

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)

VERGIL D. REED, Assistant Director

HOWARD H. McCLURE, Assistant Director



SIXTEENTH CENSUS OF THE UNITED STATES : 1940

**DRAINAGE OF
AGRICULTURAL LANDS**

**Land in Drainage Enterprises, Capital Invested
and Drainage Works**

**Statistics for Counties With State and United States
Summaries and a Synopsis of Drainage Laws**

Prepared under the supervision of

ZELLMER R. PETTET

Chief Statistician for Agriculture

**UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942**

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LETTER OF TRANSMITTAL

DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
Washington, D. C., September 30, 1942

SIR:

I transmit herewith the volume on Drainage of Agricultural Lands of the Sixteenth Decennial Census. This report contains detailed statistics for 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 Drainage was made in the Act providing for the Fifteenth Decennial Census which was approved on June 18, 1929. The information on drainage was obtained from a canvass of officials and records of enterprises and from county and court records.

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, Warder B. Jenkins, Chief of Technical Staff, Hilton E. Robison, Principal Statistician, and Roger D. Marsden, Principal Drainage Engineer. The graphic material was prepared under the supervision of Clarence E. Batschelet, Geographer of the Census.

Acknowledgment is made of the cooperation of the Soil Conservation Service of the United States Department of Agriculture; of the Bureau of Reclamation and Office of Indian Affairs of the United States 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; Livestock and Livestock Products; and Crops.

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

Part 4.—East South Central States
Part 5.—West South Central States
Part 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
Chapter II.—Size of Farms
Chapter III.—Color, Tenure, and Race of
Farm Operators
Chapter IV.—Farm Mortgages and Farm Taxes
Chapter V.—Work Off Farm, Age, and
Years on Farm

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

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

Twenty separate State maps showing irrigation by drainage basins.
Separate composite map showing irrigation by drainage basins.

Drainage of Agricultural Lands.—Statistics for 38 Drainage States with county data for 36, and a summary for the United States. (One volume.)

Separate map of the United States showing land in drainage enterprises.

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Land and capital invested, by character of enterprise, Jan. 1, 1940	61	68	81	92	101	105	116	124	133	155	178	201
Land and capital invested, by type of drainage: Jan. 1, 1940, 1930, and 1920	62	68	81	92	101	105	116	124	133	155	178	201
Pumping plants and land served, by kind of power: Jan. 1, 1940, 1930, and 1920	62	69	82	93	106	106	125	134	156	179	202	202
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Land, capital invested, and area delinquent in drainage taxes, by arrearage in payment of obligations: Jan. 1, 1940 and 1930	62	69	82	93	101	106	117	125	134	156	179	202
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Land and capital invested, by type of drainage: Jan. 1, 1940, 1930, and 1920	210	218	231	255	253	278	293	311	319	352	358	344
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Land, capital invested, indebtedness, arrearage in payment of bonds, reduction of debt by refinancing, and acreage delinquent, 1940; drainage taxes collected in 1939; by indebtedness and arrearage, Jan. 1, 1940	211	219	231	256	254	279	294	312	320	353	359	345
Land and capital invested, by principal purpose of drainage, Jan. 1, 1940	211	220	232	237	255	279	295	312	321	353	359	345
Land and capital invested, by date of organization, Jan. 1, 1940	211	220	232	237	255	279	295	312	321	353	359	345
Drainage condition, development, and use of land in enterprises, by date of organization, 1939	212	220	232	237	255	280	295	313	321	354	359	346
Cost of operation and maintenance, by type of drainage, 1939	212	220	232	237	255	280	295	313	321	354	359	346
Land and capital invested, by method of maintenance and by whether maintenance is systematic, Jan. 1, 1940	212	221	232	238	256	280	296	313	322	354	340	346
Land, capital invested, and drainage works, by ownership of power equipment for maintenance, 1940	212	221	232	238	256	280	296	313	322	354	340	346
Land, capital invested, and drainage works, by Federal agency giving aid in maintenance, 1940	212	221	232	238	256	281	296	313	322	354	340	346
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STATE TABLES												
Summary of drainage for the State: Jan. 1, 1940, 1930, and 1920	356	365	381	387	396	408	413	421	432	438	447	460
Area of enterprises, by size: Jan. 1, 1940, 1930, and 1920	356	365	381	387	396	408	413	421	432	438	447	460
Land and capital invested, by character of enterprise, Jan. 1, 1940	356	365	381	387	396	408	413	421	432	438	447	460
Land and capital invested, by type of drainage: Jan. 1, 1940, 1930, and 1920	356	365	381	387	396	408	413	421	432	438	447	460
Pumping plants and land served, by kind of power: Jan. 1, 1940, 1930, and 1920	---	---	---	388	---	---	---	422	---	439	---	---
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Land, capital invested, indebtedness, arrearage in payment of bonds, reduction of debt by refinancing, and acreage delinquent, 1940; drainage taxes collected in 1939; by indebtedness and arrearage, Jan. 1, 1940	357	366	382	388	397	404	415	422	432	439	448	461
Land and capital invested, by principal purpose of drainage, Jan. 1, 1940	357	366	382	389	397	404	414	422	433	440	448	461
Land and capital invested, by date of organization, Jan. 1, 1940	357	366	382	389	397	404	414	423	433	440	448	461
Drainage condition, development, and use of land in enterprises, by date of organization, 1939	358	367	383	389	397	404	414	423	433	440	449	461
Cost of operation and maintenance, by type of drainage, 1939	358	367	383	390	398	405	414	423	434	440	449	462
Land and capital invested, by method of maintenance and by whether maintenance is systematic, Jan. 1, 1940	358	367	383	390	398	405	415	423	434	441	449	462
Land, capital invested, and drainage works, by ownership of power equipment for maintenance, 1940	358	367	383	390	398	405	415	424	434	441	449	462
Land, capital invested, and drainage works, by Federal agency giving aid in maintenance, 1940	---	367	---	390	398	---	415	424	434	441	449	462
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Land in drainage enterprises classified by condition and by use, 1940, 1930, and 1920; and by kind of works, 1940	359	368	384	391	399	408	416	425	435	442	451	463
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¹ Alabama and Virginia, combined report on pp. 465-467.

INTRODUCTION

CENSUS OF DRAINAGE: 1940

ROGER D. MARSDEN, *Principal Drainage Engineer*

INTRODUCTION

This volume, prepared under the supervision of Zellmer R. Pettet, chief statistician for agriculture, assisted by Roger D. Marsden, principal drainage engineer, presents statistics relating to drainage of lands for agricultural purposes.

History and Scope of Census of Drainage.—The first census of drainage in the United States was taken in 1920, the second in 1930, and the third in 1940; each as part of the decennial census of agriculture.

The 1940 census of drainage covered 38 States. Delaware and Maryland have been included for the first time in the canvass of organized enterprises. The States omitted are the New England States, New York, New Jersey, Pennsylvania, and West Virginia.

