drainage States with County Data for 38 States and a summary for the United States (one volume).

A Separate Map of the United States Showing Location of Land in Drainage Enterprises for 38 States.

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| Census of Agriculture—Number of farms, farm acreage according to use, and specified farm values for irrigated and nonirrigated farms, by tenure of operator, 1940----- | 92 | 116 | 132 | 184 | 668 | 232 | 270 | 292 | 312 | 354 | 384 | 414 | 444 | 458 | 474 | 510 | 528 | 566 | 600 | 630 |
| Number of enterprises, irrigable area, area works were capable of supplying with water, 1940; irrigated area, 1939, 1929, and 1919; water delivered to irrigators, 1939; by source of water supply----- | 93 | 117 | 133 | 185 | 669 | 233 | 271 | 293 | 313 | 355 | 385 | 415 | 445 | 459 | 475 | 511 | 529 | 567 | 601 | 631 |
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| Investment in irrigation enterprises, by type of enterprise: 1940, 1930, and 1920----- | 94 | 118 | 134 | 186 | 670 | 234 | 272 | 294 | 314 | 356 | 386 | 416 | 446 | 460 | 476 | 512 | 530 | 568 | 602 | 632 |
| Indebtedness, arrearage, and charges, by type of enterprise, Census of 1940----- | 95 | 118 | 135 | 187 | 671 | 235 | 273 | 295 | 315 | 357 | 387 | 417 | 447 | 461 | 477 | 513 | 531 | 569 | 603 | 633 |
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| Area within irrigation enterprises for which drains have been installed, and additional area in need of drainage: 1940, 1930, and 1920----- | 96 | 120 | 136 | 189 | 671 | 236 | 275 | 296 | 316 | 358 | 388 | 418 | 448 | 462 | 478 | 515 | 533 | 570 | 604 | 635 |
| Water used, by source of supply: 1939, 1929, and 1919----- | 97 | 120 | 137 | 189 | 671 | 237 | 275 | 297 | 317 | 359 | 389 | 419 | 449 | 463 | 479 | 515 | 533 | 571 | 605 | 635 |
| Area irrigated, by type of rights under which water was delivered: 1939, 1929, and 1919----- | 97 | --- | 137 | 189 | --- | 237 | 275 | --- | 317 | 359 | 389 | 419 | 449 | 463 | 479 | 515 | 533 | 571 | 605 | 635 |
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| Farm values, 1940; enterprises and irrigation works, 1940, 1930, and 1920; and pay roll and number of employees, 1939----- | 114 | 130 | 178 | 226 | 679 | 266 | 288 | 309 | 348 | 378 | 411 | 440 | 456 | 472 | 506 | 526 | 556 | 597 | 625 | 665 |

¹The Census of Irrigation included Florida for the first time in 1940. The table titles herewith are not always applicable.

INTRODUCTION

(Section A)

SUMMARY FOR THE UNITED STATES

Milo B. Williams, *Principal Irrigation Engineer*
Paul A. Ewing, *Consultant*

INTRODUCTION

History of the Census of Irrigation.—Inquiries relating to irrigation were first made for the Eleventh Decennial Census taken in 1890 by the Bureau of the Census in 16 western States. These statistics were published in a separate report, "Agriculture by Irrigation in the Western Part of the United States." The Twelfth Decennial Census taken in 1900 included, as a part of the Census of Agriculture, irrigation inquiries in the same 16 States and these statistics were included in the State reports of the Census of Agriculture. A special Census of Irrigation was taken in 1902 and the statistics were published in Bulletin No. 16, of the Bureau of the Census, 1904. An irrigation census was taken as a part of the Census of Agriculture in the years of 1910, 1920, 1930, and 1940 and the data published for each Irrigation Census as separate reports. An inquiry relating to irrigated cropland harvested was also included in the middecennial Census of Agriculture in 1935, but these data were published in the Agriculture Reports for that year.

Presentation of statistics.—This volume presents statistics for irrigation in the United States collected by the Bureau of the Census in 1940 and shows some comparable data from the Irrigation Censuses of 1890, 1900, and 1910 and to a greater degree for 1920 and 1930.

Included are a summary for the United States and reprints of statistics for the 20 States where an Irrigation Census was taken on special schedules in 1940. These State reports were first presented in 18 separate bulletins (data for the States of Arkansas and Oklahoma were combined in one bulletin and those for North Dakota and South Dakota in another) entitled "Irrigation of Agricultural Lands." In addition to the statistics obtained on the special irrigation schedules, data are also shown for all States as obtained on the Farm and Ranch Schedule in the Agricultural Census.

Statistics for 17 western States and Arkansas and Louisiana are summarized as one group, and the less extensive statistics for the remaining 29 States are presented as a second group to represent the more humid portion of the United States. Although a special schedule was used for the 1940 Irrigation Census in Florida, the statistics for this State are summarized with the humid group as there are no historic data to present, comparable to the data for the 19 States in the western portion of the United States.

The following textual matter relates to the tabulations presented in this volume.

Method of collecting information.—The plan followed in both the Fifteenth and Sixteenth Decennial Censuses for the canvass of irrigation enterprises involved the use of two schedules designated as Irrigation-1 and Irrigation-2. The simpler of these schedules, or Irrigation-1, was used by the enumerators engaged in the canvass of population and agriculture to obtain reports of individual, partnership, and cooperative enterprises serving 1 to 4 farms. The more elaborate, or Irrigation-2, schedule was used in a preliminary canvass by mail, which was followed by a field canvass by special irrigation technicians. Through the medium of the mail and field canvasses reports were obtained from all types of irrigation enterprises serving 5 or more farms, except Government enterprises which were reported direct to the Bureau of the Census by the Commissioner of the Bureau of Reclamation and the Commissioner of the Office of Indian Affairs, the separate reports being prepared by local division or project engineers under the supervision of these officials.

Census dates.—The dates of the Sixteenth and Fifteenth Decennial Censuses were as of April 1, 1940 and 1930, respectively, while the date of the Fourteenth Decennial Census was as of January 1, 1920. The change of date did not affect the comparison interval of 10 years used in this report because, in general, the statistics of farms, areas irrigated, crops grown under irrigation, and amounts and costs of water related to the calendar years preceding the years of enumeration. The statistics of acreages to which existing works were capable of supplying water related to the year in which the enumeration was made, and the statistics of capital investment were as of December 31 of the preceding year, thus also retaining the comparative interval of exactly 10 years. Enterprises which began to operate after January 1, 1940 were not included in the Sixteenth Decennial Census enumeration.

Scope of the Census of Irrigation.—The basic inquiries in the irrigation census of 1940 were similar to those made in previous censuses; namely, (1) the type of the irrigation enterprises as indicated by the character of their organizations, (2) the areas of irrigable lands in enterprises and under irrigation, (3) the physical structures used in diverting, lifting, storing, and distributing irrigation water to farms, and (4) the capital investment of irrigation enterprises. Supplemental inquiries were also made regarding other phases of irrigation, such as source of water supply, number of farms irrigated in 1939, type of water rights, drainage of irrigated lands, capacity of irrigation works and the annual cost of their maintenance and operation, quantity of water diverted and delivered, indebtedness of irrigation enterprises, pay roll, and employees. Inquiries made in connection with the Census of Agriculture made it possible to show the value of irrigated farms, and the tenure of the operators of these farms.

The 1940 separate Census of Irrigation was confined to 20 States, 19 of which comprise that portion of the United States in which irrigation is a recognized feature of agricultural practice; the other State, included for the first time, being Florida. The 19 States which comprised the areas covered in the 1930 and 1920 Irrigation Censuses are Arizona, Arkansas, California, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. In the remaining 28 States, irrigation is practiced to a limited, though increasing, extent to supplement uncertain rainfall. Therefore, some irrigation statistics have been obtained for these States in the 1940 and several prior Censuses of Agriculture. These data are presented in this summary together with more comprehensive 1940 figures for the State of Florida.

RELATIVE COMPLETENESS AND ACCURACY

The 1940 Census of Agriculture included questions as to the 1939 acreage of irrigated crops harvested and of irrigated pasture in all States. A duplication of inquiries relating to numbers of farms and areas irrigated was thus involved in the 1940 Farm and Ranch Schedule and the schedules used in the irrigation census. Since the larger irrigation enterprises were canvassed independently, complete harmony between the results of the two enumerations could not be expected. Although the questions on the Irrigation Schedules calling for number of farms were accompanied with the Census definition of a farm, quoted later, and specific instructions were given to base answers on that definition, it is apparent that many enterprises were unable to furnish the exact number of farms conforming to the Census definition. Instead, they gave the numbers of ownerships on their assessment rolls, or estimates,

which in some cases may have included small plots, town lots, or other irrigated units not properly considered as farms under the definition. The units reported on the Irrigation Schedules were shown as "Irrigated farms" in the 1940 Census of Irrigation State bulletins; however, that designation has been changed to "Irrigated units" in the summary tables to more clearly define the statistics and impress upon the users of the data that the figures presented may or may not represent actual farms in the meaning of that term as defined for the 1940 Census of Agriculture.

In some instances where large irrigation enterprises were known by the enumerators to have reported their irrigation operations on the Irrigation Schedules, they failed to answer the irrigated-acreage and irrigated-crop questions on the Farm and Ranch Schedules. When filling out the Farm and Ranch Schedule, some enumerators indicated irrigation by individual or other small systems, but failed to obtain Irrigation Schedules. Efforts were made to obtain missing data by correspondence or other means but not always with success.

The irrigation questions on the Farm and Ranch Schedule asked for acreages of irrigated cropland harvested and irrigated pasture, while the question on the Irrigation Schedules asked for the total irrigated area broken down into irrigated cropland harvested, irrigated pasture, and irrigated area upon which crops failed. In numerous cases the total irrigated land reported on the Irrigation Schedules included irrigated land fallowed in preparation for fall planting, land in young alfalfa, and land irrigated for erosion control, from all of which no crops were harvested, failed, or were used for pasture. These lands were not to be included in the answers to the irrigation questions on the Farm and Ranch Schedule; however, they were retained in the irrigation census statistics to show a more nearly complete use of land and water.

Farms or units and areas.—As with previous census figures, it is apparent that while the owners of the small individual and partnership irrigation enterprises were likely to have accurate knowledge of the areas irrigated in 1939 because they were also the users of the water, the officials of many large enterprises were not so likely to know the exact areas irrigated since their records show, generally, only the areas for which the water users were entitled to receive or did receive water, and not what was done with the water delivered. In the larger enterprises farmers usually obtain rights to water for their entire farms, but it was by no means universally the case that a farmer actually applied the allotted quantity to his whole farm, even though he was assessed and paid for water on that basis. Again, some enterprises, where water was not appurtenant to the lands served, kept records only of the quantity of water delivered to users and had no means of knowing the exact number of farms or acreages irrigated; therefore, the reports of these enterprises were approximations which may not always harmonize with the Farm Census reports. However, increasing numbers of the larger enterprises conduct annual crop surveys, which has tended to make their statements of areas irrigated in 1939 more accurate than those made in previous censuses.