This census collected data relating to (1) the land in organized drainage enterprises, its area, location, and condition with respect to drainage and use; (2) the organization, with respect to form and management; (3) the drainage improvement works constructed by the enterprises, as to lengths of drains and levees and capacities of drainage pumping plants; (4) the capital investment in the drainage works, and the expenditures in 1939 for maintenance, repair, and operation of the works; (5) the extent of the enterprises that have received some degree of Federal aid in maintenance; (6) certain items of the financial status of the enterprises, including drainage taxes collected in 1939; and (7) the extent to which the drainage enterprises are dependent upon levees built by other agencies for protection against floods. No data on drainage by farm owners, individually or cooperatively, without legal organization were collected in 1940 for undertakings to benefit less than 500 acres each, although in 1930 and 1920 such information was obtained as part of the general farm census and included in the drainage census publications. No data concerning crops grown on drained land have been collected since the census of 1920.

Legal Basis for Drainage Census.—The Act providing for the Fifteenth Decennial Census, approved June 18, 1929, states in part: "A census of population, agriculture, irrigation, drainage, distribution, unemployment, and mines shall be taken by the Director of the Census in 1930 and every ten years thereafter." The census of drainage in 1940, as in 1930, was taken in accordance with that provision.

Method of Canvass and Tabulation.—The drainage enterprises in the eastern and central States were canvassed by special drainage enumerators or, in those counties where there were not many drainage enterprises, by the drainage supervisor responsible for the canvass in that State or census area. These appointees were selected because of their knowledge of land-drainage organization and practices, general and local; and, in their capacity as drainage enumerators, had no part in other phases of the decennial census enumeration. The data were obtained from officials and records of the enterprises as far as practicable, and from county and court records. A printed schedule of questions was used for recording the information concerning each enterprise, and each drainage enumerator was provided with a county map on which to mark the locations of the enterprises.

In the 11 western States and adjoining portions of Texas, Nebraska, and South Dakota, where drainage enterprises are rather widely separated and much of the drainage is supplemental to irrigation, schedules were mailed from the Washington Office of the Bureau of the Census to each known enterprise with a request for completion and return. The enterprises in this region which did not return satisfactory reports by mail were canvassed by irrigation-and-drainage technicians appointed to supervise the irrigation and drainage censuses in those States.

When the drainage schedules were received in the Washington Office, they were examined for consistency and completeness, and were prepared for tabulation. Attempt was made by individual correspondence to supply important omissions and resolve apparent discrepancies in reports for many of the larger enterprises. The information then was transferred to punch cards, and the tabulations for the States and for individual counties were made by machine.

Presentation of Statistics.—This volume presents all the statistics for drainage collected in the census of 1940. The figures were issued first in a series of State bulletins on drainage, one for each State included in the census of drainage except Alabama and Virginia. The amount of organized drainage found in those two States was not material. The State bulletins carried county data and presented the figures without discussion. Each bulletin showed the location of the land in drainage enterprises on a State map compiled from the county maps on which the drainage enumerators had platted the enterprises, from information given on the schedules and, in some instances, from other sources. The maps and tables in the State bulletins are reprinted in this volume following the general and summary tables showing combined totals for the 38 States. These data are presented by States arranged alphabetically, and tables for Alabama and Virginia combined follow the others.

The first 16 tables herein, which are summary tables, follow the same form as the State tables in the State bulletins. The area in drainage enterprises is classified by size of enterprise. Condition and use of the land are classified by date of organization of the enterprise. Land and capital investment are classified by character of organization, by type of drainage, by indebtedness and arrearage in payment of obligations, by purpose of drainage, by date of organization, by method of maintaining the drainage works, by maintenance machinery owned, by Federal aid received in maintenance, and by flood protection received from outside agencies. Cost of operation and maintenance in 1939 is classified by type of drainage. Drainage works are classified by maintenance machinery owned by the enterprises, by Federal aid received, and by flood protection by outside agencies. Drainage pumping plants and land dependent on them are classified by kind of power and kind of pumps. Comparable figures for the same items from the 1930 and 1920 Censuses are given as far as practicable, particularly with respect to land in enterprises, capital invested, and drainage works constructed.

Tables in the fore part of this volume show by States, as the State bulletins show by counties, land in drainage enterprises classified by condition and use, with comparable figures for 1930 and 1920; land classified by drainage works in 1940; drainage works and capital invested, with like items from the prior censuses; capital invested, 1940, classified by kind of works; maintenance and operation cost in 1939, divided between pumping and gravity enterprises; and amounts of drainage taxes collected in 1939, area delinquent in payment of drainage taxes on December 31, 1939, total indebtedness and indebtedness in arrears on that date, and reduction of indebtedness by refinancing prior to the same date. Number of enterprises reporting and land in these enterprises are shown for maintenance and operation expenditures, drainage taxes collected, indebtedness, arrearage, and reduction of indebtedness; however, only number of enterprises reporting is shown where there were less than 3, unless permission to publish has been given by each enterprise affected.

Succeeding tables bring together, for comparison, the State figures as broken down in a number of the classifications.

Following these are a table of the monthly and annual precipitations in 1939 for each of the 38 States, with departures from the normal, and a table showing by States the expenditures for wages in 1939 and the number of persons employed in the week ending April 29, 1939, by the enterprises.

In the Appendix is given a facsimile copy of the Drainage Schedule used in the 1940 Drainage Census, including the instructions for making the canvass. Also given, is a synopsis of the drainage laws of the 38 States covered by this census, and a chart showing the principal features of those laws and of the laws under which drainage enterprises may be organized in the other 10 States.

Comparability of Data.—The date of each drainage census has been January 1 of the census year. Questions on financial status in the 1940 Census specified December 31, 1939. The data on condition and use of land and on expenditures for maintenance and operation relate to 1939 and 1929. The status of a drainage enterprise, however, is not subject to seasonal fluctuations.

DEFINITIONS AND EXPLANATIONS

The following definitions were printed on the Drainage Schedule used for reporting the information concerning the individual drainage enterprises:

Drainage of agricultural lands is the act or process of drawing off an excess of water by underground conduits, pipes, or tiles; or by open or covered trenches in the surface of the ground; or by pumping, for the purpose of improving the condition of the soil and crops. In this connection the area drained does not include land from which water flows without artificial aid into natural watercourses; nor does it include land protected from overflow by levees, dikes, or embankments; nor areas guarded by trenches from the run-off from higher lands, unless some form of drainage works has been constructed on the protected land.

Drainage works of an enterprise include all varieties of underground conduits, pipes, or lines of tile; drains of stone, wood, or other materials; and all open ditches, canals, and pumping equipment for drainage. Levees, dikes, dams, weirs, gates, and other devices for draining away or controlling surface and soil waters are to be considered "Drainage works" when, and only when, they are constructed or operated with drainage ditches, underdrains, or drainage pumps.

A *drainage enterprise* was defined, for the purpose of the census, as the area (1) organized in one drainage district, or (2) assessed for the same public drain, or (3) in corporate or in private ownership drained by works operated as one undertaking. Privately owned enterprises draining less than 500 acres each were omitted from the census, but all enterprises established under State drainage laws were included.

Character of Enterprises.—Drainage enterprises have been classified, for Census purposes, on the basis of ownership or management. The following classification has been used in this volume.