In irrigation census enumerations, several types of duplication have to be guarded against. Many farms receive water from more than one enterprise and may be included in the areas reported by all the enterprises from which they receive water; some enterprises extend across county lines and may be reported completely more than once; and some enterprises may be known by more than one name and may be reported under each. Many differences appearing in the comparison of 1940 and 1930 statistics reflect a corrected distribution of the statistics of 1940 for extensive interstate, interdrainage basin, and inter-county projects.

The likelihood of omissions was indicated by the occasional absence of Irrigation Schedules for Farm and Ranch Schedules reporting irrigation. The two sets of schedules were carefully compared, and when irrigation reports appeared to be missing they were requested. Replies in some cases showed service by extensive enterprises for which reports had been received, and many farmers returned schedules describing small systems not previously reported. Of those who did not reply at all, it is impossible to estimate the proportion who operated

unreported systems. Relative to the total, however, the unreported enterprises did not involve large numbers, acreages, works, or investments.

The irrigable area in enterprises is probably greater, in many cases, than the area to which the reporting enterprises will ultimately be able to supply water. However, since 1920, many of the larger enterprises, especially those which have undergone financial reorganization, have carefully surveyed and scrutinized their lands, in order to ascertain the practical extent of their irrigability, considering topography, quality of soils, and quantity of water normally available or expected to be made available.

The figures for the area enterprises were capable of supplying with water in 1940 are based on the extent and condition of the physical works as they existed on December 31, 1939.

Investment in irrigation enterprises.—The amounts reported for the individual and partnership enterprises are largely estimates. The greater part of the works of such enterprises was built by the owners or their predecessors who kept no records of money or time expended. This is true also of many of the cooperative enterprises. A substantial proportion of these systems was built decades ago. Many have changed ownership within recent years, some repeatedly, with greatly changed capitalization and indebtedness resulting. Thus, investment of present owners may correctly be reported as more or less than the investment of the original or previously reporting owners.

In the 1940 census of interstate, interdrainage basin, or intercounty irrigation enterprises, the investment, indebtedness, assessments, and other charges were allocated to the various subdivisions, in proportion to the lands in each for which the works were capable of supplying water in 1940. However, the items of physical works were tabulated in the county or other subdivision in which they existed. In some instances this procedure distorted the comparisons of 1940 statistics with those of previous censuses.

Amount expended for water rights.—The question on the schedule sought any actual purchase price of water rights and also filing fees, legal fees, and court costs, but the statistics obtained, although carefully edited and checked by correspondence, can only be considered approximations of actual water-right expenditures.

Cost of maintenance and operation.—For many enterprises this cost was not reported, and no attempts were made to estimate it. It is probable, therefore, that the cost reported is based on records or on good memory and is substantially correct. In tables showing this item the irrigated areas reporting are also shown, in order to provide a gauge of the value of the averages.

Quantity of water used.—Reports on this item were obtained from the more extensive projects and from all but a few of the pumping enterprises. No figures were supplied for enterprises if the question was not answered. The data for enterprises reporting estimates and those reporting measurements are shown separately. In every case the irrigated area reporting is given to indicate the value of the averages.

Area for which drains have been installed.—The figures shown for this item are probably more accurate than those for the additional areas in need of drainage, the latter necessarily being largely estimates based on the opinion of the persons supplying the information.

Irrigation works and equipment.—The reported inventory of physical works sometimes indicated a lack of exact knowledge regarding the lengths and capacities of canals, the sizes and lengths of pipe lines, and the capacities of small reservoirs, pumps, prime movers, and wells. In some cases farm ditches may have been included and in other cases community laterals excluded, contrary to instructions. A complete inventory of quantities was not obtained for all farm pipe lines located in the large enterprises; however, the pipes reported were well grouped according to materials and types. Some confusion appeared in the designations of certain kinds of pumps, especially, in the 1940 irrigation census, between centrifugal and turbine types, and in the 1930 census, between centrifugals and rotaries. Owners of pumps and engines are presumed to know the capacities at which the pumps and engines were rated

by their manufacturers, but these ratings often vary widely and usually exceed the discharges produced in actual use. Most wells have never been tested beyond the capacities of the pumps used in them, and it is probable that in only a minority of cases have the most economic yields been determined. Therefore, in most instances the reported yields of pumped wells represent the owners' estimates of what has been pumped, based on the rated capacities of the pumps used, and not on the amounts of water which the wells could produce economically as determined by tests or measurements. Similarly, the exact lifts, including drawdown, for many pumping plants have not been ascertained accurately by farmers, although in most sections where pumping from wells is widespread, close approximations to correct figures are increasingly obtainable. Many farm tractors, pumping irrigation water, reported power much in excess of that necessary for the work performed. When such cases were revealed the horsepower was adjusted to correspond to a reasonable efficiency representative of that obtained from stationary types of internal-combustion engines, and the investment in such farm tractors was deleted from the irrigation investment. The 1940 census made inquiry as to the number of hours pumping plants were operated in 1939. This time-factor was used with the reported capacity of the pump to obtain more accurately the amounts of water pumped and applied to the land.