Drainage districts, county drains, and township drains are community enterprises organized under general or special State laws for obtaining equitable cooperation between landowners who will be benefited by the same drainage works. A drainage district is governed by officials elected or appointed for that particular enterprise. A county drain is governed by county officials who manage the affairs of all enterprises in the county organized under the same statute. Township drains are managed by township officials as county drains are managed by county officials. In these three classes the costs of each enterprise are assessed, almost universally, against the property benefited and more or less in proportion to the amounts of benefits.

The distinction here made between drainage districts and county drains is not made universally in the States. In Iowa, for example, almost all of the enterprises are classed herein as county drains although they are by law named drainage districts; and in some other States the term "district" is used locally, even in the statutes, for enterprises classed differently herein.

State projects are administered by State officials. The cost of each such enterprise is divided between the State and local interests according to a method provided in the statute, which commonly considers the relative amounts of land owned by the respective interests.

Irrigation enterprises included in the drainage census are those organized for the purpose of irrigating land that have constructed drainage works to relieve or protect that land as a part of the irrigation development and maintenance. The drainage costs commonly are assessed against all land assessed for irrigation, even if only a minor portion has developed need for drainage, on the assumption that all land irrigated is in some measure responsible for injury caused or threatened.

The Federal enterprises are mostly projects or parts of projects of the Bureau of Reclamation and the Office of Indian Affairs, Department of the Interior. The classification of enterprises by character has generally been made according to type of control or management, but developments by the Bureau of Reclamation that have been turned over to water users for operation have been tabulated as Federal.

Commercial developments, as the term is used in the Drainage Census, are those drainage enterprises established for the purpose of developing lands for sale, without organization under drainage laws. Many are organized under general corporation laws.

Individual-ownership enterprises comprise drainage undertakings by individual owners, each for his own farm, and by two or more owners cooperating without organization under statute law.

Land, Area, and Number of Enterprises.—In this volume the terms "land in enterprises" and "area of enterprises" are used with somewhat different meanings, and "number of enterprises" with different significance than the number of reports obtained or tabulated. The distinctions are necessary because of the overlapping of enterprises.

Overlapping of enterprises has resulted from the fact that some land has been assessed in more than one enterprise. Lands already wholly or partly within a drainage district have been organized as subdistricts to construct drainage works of local benefit and assess the costs against the land benefited by those works. Some subdistricts may be administered by the same officers as the main or parent district, and some by their own officers. Subdistricts may be organized to construct or install all the drainage works within the boundaries of the main district, which may be established merely to correlate the plans of the subdistricts.

Some land may be assessed and be paying drainage taxes in two entirely independent enterprises at the same time, because the earlier one gave only incomplete benefit and, commonly, most effective drainage required utilization of a differently located outlet.

Some lands which were in drainage enterprises that have been dissolved or have expired legally, or have been abandoned as organizations, have been included in subsequent enterprises organized to replace or reconstruct or maintain part or all of the drainage works of the earlier enterprise. The later enterprise, in designing its works and establishing its boundaries, may entirely disregard those of the earlier enterprises which are partly or wholly overlapped.

Land in enterprises in a county or State represents that portion of the county or State which has been included in drainage enterprises. For irrigation enterprises that have installed drains for part of the area included, and assessed the cost against all the land as part of the irrigation expense, the acreage tabulated and mapped is that of the area assessed.

Area of enterprises is the sum of the areas of the individual enterprises, and exceeds the land in enterprises by the amount of overlapping.

Number of enterprises represents the number of separate drainage organizations in the State or county, not including those that have been dissolved, abandoned, or entirely superseded by later organizations. Subdistricts that have been reported separately from the main or parent district have been counted as independent enterprises. Old enterprises have been included in the census if they still have authority to maintain the drainage works or if the works are still providing drainage to the lands. The number of reports tabulated includes those for enterprises that have been superseded but have contributed to the investment and works of later organizations.

Intercounty enterprises or joint-county enterprises are enumerated as if the part in each county were organized separately. Only in this way is it possible to show the data by counties in those States where there is a considerable amount of organized drainage for agriculture. Elimination of this duplication in number of enterprises has been made for the State, and the number of separate enterprises is shown in a footnote on each county table.

Condition and Use of Land.—The drainage condition, development, and use of the land in 1939 were reported independently of each other, although they are not independent. They are not matters of record, and the figures reported necessarily were estimates and were obtained from persons acquainted with the lands.

Drained land, partly drained, and undrained land are so classified with respect to the sufficiency of drainage for producing crops suited to the locality, but without regard to whether other improvement—such as clearing of trees, brush, or stones—might be needed to fit the land for cultivation. Incomplete drainage, however, may not indicate that the works of the enterprise are inadequate, because the only lack may be farm laterals which the individual owners are expected to provide for their own lands.

Improved land was defined to comprise land regularly tilled or mowed; pasture that has been cleared or tilled; fallow land; gardens, orchards, vineyards, and nurseries; land occupied by buildings, house yards, barnyards, etc.; and land occupied by ditches, levees, highways, and railroads.

Land in occupied farms comprises all improved land used for farming, all used regularly for pasture, and woodland contributing to operation of the farm. The definition permitted some latitude in judgment where the enterprise included large individual ownerships embracing much unimproved land or large plantations inadequately provided with tenants.

Idle land purports to show the acreage in the drainage enterprises that in 1939 was not being used for farming or for other purposes such as highways, drainage works, etc.

Land available for settlement is the land drained or being drained to be sold for establishing new farms, rather than to benefit existing farms.

Cost and Finances.—*Capital invested* represents the original cost of the drainage works, including all expenses incident to organizing the enterprise, and similar costs for extensions and enlargements, but not expenditures for repair, maintenance, or operation of the works or enterprise. Costs of superseded enterprises are included if the drainage works are still in use. For those smaller and earlier enterprises in which construction of ditches was done largely by the landowners benefited without compensation from the enterprise, it has been impossible to include any cost or value of that labor.

Indebtedness represents the total legal obligations of the enterprises outstanding on December 31, 1939.

Arrearage is the amount of funded obligations, including interest, that was outstanding and past due on December 31, 1939.

Reduction of indebtedness is the amount by which the costs to be paid by the landowners have been reduced through refunding or refinancing operations.

Drainage taxes collected is the amount actually received by the enterprises in 1939, regardless of when assessed or of how much may have been levied in that year.

Area delinquent in payment of drainage taxes is the area against which such taxes are valid liens and classed as delinquent under the law of the State. This area does not include the lands for which such liens have been cancelled by tax sales, reversion to State ownership, or other procedure.

Drainage Works.—*Open ditches* of a drainage enterprise were defined to include all open artificial drainage channels and all natural watercourses improved for land drainage that were being maintained or used by the enterprise, but not private ditches.

Tile drains were defined to include all covered drainage conduits of earthenware, concrete, or other materials, that were being maintained or used by the enterprise, but not private drains.

Levees, by instructions issued, do not include spoil banks thrown up in construction of ditches unless the embankments were particularly designed and constructed to act as levees. Conversely, borrow pits resulting from construction of levees are not included as drainage ditches unless particularly designed and constructed as part of the ditch system.

Pumping for drainage is required where river floods or other conditions do not permit gravity flow of water from the enterprise rapidly enough to avoid causing injury. Pumping enterprises, as classed herein, are all those which operate pumps for drainage during any part of the time. Few enterprises pump all their drainage. In this publication, enterprises are classed "all by pumping" if all the land sometimes requires operation of the pumps, and "part by pumping" if part of the land can always have drainage without operation of the pumps.