Finances, pay roll, and employees.—The 1940 Census of Irrigation inquired as to the "Amount expended for construction, etc. (capital expenditures), in 1939," the "Total amount of wages and salaries paid and payable for 1939," and the "Total number employed during the week ending April 29, 1939," of irrigation enterprises serving 5 or more farms. Statistics obtained from these inquiries are shown by type of enterprise and size of enterprise, and in various detailed tabulations.

Employment during the period of one week was requested in order to eliminate the effect of turn-over—so that the number of employees can be taken to correspond to the number of jobs in that period. The last week in April 1939 was selected to harmonize with the period covered by inquiries of the Bureau of the Census, on State and local governmental employment. This was desirable because many irrigation enterprises are themselves governmental units.

Wages and salaries paid and payable were requested for the year 1939 because pay-roll figures are not distorted by turn-over of personnel. The annual total thus provides a reliable indication of the volume of employment throughout the year, including both year-round and seasonal work.

The amount of wages shown should not be divided by the total number employed to arrive at average earnings per employee during the year, because turn-over and seasonal variations in employment would result in a much larger number being employed during the year than during any one week in the year.

DEFINITION OF TERMS AND EXPLANATION OF TABLES

Irrigation Census statistics are presented for 20 States, according to source of water supply, type of irrigation enterprise, type of equipment, and size of enterprise. Similar statistics are given in more detail for drainage basins and counties in each State, and in a summary, for drainage basins and individual States. The summary includes the 17 western States and Arkansas and Louisiana. In the summary, data are shown for Florida only in tables 20 and 21 (section C).

Farms.—A "farm," irrigated or nonirrigated, as considered in tabulations referring to "all farms," was defined on the 1940 Farm and Ranch Schedule as:

***all the land on which some agricultural operations are performed by one person, either by his own labor alone or with the assistance of members of his household, or hired employees. The land operated by a partnership is likewise considered a farm. A "farm" may consist of a single tract of land, or a number of separate tracts, and the several tracts may be held under different tenures, as when one tract is owned by the farmer and another tract is rented by him. When a landowner has one or more tenants, renters, croppers, or managers, the land operated by each is considered a farm. Thus, on a plantation the land operated by each cropper, renter, or tenant

should be reported as a separate farm, and the land operated by the owner or manager by means of wage hands should likewise be reported as a separate farm.

The enumerators were instructed not to report as a farm any tract of land of less than 3 acres, unless its agricultural products in the year preceding the enumeration were valued at \$250 or more. (See also discussion under "Relative Completeness and Accuracy.")

"Irrigated farms" are those reporting irrigation in the year preceding the date of enumeration. "Wholly irrigated" farms are those reporting the irrigation of all cropland harvested. "Partly irrigated" farms are all other farms reporting irrigation, including those farms on which the irrigation was confined to pasture.

Land in all farms.—The acreage designated as "Land in all farms" includes considerable areas of land not actually under cultivation and some not even used for pasture, since each farmer was asked to report as a unit all the land under his control, or rather all the land which he thought of as a part of his farm. Isolated tracts of timberland and other areas not connected with the farm were not included.

Land in irrigated farms.—This is the area of those farms which were wholly or partly irrigated in the year preceding the enumeration.

Farm values.—The operator of the farm was asked to report, first, the total value of his farm (land and buildings), including all the land which he operated, both owned and hired, whether operated for himself or managed for others. He was asked to give the current market value—that is, the amount for which the farm would sell under normal conditions, not at forced sale. The tabulated results of this inquiry are shown as "Value of land and buildings" and represents the total value of farm real estate. The values of irrigated farms are thus the values of farms which were wholly or partly irrigated.

The value of farm implements and machinery shown is that reported on the Farm and Ranch Schedule. Enumerators were instructed to exclude the value of commercial mills and factories and "permanently installed irrigation and drainage equipment."

Tenure of farm operator.—A "farm operator," according to the Census definition, is a person who operates a farm, either performing the labor himself or directly supervising it.

Owners, as used in the term "Owners and managers", include part owners as well as full owners, as classified in the Census of Agriculture.

Irrigated land.—The following instruction was given to enumerators in 1940, 1930, and 1920:

Land should be classed as irrigated which has water supplied to it for agricultural purposes by artificial means or by seepage from canals, reservoirs, or irrigated lands, but land which has natural ground water sufficiently near the surface to support plant life should not be classed as irrigated. Land which is flooded during high-water periods should be classed as irrigated if water is caused to flow over it by dams, canals, or other works, but should not be classed as irrigated if the overflow is due to natural causes alone.

"Area irrigated" is, therefore, the acreage to which water was actually applied in the seasons (1939, 1929, and 1919) preceding the enumeration years of the sixteenth, fifteenth, and the fourteenth censuses, respectively. It is not necessarily the area for which water was available or the area entitled to water; hence it does not include land under canals and sometimes irrigated but which was not watered in 1939, 1929, or 1919. Moreover, it takes no account of the degree of sufficiency of the irrigation.

Area works were capable of supplying with water.—This item relates to the year of the census (1940, 1930, or 1920). It is based on reports made by those controlling the enterprises, and represents the area which the constructed works, as they existed on January 1 of the census year, could serve, regardless of whether or not the land was farmed.

Irrigable area in enterprises (1940 and 1930) and total area in enterprises (1920).—These items represent the extent of the plans of those controlling the enterprises. Possible extensions of projects not definitely planned in 1940 or 1930 were not included in the area reported as irrigable.