Area served by pumps is the acreage in the enterprise that requires pumping for any part of the time.

Wells pumped for drainage are those operated to obtain drainage by lowering the ground-water table; they are not sumps into which surface water is discharged by open ditches.

Flood protection by levees of an outside agency relates in most cases to protection received from works constructed by the Federal Government or by a flood-protection district that does not come within the scope of the drainage census.

Maintenance of drainage works is reported as systematic or otherwise, according to the judgment of the person furnishing the information. Power equipment for maintenance was not itemized, but it does not include automobiles or trucks.

Cost of maintenance and operation in 1939 includes all expenses for that year except additions to capital investment and payments of principal and interest on bonds and notes. Instructions were issued that no cost should be included for any aid obtained from Federal agencies without obligation for repayment, as in repair or rehabilitation of the drainage works by Work Projects Administration, Civilian Conservation Corps, or Corps of Engineers, U. S. Army.

GENERAL DISCUSSION

General Extent and Condition of Land in Drainage Enterprises.—The land in drainage enterprises in 1940 in the 38 States covered by the Census of Drainage is shown in table 1 as 86,967,039 acres, which is 2 percent more than the land area of Illinois, Indiana, and Ohio together. These enterprises have constructed 146,152 miles of open ditches, 55,734 miles of tile drains, 6,793 miles of levees (table 18), and have installed drainage pumping plants of 102,196 horsepower and 20,716,025 gallons per minute capacity. The investment in these enterprises is shown as \$691,724,519, an average of \$7.95 per acre.

Of the approximate 87,000,000 acres in all drainage enterprises, improved land comprised 67,000,000 acres or 77 percent, and timber and cut-over land about 13 percent. Of the total, 86 percent was reported as being sufficiently drained for production of normal crops, and 8 percent as too wet for producing any crop. Part of this drained land evidently required additional work to be actually fitted for cultivation. Of the total land in drainage enterprises, 80 percent is shown as in occupied farms and 57 percent in planted crops in 1939. This percentage in farms is considerably greater than the 55.7 percent shown by the Census of Agriculture for land in all farms in the United States. The acreage in planted crops, amounting to 71 percent of all land in farms in these enterprises, is much greater than the average of 32 percent used for crops in all farms as determined by the Census of Agriculture. For many localities the land in crops reported for drainage enterprises probably corresponds more nearly to land available for crops including idle cropland and plowable pasture, which was 50 percent as determined by the Census of Agriculture.

The increase in land in drainage enterprises since the first Census of Drainage in 1920 amounts to 33 percent; the increase in the decade 1920 to 1930 was 29 percent. There is the possibility that the first canvass of drainage enterprises was not entirely complete, for lack of prior experience or information except a general knowledge of the location of such enterprises. It is believed that the approximate 87,000,000 acres reported in 1940 is reasonably accurate, as the drainage enumerators were furnished lists of the enterprises reported in 1930, supplemented by inquiry addressed in 1939 to officials in each county of the 38 States. Table 1 shows that improved land constituted approximately 77 percent of all land in drainage enterprises in 1940, 75 percent in 1930, and 68 percent in 1920. The portion in farms is shown to be about 1 percent less in 1940 than in 1930, and the percentage in planted crops about 7 percent less. The small increase in drainage enterprises between 1930 and 1940 as compared with the increase during the preceding decade, undoubtedly, is fairly representative of the effect of the change in economic conditions upon the demand for farm crops and of the policy initiated for conservation to prevent or check depletion of the soil resources of the Nation.

The increases in open ditches and tile drains in the periods 1920 to 1930 and 1930 to 1940 compare with the increases in land included in the enterprises. The figures show a tendency in the latter decade toward use of open ditches instead of tile drains, which before 1920 and for a few years thereafter were used in large sizes many times when open ditches would have been more economical on the basis of investment and maintenance costs.¹ The capital invested in drainage enterprises for 1940 was but little greater than for 1930, and the average cost per acre was somewhat less in 1940 than in 1930, whereas there was a large increase in each in the preceding ten years. Were the data for Delaware and Maryland omitted from the computation, the average cost would appear as \$8.00 per acre, midway between the costs shown for 1940 and 1930.

Location of Enterprises.—As shown by the map and in table 17, the greatest portion of the land in drainage enterprises is located in the East North Central and West North

Central States, which embrace respectively 38 and 27 percent of the total. The State embracing the largest acreage in drainage enterprises in 1940 was Minnesota, with almost 11,000,000 acres. Indiana and Michigan had approximately 10,000,000 and 9,000,000 acres, and Ohio, Iowa, Florida, and Illinois rank next in the order given, each with more than 5,000,000 acres in drainage enterprises. Capital invested is shown greatest for the West North Central and East North Central States with \$210,000,000 and \$200,000,000, respectively, reported in the Drainage Census, together comprising almost 60 percent of the total for all enterprises. The State showing the largest investment in drainage enterprises is Iowa, with approximately \$75,300,000 invested as of January 1, 1940. Illinois ranks second in this respect with an investment of more than \$72,000,000, and California third with \$70,000,000.

Including a total of almost \$4,000,000 estimated additional investment to complete works authorized (table 23), the average cost when the present enterprises have completed construction will be \$8.00 per acre. Table 18 shows the average cost in the Pacific States as \$23.99, nearly twice that in Mountain States which in turn is a third larger than the next highest, in the West North Central States. The highest State averages are \$26.54 in California, \$24.47 in Georgia, \$24.45 in Utah; all other States that show average cost exceeding \$16 per acre are in the Pacific and Mountain States.

The figures in some States show slight reductions in the amount of land in the drainage enterprises. There were reports of several drainage enterprises dissolved or abandoned since prior censuses. Some of the apparent reductions may be the result of more accurate determination of overlapping of enterprises, concerning which special emphasis was placed in the 1940 Census. Some areas in drainage enterprises have in the past decade been transferred to State or Federal control for purposes of reforestation or wildlife conservation.

Number and Size of Enterprises.—In the drainage census a report was received and tabulated for each enterprise organized that had constructed drainage works which still were serving agricultural lands, or that had contributed to the capital invested in such existing works. This practice followed that of the preceding Drainage Censuses. The numbers of these reports received in 1940, 1930, and 1920 are shown in table 19. The total number of reports tabulated in the 1940 Census was 79,220, approximately 16 percent more than were tabulated in 1930, and 67 percent more than in 1920. In each census 85 percent of these reports was received from the East North Central States. The three States of Ohio, Indiana, and Michigan totaled in each census a fraction more than 81 percent of the total for the 38 States.

The numbers of enterprises in 1940 published in this volume and the State bulletins are intended to represent those enterprises that have not been superseded by later organizations. Separation of reports for the superseded enterprises was made in the Washington Office, on the basis of overlapping areas and other pertinent information on the reports.

For enterprises embracing land in more than one county, a separate report was made and tabulated for the portion in each county. In this way, by county count, the number of enterprises that still are serving agricultural lands is 42,363, which is 53.5 percent of the number of reports tabulated. The number of separate enterprises by State count, however, eliminating duplications arising from adding the county figures, is but 39,597. The number of enterprises in each State and geographic division by State count and by county count, and the number of reports, are shown in table 20. In Ohio and also in Indiana, the number of enterprises is only about 40 percent of the number of reports.

Classification of the land in enterprises according to size of enterprise necessarily must be made on the basis of area assessed in each enterprise as organized. The sum of the

¹Technical Bulletin, 269, U. S. Department of Agriculture.

acres assessed as shown in table 2 is 53 percent greater than the land included in the enterprises. Enterprises of less than 500 acres each amount to nearly 7 percent of the total area; those of 500 to 5,000 acres each, to 35 percent; those of 5,000 to 50,000 acres, to 40 percent; and those 50,000 to 500,000 acres to 15 percent of the total acreage assessed. This classification was made on the basis of dividing the intercounty enterprises on the county lines. On this basis, the average size is shown in table 2 as 1,677 acres in 1940, as 1,892 acres in 1930, and as 2,018 acres in 1920. The table shows for 1940 a noticeable increase over 1930 in percentage included in enterprises under 500 acres, and a decrease in the enterprises greater than 50,000 acres. The total acreage assessed is 3.3 percent greater in 1940 than in 1930, and 39 percent greater than in 1920. In each census the land included has been about two-thirds of the sum of acreages assessed in the individual enterprises. The land in enterprises in tables 2, 19, and 20 is, for each size group, the land in the same enterprises that has not been overlapped by later enterprises.

The area assessed in drainage enterprises in the East North Central Division in 1940 was 51 percent of the total, in the West North Central was 23 percent, and the highest in the other divisions was 11 percent in the West South Central. The three States of Ohio, Indiana, and Michigan together embraced 46 percent of the total assessed acreage.

Classification of drainage enterprises by size considering each as a whole, without division on county lines as in table 19, is shown in table 20. The greatest portion of the acreage was organized in enterprises of from 20,000 to 49,999 acres each, while the greatest number of enterprises was organized in the group from 200 to 499 acres. The size group 20,000 to 49,999 acres has included the greatest portion of the acreage in four of the seven geographic divisions included in the drainage census. In each State of the East North Central Division, the greatest portion of the acreage has been organized in enterprises of 2,000 to 4,999 acres. But in each of these States, the greatest number of enterprises is in the 200 to 499 acre group, except Illinois where most have been between 1,000 to 1,999 acres in size. The largest average acreage assessed is shown for Arizona, 60,181 acres; next in order are Florida with 51,297 acres, and Texas with 48,722 acres. Whereas the average size of all enterprises as organized was approximately 1,680 acres, the average size of those existing on January 1, 1940 was approximately 2,060 acres for intercounty enterprises divided on county lines, and 2,200 acres for intercounty enterprises tabulated each as a whole.

Date of Organization of Enterprises.—The rise and recession of activity in land drainage under cooperative organization are indicated by classification of the enterprises according to date of organization, shown in tables 10 and 30. The increase and decrease are indicated better by the figures for area of enterprises without deduction for overlapping, than by the figures for land in which deduction has been made in each case for the area that has been included in later organizations. The greatest activity in establishing such enterprises for the 38 States as a whole occurred in the period 1905 to 1919. The decades of greatest activity in the different geographic divisions have been: In the East North Central, 1900 to 1909; West North Central, 1905 to 1914; South Atlantic, 1910 to 1919; East South Central, 1915 to 1924; West South Central, 1910 to 1919; Mountain, 1915 to 1924; and Pacific, 1910 to 1919. From these high points there was a gradual recession until the half decade 1930 to 1934. In the period 1935 to 1939 there was a rather marked increase in the rate of organization in each division except the Pacific.

Capital invested by date of organization, as given in table 10, shows the highest cost to have been \$8.69 per acre assessed, for those enterprises organized in 1920 to 1924. The average cost for the enterprises organized in 1915 to 1919 was \$8.27 per acre assessed; the other periods for which the average cost was as much as \$5.00 per acre were 1910 to 1914 and 1925 to 1929. The lowest cost for any decade or half decade shown was \$1.62 per acre assessed, for the enterprises organized 1935 to 1939. This low cost may have been the result of a relatively large portion of aid from Federal relief agencies, and of the organization during this period of only low-cost undertakings, including those for improvement of old ditches or small natural watercourses.

Completion of Enterprises Under Construction.—On January 1, 1940, enterprises comprising 3,914,299 acres, or 4.5 percent of the land in all drainage enterprises in the 38 States, had not completed construction of the drainage works that had been authorized. An estimated additional investment of \$3,967,857, or 0.6 percent of the amount invested to that date in all enterprises, was required to complete the works authorized. These percentages, 4.5 percent of the land and 0.6 of the capital invested, are to be compared with 3.4 percent and 1.4 percent, respectively in 1930, and with 13.3 percent and 16.7 percent, respectively in 1920. Of this additional investment required for completion of works under construction, approximately 55 percent was reported by enterprises in California, Idaho, Oregon, and Texas, each of which reported more than \$450,000 required. The amounts of the additional investment in proportion to the investments made to the census date amounted to 8.6 percent for Oregon, 8.1 percent for Idaho, 7.1 percent for North Carolina, and none other as much as 4 percent. The land and capital investment in completed enterprises and enterprises under construction, and the additional investment required to complete the works authorized are shown by States and geographic divisions in table 24.

Character of Enterprises.—The land and capital invested in drainage enterprises have been classified by character of enterprise as determined by the form of management or control (see definitions, page II), except that all those enterprises which were organized primarily for irrigating land and have provided drainage works as part of the irrigation development have been classed separately and divided between Federal and non-Federal control. This classification is shown in table 3, and by geographic divisions and States in table 21.

The drainage district form of organization, with its own officials almost universally elected by the landowners assessed for the cost of the enterprise, is used generally in most of the States. Enterprises of this character, however, comprise only 40 percent of the land in all drainage enterprises, but represent 54 percent of the capital invested. The county drain form of organization is used most largely in Ohio, Indiana, Michigan, Minnesota, Iowa, North Dakota, South Dakota, Kentucky, and Oklahoma. Enterprises of this character embrace 53 percent of the land in all enterprises and approximately 40 percent of the capital invested. Township drains and State drainage projects together constituted 1 percent of the land and a lesser percentage of the capital invested; commercial developments and individual-ownership enterprises comprised slightly more than 1 percent of the total; irrigation enterprises comprised a little less than 5 percent of the total. The district form of organization under its own officials is generally considered more suited to the larger and the more costly undertakings, as giving the landowners the greatest degree of local control. The county drain form administered by county officials is generally more economical in administrative costs for small enterprises, in which the problems of engineering and financing are relatively simple. This form is most common in those States where drainage is promoted for draining land already in farms. The district form is general in those areas where reclamation and development of unimproved lands for making new farms has been an important consideration in promoting the drainage enterprises.