Irrigated areas (1939, 1929, and 1919), irrigable areas (1940 and 1930), and areas works were capable of supplying (1940, 1930, and 1920) are net; i.e., they do not include known duplications representing areas served or susceptible of being served by more than one primary enterprise. Acreages shown for supplemental enterprises (1940 Census) constitute the portions of the areas shown for primary enterprises that received or could receive additional water.

Irrigation enterprise.—An "enterprise" is an independent irrigation establishment owning or operating works for supplying water to agricultural land. An enterprise may represent a short canal or a pumping plant watering a single small farm, or a great system of canals and reservoirs operated under one management supplying thousands of farms. Only such enterprises as supplied water for irrigation in 1939 and 1929, or were capable of supplying water for irrigation in 1940 and 1930, or were in advanced stages of construction January 1, 1940 or 1930, were included in the sixteenth and fifteenth censuses. The 1940 totals take into account various consolidations made since 1930.

Presentation of the statistics by States, drainage basins, and counties, requires that for an enterprise comprising land in more than one State, basin, or county, the part in each be considered a separate enterprise. However, the actual number of enterprises, eliminating such duplications, is shown in summary tables showing areas and investment by character of enterprise.

Type of enterprise.—The types of enterprises under which all data are classified are as follows:

Individual and partnership enterprises belong to individual farmers or to neighboring farmers who control them without formal organization. These are largely enterprises using small gravity diversions from streams, springs, or water from pumped wells.

Cooperative or mutual enterprises are controlled by the water users, under some form of cooperation, either incorporated or unincorporated. The most common form of organization is the stock company, in some sections known as the mutual water company; the shares of stock are owned by the water users and represent proportionate amounts of the available water. The stock may or may not be appurtenant to the land irrigated.

In the Southwest, where irrigation was practiced before the region became a part of the United States, part of the land is still watered by "community ditches," or public "acequias," organized and operated in accordance with old Mexican customs providing for the election of officials by the landowners and for forced labor on repairs and cleaning. These enterprises are classed as cooperative. Included also in the cooperative classification are a number of "lateral" companies, the chief function of which is to handle the distribution of water to their members beyond the places where the responsibility of their parent enterprises terminates; various storage companies controlled on a cooperative basis by groups of other enterprises; and a few mutual companies, especially in southern California, which expect eventually to supply their members with water for domestic purposes only, but meanwhile use their surplus supplies for irrigation.

Not included in the tabulations were various water-user organizations, essentially cooperative, which have administrative, managerial, protective, or sometimes promotional functions but own and operate no physical works although perhaps assessing their members for various costs and expenses. (See, also, United States Bureau of Reclamation enterprises.) Usually such omitted enterprises operated within the year to safeguard the existing or prospective rights of their members but did not own or distribute water.

Irrigation districts are public corporations established under State laws empowering them to issue bonds to obtain funds for the purchase or construction of irrigation works and to levy and collect taxes or assessments for the payment of bonds and interest on them, and the cost of maintenance and operation of the works. The term "irrigation districts" also covers water-improvement districts, water-conservation districts, and water-storage districts, which in some States are in addition to irrigation districts and in other States are in lieu of them.

Irrigation districts are controlled by the owners of the lands comprising them through boards of directors elected by the landowners. A few districts which have the sole function of storing water for other enterprises are included in the classification. (See, also, United States Bureau of Reclamation enterprises.)

Commercial enterprises, incorporated or otherwise, supply water for compensation to farmers who own no interest in the works. Such enterprises may be organized in any form, but their operations are subject to some degree of public control in most States. This was the earliest type of enterprise for the construction of large irrigation systems. Such enterprises built irrigation works and sold rights entitling the purchasers to receive water carried by them upon the payment of annual charges, but conveyed no interest in the works. Some States have enacted laws prohibiting the sale of such rights, and commercial enterprises organized since the passage of these laws usually sell stock representing part ownership in the works, to become effective upon the payment of specified portions of the purchase

price. These enterprises eventually become cooperative. There are some commercial enterprises that sell no rights but supply water to the public upon payment of charges based, in some instances, on acreage served and in other instances on the quantity of water delivered. In most States rates charged by commercial enterprises are subject to public control; they are, therefore, considered public utilities.

United States Office of Indian Affairs enterprises operate under various Acts of Congress providing for the construction of works for the irrigation of land in Indian reservations.

United States Bureau of Reclamation enterprises were established in the Department of the Interior under the Federal law of June 17, 1902, which provided for the construction of irrigation works with the receipts from the sale of public lands or other sources, and subsequent legislation which provided other funds. In addition to serving land within its own projects, the Bureau of Reclamation supplies supplemental water to land within other enterprises. Statistics relating to "primary" acreages classified as "United States Bureau of Reclamation" do not include acreages served with supplemental water, since the latter areas are represented in other classifications, but the construction costs of facilities under contract to provide such supplemental water are included in the investment credited to the Bureau of Reclamation. Drainage construction costs, which are an integral part of the cost of most Bureau of Reclamation projects, are excluded from the investment credited to the Bureau of Reclamation. In many instances construction costs which will be repaid by power revenues from works operated in conjunction with Bureau of Reclamation enterprises are included in the investment so credited, as specifically noted in the appropriate tables. Statistics apply only to Bureau of Reclamation enterprises in operation and not to projects under construction which are not yet irrigating land.

Amendments to the Reclamation Act provide that on the request of any water-user organization or irrigation district the Secretary of the Interior, at his discretion, may transfer to such local organization the operation and maintenance of all or any part of the project works. Under this provision the operation and maintenance of 41 projects or divisions of projects have been turned over to water-user organizations or irrigation districts. As the construction cost of no project has been paid in full, title to the works remains with the Federal Government and all projects in this status are classified as Bureau of Reclamation enterprises.

State enterprises are undertakings by the States themselves to effect irrigation development under special legislation. Some projects originally in this status have been reorganized and their statistics appear in other classifications. Also, "State" enterprises include various State institutions having independent irrigation systems serving their own lands exclusively.

City water and city sewage-disposal enterprises include those established by a few cities to dispose of sewage by utilizing the effluent for irrigation. Others, notably in Utah and California, maintain substantial irrigation service in conjunction with their domestic and industrial deliveries on an irrigation rate schedule. Statistics for both such types of enterprise are classified as "city."

Other enterprises include several projects still operated by companies established under the Federal law of August 18, 1894 (usually referred to as the Carey Act), granting each of the States in the arid region 1,000,000 acres of land on condition that the State provide for its irrigation, and under amendments to that law granting additional areas to several of these States, if applied for. The conditions in this law necessitate State legislation before the law becomes operative; thus Carey Act enterprises operate under both Federal and State laws. Practically all enterprises which were originally Carey Act projects have been reorganized and were enumerated as cooperatives or other types in the 1940 Irrigation Census. Also among the enterprises classified as "Other" are a few "drainage" districts which operate irrigation as well as drainage systems, and a number of "reclamation" districts (largely in California). Most of the reclamation districts have flood control or drainage as their principal function, irrigation being of varying importance but subordinate to flood control. Reclamation districts have no connection with United States Bureau of Reclamation enterprises.

Data were obtained from various Government agencies not referred to above which use water on areas devoted to refuges for wild life. Since these enterprises appeared to be outside the scope of both the Census of Agriculture and the Census of Irrigation the data reported were not retained. Forest nurseries operated by the United States Department of Agriculture were likewise omitted.

Multiple-purpose enterprises.—The number of multiple-purpose enterprises which render irrigation service in connection with other services has increased during recent years. In the 1940 census, cities and public utility enterprises which supply irrigation water from domestic water systems or extensions thereof and/or from the effluent of sewage disposal plants, were recorded as irrigation enterprises, provided the revenues received from irrigation were segregated from other receipts and represented substantial amounts. Cities supplying water to only a few irrigators at domestic water rates were not considered irrigation enterprises; however, each farmer receiving such water was counted as an individual enterprise with a "City water" supply. Large multiple-purpose enterprises involving water storage, power development, flood protection, channel betterment, ground water recharge, and other

functions in addition to irrigation, were enumerated as irrigation enterprises. In each case, however, unless otherwise indicated, only such construction statistics were included in the 1940 Irrigation Census tabulations as could reasonably be allocated to the irrigation phase or purpose. Thus, the allotment was determined from varying factors such as capital chargeable to the irrigated land, works used wholly for irrigation, actual or anticipated irrigation revenues, etc. Drainage, reclamation, irrigation, and other types of districts which in 1939 rendered an irrigation service with one or more additional services were classed as irrigation enterprises and the works and costs in each case were allocated as closely as possible to each purpose. For instance, in the case of enterprises operating pumping plants primarily installed for drainage purposes but using the pumped water for irrigation, the capital costs were allocated to drainage and the cost of maintenance and operation to irrigation.

Primary and supplemental enterprises.—Each irrigation enterprise, regardless of type, was classified in the 1940 Census as "primary," "supplemental," or a combination of both, according to the water service it rendered to irrigators.

A primary enterprise is one which furnishes to the irrigators all, or the major portion, of the irrigation water used. A stream diversion or pumping plant which one or more farmers consider a principal source of water and which is used first in preference to other available sources because of ownership of works or water rights, or lower costs of water, is a typical primary enterprise regardless of the proportion of water obtained from such other available sources. All irrigated land must receive water from one primary enterprise, and the area statistics for primary enterprises are totals.

A supplemental enterprise is one which, directly or indirectly, furnishes a user with water from a source either like or different from the primary source, in addition to the water he receives from a primary enterprise. Notable supplemental enterprises are upstream or offstream storage projects established for the conservation of winter run-off and floodwater and to augment the insufficient primary supplies of downstream users. Likewise, many supplemental pumping plants have been installed either by individuals or groups for lifting ground water or water from streams to provide for areas served inadequately from primary sources alone.

Drainage basins.—The drainage basin of a stream is the geographic area drained by that stream and its tributaries. Large river systems drain major basins, each of which for the purpose of the Irrigation Census has been divided into tributary or minor drainage basins. Each basin, major or minor, is usually designated by the name of its arterial stream. Waters from most major basins ultimately reach the sea through surface or underground channels. However, the areas of the "Great Basin" comprising portions of Wyoming, Utah, Nevada, Oregon, and California, and similar smaller areas in other western States, drain into landlocked lakes or sinks and are considered as closed or independent basins. The drainage basin tables for a State set forth the portions of the major basins and their principal tributaries or minor basins located within the State, while the summary tables for the 17 western States and Arkansas and Louisiana set forth totals for all interstate basins and for groups of intrastate basins. Because a drainage basin is the natural geographic planning unit for the efficient utilization and administration of waters of the drainage basin streams and the included lands, irrigation statistics are shown in detail for drainage basins similar to those shown for States and counties.

Twenty State maps and a key map of the western portion of the United States, with Florida inserted, are published separately to show the boundaries of the specific drainage basins enumerated in the 1940 Census of Irrigation with symbols which represent the acreages irrigated in 1939. These maps, "Irrigation—By Drainage Basins—1939", may be purchased for 15 cents each, except for California and Texas which are printed in two sections and each section is 15 cents, from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Areas irrigated from springs, flowing wells, or pumped ground waters are credited to the drainage basin in which they are located.