In several States in the Mountain and Pacific Divisions, the greater portion of the land reported in drainage enterprises is organized as irrigation enterprises; in Montana, Idaho, Wyoming, Arizona, and Nevada the portions were from 70 to 98 percent. In the same divisions there are also drainage districts that have been organized to drain irrigated lands. The importance of drainage in irrigation enterprises is indicated in table 22, which shows by States the land in all irrigation enterprises included in the census of drainage, divided between Federal and non-Federal control, except that generally projects or divisions of projects of the United States Bureau of Reclamation that have been turned over to water users for operation have been classed as Federal enterprises. The land assessed for drainage in these irrigation enterprises is 4,240,578 acres, of which approximately 53 percent is shown as benefited or to be benefited by the drainage works installed

or under construction. The Federal enterprises comprise about 46 percent of the land in all irrigation enterprises. Idaho, Montana, and Wyoming have the greatest acreages in the Federal irrigation enterprises included in the Drainage Census, whereas California includes the largest acreage in the non-Federal irrigation enterprises.

From table 3 it may be determined that the average cost of the drainage districts has been \$10.73 per acre, which is exceeded only by the incorporated commercial developments and is approached only by the Federal irrigation enterprises and the individually owned projects.

Purpose of Drainage.—Improvement of land already in farms was reported as the principal purpose of organization by enterprises that embraced 71 percent of the land in all enterprises. The capital investment in these enterprises is shown by table 9 as 60 percent of the total reported in the Census of 1940. These percentages are somewhat larger than the 63 percent of land and 53 percent of capital reported in 1930. Reclamation of swampland not previously in farms is shown as the principal purpose of enterprises that comprised 16 percent of the total acreage and 19 percent of the capital investment, as compared with 27 and 31 percent shown in the 1930 Census. The apparent increase in farm-improvement enterprises between 1930 and 1940 may be largely the result of two factors. It is evident, from comparison of figures published in the State bulletins, that in 1940 some irrigation enterprises reported the drainage as for improvement of land already in farms rather than for removal of alkali or seepage. Also, for 1940 the land in overlapping enterprises was tabulated in the latest enterprise in which it was included, whereas for 1930 it was tabulated in the earliest enterprise.

The percentages shown in table 9 for enterprises organized to obtain protection against stream overflow, and removal of alkali and seepage as a result of irrigation, are somewhat larger than the corresponding percentages reported in 1930 but not shown in this volume.

Condition and Use of Land in Enterprises.—The condition and use of the land in drainage enterprises in 1939, classified by date of the latest drainage organization in which it was included, are shown in table 11. The amount drained for normal crops is shown as nearly 75,000,000 acres; the amount improved as exceeding 67,000,000 acres, one-sixth timbered or cut-over; and 70,000,000 acres in occupied farms. For all enterprises, there is shown 11 percent more land drained than has been classed as improved. The enterprises showing the least percentage drained, least improved, least in farms, and least in planted crops are those organized in 1910 to 1914, and ranking next in each case are those organized in 1935 to 1939.

Drainage Works.—Drainage by pumping, as shown in table 4, has increased somewhat in importance since 1930, but is shown in 1940 to be utilized by only 5.0 percent of all land in drainage enterprises. The importance is more evident, however, when it is noted that the pumping enterprises represent 17.8 percent of the entire capital investment. These figures compare with 4.3 percent of the land and 15.7 percent of the capital invested in 1930. The average capital investment to January 1, 1940 amounts to \$6.88 per acre for the gravity-drainage enterprises, \$53.40 per acre for the enterprises which obtain all drainage by pumping, and \$28.18 per acre for all enterprises that are dependent either entirely or partly upon pumping.

Drainage pumping equipment is classified in tables 5 and 6. The Census did not determine the relation between kind of pumps and kind of power where more than one kind of either was used. It is evident from table 5 that electric motors and internal-combustion engines are replacing steam plants. The electric motors are more suitable for the small installations, and the internal-combustion engines for the larger plants. The average capacities for those enterprises using electric power entirely were 269 horsepower and 39,500 gallons per minute; whereas the average installation of internal-combustion engines, where no other kind of power was employed, was 288 horsepower and 89,000 gallons per minute. It is evident from table 6 that between 1930 and 1940 there has been considerable replacement of centrifugal pumps with those of the screw and turbine types. The turbine pumps are used more largely for

pumping from wells and against higher average lifts than are other types. It is probable that the few pumps classed as rotary should have been designated either as screw or centrifugal. It may be surmised that the pumps classified "Other" in 1930 were mostly either screw or turbine.

The average cost of drainage per acre by type of drainage is shown in table 25 by divisions and States. For those enterprises not having pumping plants, the average costs are shown as \$5.90 per acre for open ditches only, \$11.02 per acre for tile drains only, and \$9.56 per acre where both open ditches and tile drains have been used. These figures indicate a willingness of landowners to invest more for tile drains than for open ditches. The reasons for this have been the lower cost of maintaining the tile drains in good operating condition, and the desire to avoid both the inconvenience of farming lands divided by the ditches and the unsightliness of the weeds and brush that usually border the ditches.

State average costs for open ditch drainage are shown in table 25 as ranging from 24 cents per acre in Maryland to \$42 per acre in Arizona. These extremes, however, are not typical. The ditches dug in Maryland before 1930 were constructed generally by the labor of the landowners, to each of whom a certain section of the drain was allotted, and the value of this work was not included in the records of cost. A large part of the drainage work done since 1930 has been by Federal agencies organized primarily for emergency relief rather than for constructing land drainage improvements, and the cost of work done by those agencies was not determined by the census. The low cost shown for Delaware is the result of such condition; in other States, drainage construction by landowners' labor and by Federal relief agencies has not comprised so large a part of the cost. In the East North Central and West North Central States, which embrace 64.6 percent of all land in drainage enterprises, is located 93 percent of the land using tile drains, entirely or in conjunction with open ditches. The higher cost of drainage per acre in the Mountain and Pacific States as compared with that in the Central and Eastern States is to be noted. This has resulted from more costly construction of drains in the more rugged topography, and higher values for good agricultural land. Some of the highest costs are related to very small acreages of special use or value.

The acreage per mile of drain is shown for each State and each type of drainage in table 26. For all States and all types of drain the average is shown as 428 acres per mile, the average for open ditches is 524 acres per mile, and for those enterprises using only tile, 225 acres per mile. The greatest acreages per mile of drain are shown for Arizona, North Dakota, and Florida. Small acreage per mile of drain ordinarily indicates comparatively close spacing of drains, so the figures indicate that the closest spacing is provided in the East North Central States, and the widest spacing in the South Atlantic and West South Central Divisions. This intensity of drainage by organized enterprises might indicate the relative thoroughness of drainage provided by the enterprises, or the degree of drainage required for the land in its natural condition. The extremely small acreages per mile shown for open-ditch-and-tile systems in Kansas and Georgia result in part from drainage for city and suburban property, and from inclusion of small farm drains usually provided by individual owners rather than by the organized enterprise.