In the 1940 Census, irrigation from or along a tributary stream, not mapped in an individual basin, was considered a part of the irrigation "Direct" from the arterial stream into which the tributary flows. In the Irrigation Censuses of 1902,

1920, and 1930, when irrigation statistics were also tabulated by drainage basins, the boundary lines of the basins were not mapped and although data were shown for the arterial streams "Direct" and for tributary basins in a manner similar to that used in the 1940 Irrigation Census, many minor basins were grouped under "Other tributaries," a grouping not used or carried forward in the 1940 Irrigation Census Reports. Since it was not always possible to identify and separate the statistics of basins included in "Other tributaries," some tributaries so included in this item in prior censuses may be included under "Direct" in 1940. Therefore, the data presented under "Direct" for these earlier censuses should be considered as only approximately comparable to those shown for 1940. Also, wherever comparable data are not shown in the 1940 drainage basin tables, it is reasonable to assume that the statistics for the basins involved were probably included in "Other tributaries" in the reports of prior censuses.

Sources of water supply.—The water supplies named in the tabulations are self-explanatory with the possible exception of "Stored storm water," which refers to storm water collected from channels that carry water only during storms and are not classed as streams, or by run-off from local lands usually owned or controlled by the irrigators and stored in small reservoirs. Storm water reservoirs are usually owned by individual farmers and have recently been increased in number to provide irrigation and stock water, or to retard surface waters until they percolate into underground storage from which irrigation water is pumped.

In the 1940 Census, the classification of sources of water supplies was expanded somewhat to group those enterprises which have like combinations of primary sources and those which receive supplemental water from streams by gravity, from storage, or by pumping. Where these supplemental sources appear, no comparison can be made with the statistics of previous Censuses. All areas shown as receiving water from supplemental sources are also included in the areas shown as receiving water from primary sources; however, duplication of area statistics is avoided in the tables showing sources of supply by omitting from the totals land served from supplemental sources. The amounts of water delivered, and investment and cost statistics are shown separately for each source classification.

Water rights.—The 1940 irrigation census made inquiry regarding the type of water rights held by the reporting enterprise with three questions calling for indication of "Riparian," "Appropriation," and "All other" rights, with instruction accompanying the questions directing that rights other than riparian or appropriative be reported under "All other," and that definite designation of the "Other" type be made. More specific questions or instructions might have resulted in the reporting of a greater number of "Other" types, as in many instances the enterprises failed to identify such other rights. The water-right tabulations present acreage figures according to the predominating types of rights reported, but owing to the lack of knowledge of the distinctions between the various types on the part of many irrigators and enumerators, the tabulations can only be considered to disclose approximately the actual situation.

For the sake of such comparisons as may be significant, the water-right tabulations of the 1930 Irrigation Census are shown. However, present interest in water-right statistics appears to lie principally in the relative status of appropriative to riparian rights in States which recognize both, and in rights to ground water, rather than to the various stages in which appropriative rights exist.

Cost of irrigation works and equipment.—The census instruction was as follows:

Include the original cost of the irrigation works plus the cost of extensions and improvements; also the cost of equipment, buildings, and land used for maintenance and operation, but not water rights. If works are not completed, give investment to December 31, 1939. If there are no records of cost, or if the owners have done all or part of the construction, the best estimate of cost obtainable should be reported, including the estimated value of the work done by the owners. Only such costs for drainage works as are chargeable to irrigation should be included.

Cost of water rights.—Instructions specified that this item should "include filing and legal fees paid by the enterprise in acquiring them; and, if they were purchased by the enterprise, give the purchase price."

The 1940 Census tabulations show the reported cost of water rights separately, while in previous censuses this item was added to the cost of irrigation works and presented as "capital investment." However, the cost of irrigation works and equipment and the cost of water rights were added together in 1940, as in previous censuses, to produce figures representing total investments and these totals were related to acreages the works were capable of supplying with water in 1940, as previously, to produce comparable average investments per acre.

Financing.—The 1940 Irrigation Census made inquiry for the first time regarding the financial status of those enterprises designed to serve 5 or more farms. The total indebtedness and the arrears in payment of principal or interest on bonds or other funded obligations, were reported as of December 31, 1939. Inquiry was also made as to the amount of arrearage, December 31, 1938, the amount of water taxes, including special assessments, and the amount expended for construction in 1939, as capital expenditure. In the tabulations shown the financing items have been related to the areas, capital investment, and charges and assessments of enterprises reporting indebtedness, as far as the replies permit.

Cost of maintenance and operation.—Instructions were to "report only the costs of maintenance, including ordinary cleaning and repairs, and operations, including fuel, electric energy, and attendance." Also to be included were the amounts of operating and maintenance costs of the drainage pumps or systems which are chargeable to irrigation. In tables showing these costs, they are related to the acreages irrigated in 1939 by the enterprises reporting.

Main canals and laterals.—A main canal is any open conduit conveying water from the source of supply to the tract of land to be irrigated or to a storage reservoir. A lateral canal is a branch of a main canal conveying water from a main canal to one or more farms. Main canals and laterals are tabulated as "canals." Farm ditches which distribute water to fields within the boundaries of the individual farm are not reported. Lengths of earth canals and lined canals, including flumes, appear separately in the tabulations. The material used, for most lined canals, was reported as concrete.