The enterprises that have installed pumping plants to obtain all or part of their drainage comprise 5.0 percent of the land in all the enterprises, according to table 25. Those that have installed pumps to serve all of their land embrace 1,510,929 acres, of which 673,124 acres are in California and 325,499 acres are in Illinois, and 234,416 acres divided about equally between Florida and Louisiana. The average cost of such enterprises in the 38 States has been \$53.44 per acre, the State averages ranging from \$13.43 per acre for a small area in Michigan to \$71.35 per acre in Illinois. The last, however, includes the cost of a few enterprises that have provided sanitary benefits in addition to improving land for crop production. The enterprises that have installed pumps but require them for only part of their land comprise 2,856,166 acres, of which 1,462,590 acres are in California and 354,903 acres are in Idaho. The average cost of all such enterprises has been \$14.81 per acre. The State averages range up to \$105.21 in Kansas and \$142.86 in Georgia. The high cost in Kansas

includes pumping for drainage of city property; the high cost in Georgia includes complete farm drainage, and perhaps other improvements for land in truck crops.

Table 27 shows for each State the average capacity of drainage pumping plants with respect to the land served by the pumps, and makes comparison between the power end and the work end of those plants. The table shows for the 2,316,867 acres served by the pumps in the 38 States, an average capacity of 8.9 gallons per minute per acre, equivalent to a run-off depth of 0.47 inches for 24 hours. The reasons for the extraordinary capacities shown for Georgia and Arizona were not determined. The capacity shown for the small acreage in Wyoming possibly results from using equipment available instead of purchasing the equipment required. Omitting consideration of these extremes, the capacities range, by States, from 0.12 inch in Texas to 2.17 inches in Louisiana. The average lift of water by States ranges from 4.6 feet in Florida to 23.4 feet in Arizona. The ratio of engine or motor capacity of a pumping plant to the work that would be done by pumping the capacity of pumps against the average lift of water is herein termed "plant ratio". It is, in effect, the reciprocal of the overall efficiency required of the plant to operate the pumps at their rated capacity at the average lift. The average plant ratio for the 38 States is 2.0, and by States ranges from 0.6 in Wisconsin to 6.3 in Nebraska and 7.4 in Wyoming.

A considerable part of the land drainage work in some areas, more especially in the South Central and the Pacific States, is closely related to flood-protection undertakings, as these enterprises involved drainage of alluvial lands that are naturally subject to frequent or occasional overflow by stream floods. Construction of levees to afford such protection is done by many of the drainage enterprises covered in the census. In many instances, levees have been built by levee districts organized under laws that are generally similar to drainage laws, but flood-protection enterprises that have not included construction of drains or drainage pumping plants were not included in the drainage census. Flood-protection works by the Corps of Engineers, United States Army, also have afforded flood protection to enterprises included in the drainage census. The extent to which the drainage enterprises received benefit from levees built by these outside agencies is shown in table 16 to comprise 12.2 percent of the land in all drainage enterprises and represents 17.0 percent of the capital invested in the enterprises. The drainage works of the enterprises receiving such benefit represent 10 percent of the length of open ditches, 0.4 percent of the tile drains, and 27 percent of the levees that have been built by the drainage enterprises. The cost of the levees built by outside agencies, or the value of the benefit conferred, has not been included in the investment figures for drainage enterprises.

Maintenance and Operation.—Cost of maintenance and operation in 1939 was reported by drainage enterprises including 86,160,078 acres or 99.1 percent of the total. This includes 54,493,896 acres that reported that no expenditures were made in 1939. The total expenditure of \$5,996,672, as shown in table 12, averages 7 cents per acre on the total acreage reporting, and 19 cents per acre on the area making the expenditures. Of the enterprises drained entirely by gravity, only 34 percent of the acreage incurred any of the cost; and the average expenditures amounted to 4 cents per acre for all and 13 cents per acre for those incurring cost. Of the enterprises that employed pumping for part or all of drainage, 88 percent of the acreage incurred expense for maintenance and operation in 1939, which averaged 53 cents per acre for all pumping enterprises and 60 cents per acre for those incurring the expense. Of the gravity enterprises, those with levees incurred markedly higher costs for maintenance than did the others. Maintenance costs based on the total reporting, including land that made no expenditures during the year, are a better criterion of average annual cost than figures based on only those acreages that reported cost incurred.

The average expenditure per acre for maintenance and operation in 1939 ranged by States, as shown in table 31, from nothing in Oklahoma to 28 cents in Oregon and 42 cents in California, for all enterprises reporting as to such expenditures, and from nothing in Oklahoma to 86 cents in Georgia based on the land in those enterprises that actually incurred the expense. For the enterprises drained by gravity only, the

State averages ranged up to 27 cents per acre in California and 28 cents per acre in Colorado, based on all land reporting, and to 31 cents per acre in Arkansas and 48 cents per acre in Ohio based on the land incurring the cost. It is apparent that regular maintenance of drainage works is more general in the western than in the central and eastern States. The enterprises that had installed pumping plants expended for maintenance and operation much more per acre than did the gravity enterprises. Those that pumped for all their land incurred costs almost four times the costs for the part-gravity enterprises, or \$1.04 and \$1.15 per acre as compared with 27 cents and 30 cents per acre. The highest costs are shown in the table for land drained partly by pumping and partly by gravity in Kansas, of which a considerable portion is city and suburban property. The next highest costs were in Illinois, averaging \$1.55 and \$1.64 per acre for those enterprises that had provided pumping for all their land. It should be noted, however, concerning the figures for States where the drainage water pumped by irrigation enterprises is used for irrigation, and for that use has a value greater than the cost of the pumping, that the cost of operating the pumps is charged to irrigation and is not included in the figures in table 31.

Maintenance work by drainage enterprises usually is done by letting contract for specified work, or by labor employed and directly supervised by the officials of the enterprise. In some localities, it is not uncommon for small enterprises to allot the work directly to the landowners who do the work themselves or have it done for their specified portions without drainage taxes being levied therefor. Table 13 indicates 35 percent of the enterprises, on the basis of land included, do maintenance work by district forces, and a like portion by letting contracts, and 10 percent by apportioning the work to the landowners. Enterprises comprising 45 percent of the land and 57 percent of the capital investment reported that the drainage works are maintained systematically; but no definition of that term was made, and it might have included a "system" under which the work is done when the need is apparent or landowners make complaint. The percentage stated probably is greater than the portion for which work is done regularly every one, or two, or three years.

Method of maintenance is shown by States in table 32. Maintenance by district forces is practiced most generally in the West North Central, the Mountain, and the Pacific States, and in Kentucky, Louisiana, and Texas. The method of letting specific jobs by contract is followed most commonly in the East North Central States, except Wisconsin. The method of apportioning the work directly to the landowners apparently is used in Mississippi, Indiana, and Wisconsin more largely than in the other States. About one-fifth of the land reported that maintenance work was not done, or did not report concerning it. Systematic maintenance was reported for less than half the land in drainage enterprises in Minnesota, Iowa, Arkansas, Oklahoma, and all States east of the Mississippi River except Illinois, Kentucky, and Michigan.

Table 14 shows that enterprises comprising nearly 12 percent of the land in all enterprises, and representing 19 percent of the capital investment, owned power machinery other than automobiles and trucks for the purpose of keeping their drainage works in operating condition. The same table shows that these enterprises have 11 percent of the open ditches, 4 percent of tile drains, and 28 percent of the levees constructed by the drainage enterprises covered by the census. The fact that percentage of levees is higher than percentage of open ditches may suggest that there is more general appreciation of the need for continued maintenance of the levees to prevent large losses in the enterprises than of the necessity for immediate repair of obstructed ditches. However, a large portion of all the ditches consists of sizes small enough that use of large equipment is not required frequently. Distribution by States of ownership of power maintenance equipment is shown in table 33, which discloses that those States in which the enterprises owning power equipment comprise more than half the land in enterprises are western States, where irrigation has been the primary object of a considerable portion of the enterprises included in the drainage census.