Diversion dams.—A diversion dam is a structure placed across the channel of a natural stream for the purpose of diverting all or a portion of the stream flow into a canal or other water conduit. Many of the diversion dams reported are temporary structures built of sand, rock, brush, or other accessible materials. Tables classifying diversion dams by material include these temporary structures as "other and mixed" because of the variety of materials used. Most such dams are destroyed during periods of high water and have to be replaced annually or even more frequently.

Storage dams and reservoirs.—A storage dam is a structure built for the purpose of storing water in a stream channel, ravine, or other natural depression. These dams are tabulated according to the materials of construction. Dams were not reported for all reservoirs as many small reservoirs are built by excavation and embankments on level ground in connection with pumping plants for overnight storage. Tanks and other small structures capable of storing less than 1/2 acre-foot of water were not included in the tabulations.

Pumping plants.—The census of pumping plants was confined to those used for lifting irrigation water and were enumerated and tabulated according to the kind of motive power, i.e., "electric motors," "internal-combustion engines," and "other power"; and by type of pump, i.e., "centrifugal," "turbine," "plunger," and "other pumps." Steam, water, and wind were classed in "other power." Rotary, hydraulic ram, air lift, and home-made pumps were classed as "other pumps." The inquiry regarding the average lift of pumping plants called for the vertical distance, in feet, between the average elevation of the water in the source of supply when the pump is running at usual capacity and the average elevation to which the water is lifted. It does not take into account friction and velocity heads. The lift statistics show separately the lifts from wells and from surface sources to indicate the lifts of ground water in areas irrigated from wells.

Units of measure.—The following units of measure are used in this report:

Capacity of a canal at main heading is given in second-foot ("sec.-ft." or "c.f.s."), abbreviations for "cubic feet

per second." A second-foot is the rate of discharge of water flowing in a channel when the cross-sectional area is 1 square foot, and the average velocity is 1 foot per second.

Capacity of a pump and yield of a well is given in gallons per minute ("g.p.m."). Approximately 450 g.p.m. equals 1 sec.-ft.

Capacity of a reservoir is given in acre-feet ("ac.-ft."). An acre-foot of water is the quantity that will cover 1 acre to a depth of 1 foot, and equals approximately 43,560 cubic feet or 325,851 gallons.

Capacity of a motor and an engine is given in horsepower ("hp."). One horsepower is the energy required to lift 33,000 pounds through a vertical distance of 1 foot in 1 minute.

Irrigated crops.—Table 22 (section C) carries data for specified crops grown on irrigated and nonirrigated lands in the 17 western States and Arkansas and Louisiana in 1939, with comparable acreages for 1929, where available. The average yields shown in this table for irrigated crops are based on the farms reporting the entire crop irrigated, while the yields for nonirrigated crops are based on farms reporting no irrigation for such crops. The 1939 basic data for these crops appear in volumes I and III of the Reports for the 1940 Census of Agriculture. The 1929 basic data for the irrigated crops appear in the 1930 report "Irrigation of Agricultural Lands" and totals for all crops in volumes II and IV of the Reports for the 1930 Census of Agriculture. In the 1940 Census, a farm reporting both irrigated and nonirrigated acreages of a given crop was recorded as a farm in each group. Therefore, the total of the farms reporting irrigated and nonirrigated acreages for a crop exceed the actual number of farms harvesting that crop to the extent of the number of farms which used both irrigated and nonirrigated culture in the census year.

Farm mortgage debt and taxes on irrigated farms.—In the 1940 Census of Agriculture, mortgage and tax information was obtained only for farms of full owners and for the owned portions of farms of part owners. The mortgage inquiries called for the mortgage status (the amount of mortgage debt) and the rate of interest on the first mortgage. The tax inquiries called for taxes levied on the real estate in the farm as well as those levied on personal property on the farm. The statistics are shown separately for full owners and for part owners. In presenting the mortgage statistics, farms are classified by mortgage status and the amount of debt is related to the acreage and value of the farms reporting these items. The number of farms, acreage, and value are also shown by mortgage status.

In presenting the statistics for farm taxes, the real-estate taxes are related to the acreage and value of the farms reporting these items. A more detailed discussion of mortgage and tax statistics for all owner-operated farms are presented by States in chapter IV, of volume III, of the Reports of the 1940 Census of Agriculture. The statistics relating to mortgages and taxes presented in that volume are restricted to farms of owner operators where all of the cropland harvested in 1939 was irrigated.

In comparing the mortgage and tax statistics for irrigated farms with those for all farms it cannot be assumed that the differences in the totals represent nonirrigated farms only. Such differences include not only nonirrigated farms, but also farms where irrigation was restricted to pasture lands, fallow land, and to partly irrigated farms where only a portion of the crops harvested were irrigated.

Separate figures for mortgage debt and real-estate taxes are presented for owner operators owning no additional land. The mortgage and tax data for these farms are not distorted by any debt or taxes which might relate to other land.

The interest rate reported was the annual rate as specified in the first mortgage. Figures given for this item are presented under "Average of the rates." They do not represent weighted averages as they are simply the sum of the rates reported divided by the number of reports.

The real-estate taxes were to relate to the taxes levied in 1939 on the real estate of the farm owned by the operator on April 1, 1940, including buildings and other improvements. Taxes levied by drainage or irrigation districts were not to be included.

The personal-property taxes were to relate to taxes on personal property such as livestock, machinery, etc. owned by the operator and on the farm operated. Automobile taxes, fees, and licenses were to be excluded.