Federal assistance in maintaining their drainage works has been reported by enterprises embracing 17 percent of the land in all the enterprises and representing 23 percent of the

total capital investment, and comprising 16 percent in length of the ditches, tile, and levees of all enterprises. The activities of the Corps of Engineers, United States Army, in flood protection and aid of navigation, by cleaning and straightening watercourses and by constructing levees, during a number of decades has afforded incidentally some special assistance to many drainage districts, particularly in the lower Mississippi River valley. Since establishment of the Federal Emergency Relief Administration in 1933, that agency, the Civil Works Administration, the Works Progress Administration, and the Work Projects Administration have rendered assistance to many drainage enterprises, especially in cleaning the ditches of debris and vegetation. Such assistance has been done very largely with hand tools. The Civilian Conservation Corps during the past half decade furnished assistance to a large number of legally organized drainage enterprises in maintenance and repair of their works. More than 40 C.C.C. camps, mostly in the Central States, were allotted to drainage maintenance work only, equipped with power excavating machinery, and organized under supervision of technically trained drainage engineers. The land in drainage enterprises receiving assistance from these agencies is shown in table 15, in which the classification Work Projects Administration includes its three predecessor organizations. The cost of such assistance was not determined by the Census nor was any value placed upon the work. The aid received by some enterprises was very important in amount, and that received by others was not great. The classification "Other or not reported" in the table represents either a combination of all of these agencies or a designation that if stated could not be interpreted.

Work Projects Administration has given assistance in some measure in all but eight of the States in the Drainage Census as shown in table 34. The Civilian Conservation Corps has been of assistance to drainage enterprises in less than half of the States in the Drainage Census, and most of the drainage work for that agency has been done in the States of the Central and South Atlantic Geographic Divisions. The enterprises benefiting by the flood protection work of the Corps of Engineers, United States Army, are mostly those bordering the Mississippi River and its main tributaries, and to a less extent the Pacific streams.

Financial Status of Enterprises.—The financial status of drainage enterprises is shown in tables 7 and 8. The portion in arrears in 1940, comprising 13 percent of the land and 17 percent of the capital invested, was slightly larger than in 1930. In those enterprises that in 1940 were in arrears in payment of their obligations, more than half the land was reported as delinquent in payment of the drainage taxes. This acreage, however, is known to include some duplication because of land reported delinquent in two or more overlapping enterprises. Of approximately 11,500,000 acres reported in arrears, 2,270,000 showed none to be delinquent in payment of the drainage taxes assessed. This condition might be a result of delinquent lands having been sold for taxes and the delinquency canceled by such sale. Out of 75,000,000 acres reported not in arrears, one-sixth is shown as comprising delinquent lands amounting to 20 percent of the area included. Such condition might be the result of having the arrearage canceled through refinancing operations. For all enterprises, the land delinquent in payment of drainage taxes was somewhat less in 1940 than in 1930, both in amount and in percentage; but for those enterprises in arrears in payment of their obligations, the amount and the percentage of land delinquent in drainage taxes was greater in 1940 than in 1930.

Of the 87,000,000 acres in all drainage enterprises, 32,085,959 acres or 37 percent are shown as having an indebtedness of \$137,745,272, an average of \$4.29 per acre. This amount is 40 percent of the capital invested in those enterprises, which was \$344,440,683 as shown in table 8. Of the land in debt, 11,432,555 acres were bearing \$63,745,329, or

46.3 percent, and were in arrears in payment of their funded obligations by \$38,488,274 or \$3.37 per acre.

Refinancing operations had reduced the debt by \$51,467,173 of bonds and interest thereon, of which less than 4 percent had been received by the enterprises not in debt on January 1, 1940. Of the total debt reductions, \$43,098,365 or 83.7 percent had been for benefit of the enterprises reported as not in arrears but still bearing an indebtedness of \$71,115,043. The enterprises reported as in arrears on the census date had benefited by refinancing operations only to the extent of \$5,776,803.

The relation of indebtedness and arrearage to delinquency of land in payment of the drainage taxes is indicated in table 8. Enterprises not in debt reported less than 0.1 percent of their area as delinquent in payment of drainage taxes as of January 1, 1940. Collections of drainage taxes by these enterprises in 1939 amounted to 0.5 percent of the capital invested. The enterprises in debt but not in arrears reported a delinquency of 10.3 percent of their acreage, and drainage taxes collected in 1939 amounting to 4.0 percent of the capital investment. The enterprises that stated the amount of arrearage reported 58.0 percent of their acreage as delinquent, and drainage taxes collected in 1939 as 2.0 percent of the capital investment. In terms of indebtedness, the taxes collected in 1939 amounted to 12.8 percent for the enterprises not in arrears, and 3.5 percent for those enterprises reported in arrears, although the average collections per acre were, respectively, \$0.45 and \$0.51. As already stated, the figures for acreage delinquent may be somewhat large because of duplication in overlapping enterprises, but probably correction of the error (not possible in the Census statistics) would not materially affect the relationships indicated in tables 7 and 8.

The effect of delinquency in payment of drainage taxes on the financial status of the drainage enterprises in the different States is indicated in table 28. The duplication in acreage delinquent is especially evident for Florida, where more than 90 percent of all land in enterprises was so reported but only 82 percent was in arrears. The States showing more than 25 percent of land in drainage enterprises as being in arrears in payment of their obligations are Virginia and Alabama, South Carolina, Georgia, Florida, Tennessee, and Utah.

The relation of arrearage in payment of obligations to its drainage condition and the use of the land in the enterprises is shown in table 29. The land unfit for raising any crop because of lack of drainage is shown as 7,133,943 acres or 8 percent of the land in all enterprises in the 38 States, and the land idle in 1939 was 18,836,290 acres or 22 percent. By States, the portions unfit for crop range from 0.1 percent in Arizona to 44 percent in Tennessee and 56 percent in Florida. The amounts idle in 1939 range from 2 percent in Iowa to 60 percent in Tennessee and 82 percent in Florida. For those enterprises in arrears in payment of obligations, comprising 14 percent of the land in all enterprises, 4,077,142 acres or 35 percent were reported as unfit for any crop for lack of drainage, and 6,126,758 acres or 52 percent as idle in 1939. The comparable percentages for those enterprises not in arrears, embracing a total of 74,805,259 acres, are 4 percent unfit for crop and 17 percent idle in 1939. In general, the order of the States in respect to lack of drainage and lack of use, both for enterprises in arrears and for enterprises not in arrears in payment of obligations, corresponds roughly to the order of all enterprises with respect to the same conditions.

Employment and Pay Roll.—Inquiry was made of each enterprise as to number of persons employed during the week of April 29, 1939, and as to the amount paid out for wages and salaries during the year 1939. The figures reported by the drainage enterprises in each State are shown in table 35, classified by character of enterprise. Information was not obtained as to whether these data related to maintenance and operation of drainage works or to new construction, and doubtless both kinds of work are included.